

# Competition

A real organization called the Brotherhood for the Respect, Elevation, and Advancement of Dishwashers encourages restaurant patrons to leave tips not just for the waiters and waitresses but also for the kitchen staff who bus tables and wash dishes. What will happen if this organization achieves its goals?

In the short run, life will be better for dishwashers. They'll collect tips, and they'll probably decide to work additional hours to collect even more tips. But in the long run, people in other occupations—car wash attendants, grocery baggers, and others—will attempt to get on the gravy train. Restaurant kitchens will be flooded with job applicants, and the wages of dishwashers will be bid down. In fact, wages are likely to be bid down by the full amount of the tips—if tips amount to, say, \$2 an hour, then wages fall from \$8 an hour to \$6 an hour. It turns out that respect, elevation, and advancement don't show up in take-home pay.

Later in this chapter, we'll do a full analysis of the market for dishwashers and the effect of tipping. We'll discover the reason why wages are bid down by the full amount of the tips, and we'll learn something surprising about who *does* benefit from tipping. The key to the analysis is a recognition that dishwashing constitutes a *competitive industry*, and this chapter will give us the tools for analyzing competitive industries in general.

## 7.1 The Competitive Firm

A firm is called **perfectly competitive** (or sometimes just **competitive** for short) if it can sell any quantity it wants to at the going market price. The standard example is a farm. If wheat is selling for a going market price of \$5 a bushel, then Farmer Vickers can sell 10 bushels or 1,000 bushels or any other quantity she chooses at that price.

Microsoft is a good example of a firm that is *not* perfectly competitive. That's because Microsoft has already served all the customers willing to pay the current price for its Windows operating system. Unlike Farmer Vickers, if Microsoft wants to sell more of its product, it must lower the price.

Ordinarily, firms are competitive when they serve a small part of the market. As long as you're small, you can greatly increase your output and still find customers at

### Perfectly competitive firm

One that can sell any quantity it wants to at some going market price.

the going price. By contrast, firms with large market shares typically must lower their prices to attract more customers.

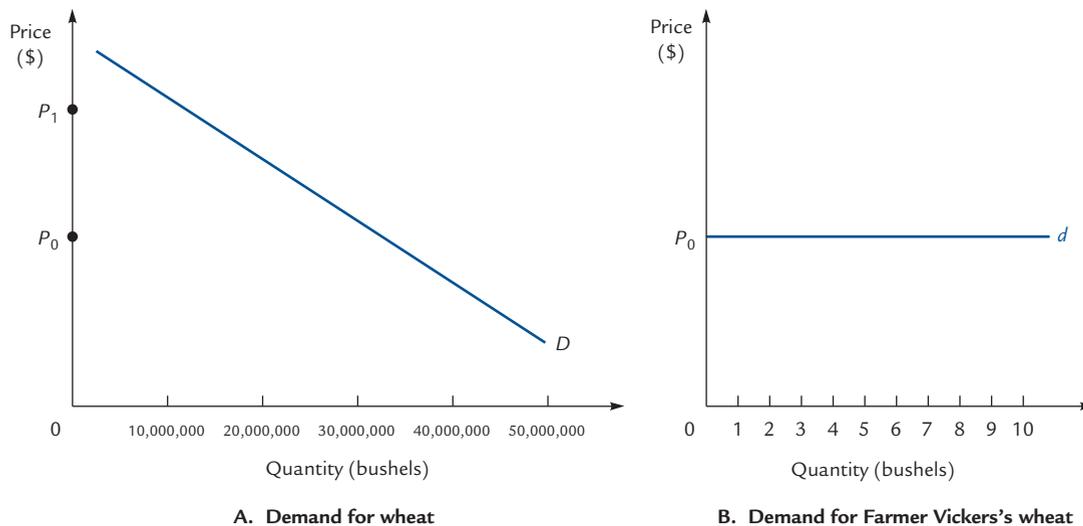
Another way to say all this is that a competitive firm faces a *horizontal* demand curve for its product, whereas a noncompetitive firm faces a *downward-sloping* demand curve for its product. For example, if the going price of wheat is \$5 per bushel, then the demand curve for Farmer Vickers's wheat is horizontal at the \$5 price. That's because she can sell any quantity she wants to at that price, so the demand curve must associate every possible quantity with the going price of \$5.

Of course, the demand curve for *wheat* is still downward sloping; it is just the demand for *Farmer Vickers's* wheat that is horizontal. To see how this can be, look at the two demand curves depicted in Exhibit 7.1. Notice in particular the units on the quantity axis. When Farmer Vickers increases output from 1 bushel to 10 bushels, she is moving a long distance to the right on her quantity axis. At the same time, she has moved the wheat industry a practically infinitesimal distance to the right—say, from 10,000,000 bushels to 10,000,009 bushels. This tiny change in the industry's output requires essentially no change in price.

Farmer Vickers's horizontal demand curve results from her being a very small part of a very large industry in which all of the products produced are interchangeable and buyers can quite easily buy from another producer if Farmer Vickers tries to raise her price. All of these conditions tend to lead to perfect competition, but perfect competition can happen even without them. The only requirement for a firm to be called perfectly competitive is that the demand curve for its product be horizontal (for whatever reason).

### EXHIBIT 7.1

#### The Demand Curve for Wheat



Panel A shows the downward-sloping demand curve for wheat. Panel B shows the horizontal demand curve for Farmer Vickers's wheat. If the price of all wheat goes up from  $P_0$  to  $P_1$ , consumers will buy less wheat. If the price of just Farmer Vickers's wheat goes up from the market price of  $P_0$  to  $P_1$ , consumers will buy none of it at all; they will shop elsewhere.

## Revenue

Suppose you're a bicycle manufacturer, selling bicycles at a going price of \$50 apiece. If you sell one bicycle, your total revenue is \$50; if you sell two, your total revenue is \$100, and so forth. Regardless of how many bicycles you sell, your *marginal* revenue from selling an additional bicycle is always exactly \$50, as illustrated in Exhibit 7.2.

In general, for any competitive firm we have the equations

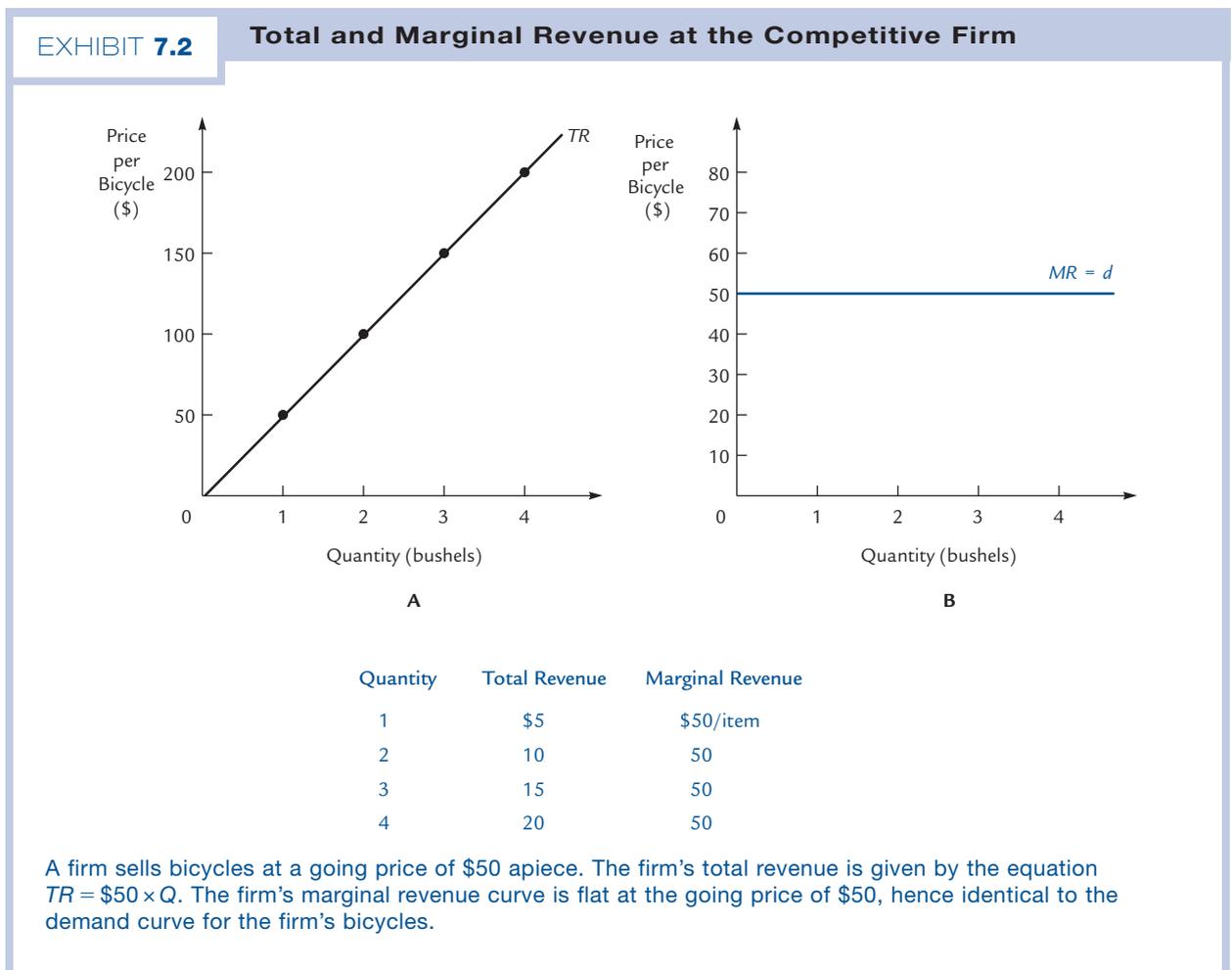
$$\text{Total Revenue} = \text{Price} \times \text{Quantity}$$

$$\text{Marginal Revenue} = \text{Price}$$

As you can see in the second panel of Exhibit 7.2:

The competitive firm's marginal revenue curve is flat at the level of the going market price.

In other words, the firm's marginal revenue curve coincides with the demand curve for the firm's product, which is also flat at the going market price.



## The Firm's Supply Decision

Continuing to assume you're a bicycle maker, how do you decide how many bicycles to make? We answered this in Chapter 5: You keep making bicycles until marginal revenue equals marginal cost.

If your firm is competitive, we've just learned that marginal revenue is always equal to the going market price. So:

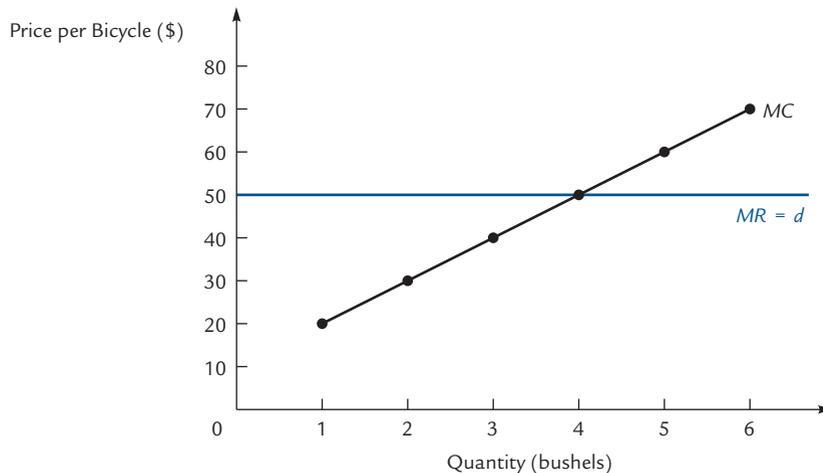
**A competitive firm, if it produces anything at all, produces a quantity where**

$$\text{Price} = \text{Marginal Cost}$$

Suppose, for example, that the going price of a bicycle is \$50 and that your marginal cost curve is the simple upward sloping curve shown in Exhibit 7.3. Then you'll want to produce exactly 4 bicycles because 4 is the quantity where marginal cost = \$50. Notice that this makes perfect sense: The first bicycle costs you only \$20 to produce and you can sell it for \$50; of course you'll produce it. Similarly for the second, third, and fourth (you just break even on the fourth one). But it would be silly to produce a fifth bicycle, because you'd have to spend \$60 to make a bicycle you could sell for only \$50.

EXHIBIT 7.3

### The Optimum of the Competitive Firm



| Quantity | Marginal Cost | Marginal Revenue |
|----------|---------------|------------------|
| 1        | \$20/bicycle  | \$50/bicycle     |
| 2        | 30            | 50               |
| 3        | 40            | 50               |
| 4        | 50            | 50               |
| 5        | 60            | 50               |
| 6        | 70            | 50               |

If bicycles sell for \$50 apiece, a competitive firm will produce bicycles up to the point where marginal cost = \$50. In this example, the firm produces 4 bicycles. But if the price rises from \$50 to \$70, the firm produces 6 bicycles.

What will you do if the market price of bicycles rises to \$70? First, of course, you'll rejoice. Then you'll rethink how many bicycles you want to make. Now you *are* willing to produce that fifth bicycle—and a sixth one as well.

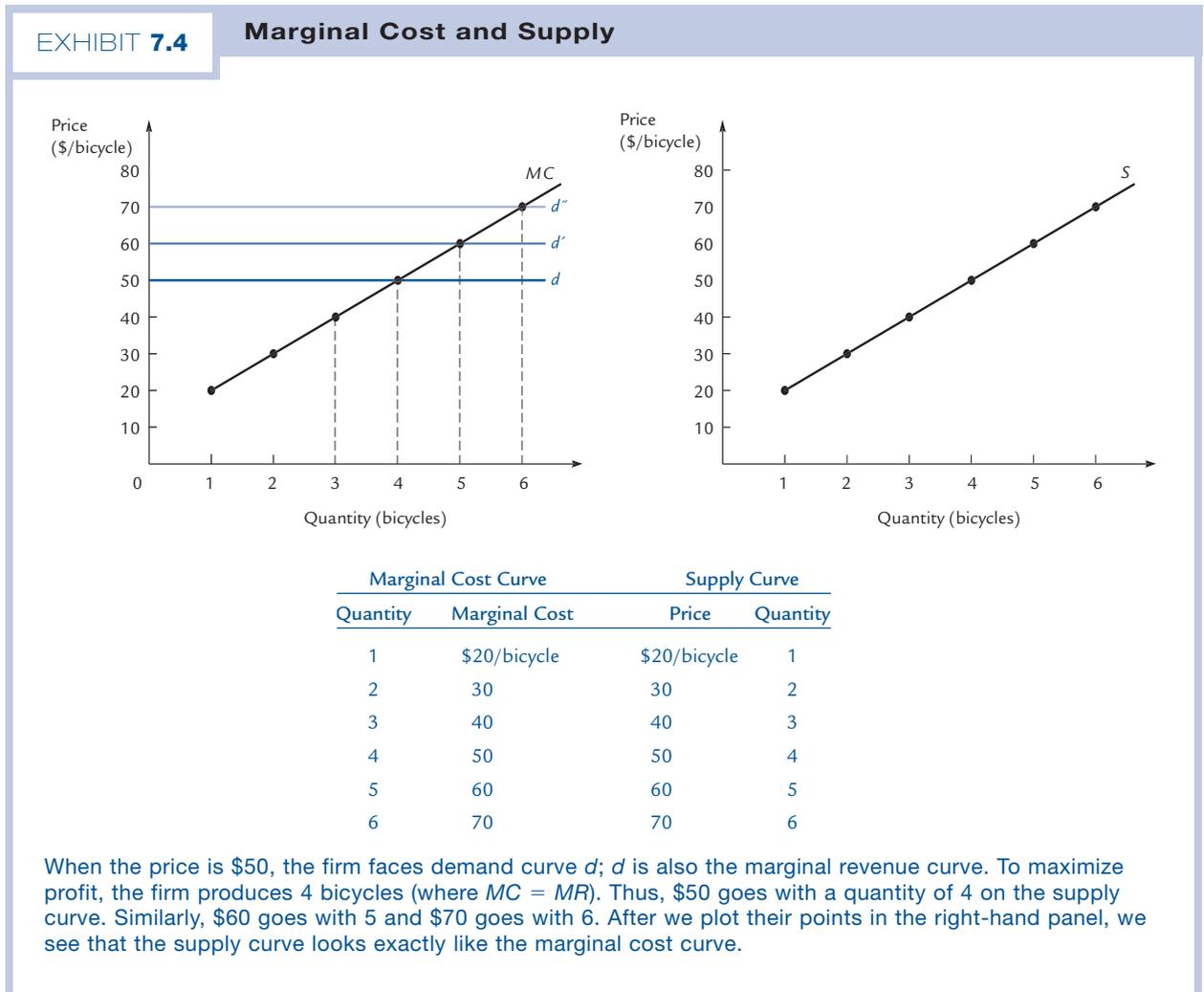
### The Competitive Firm's Supply Curve

Now let's construct your supply curve. We've said that at a price of \$50, you'd want to supply 4 bicycles. And we've said that at a price of \$70, you'd want to supply exactly 6 bicycles. That gives us two points on your supply curve:

| Price | Quantity |
|-------|----------|
| \$50  | 4        |
| \$70  | 6        |

We've plotted these points (among others) in the second panel of Exhibit 7.4.

The left panel of Exhibit 7.4 shows the firm's marginal cost curve (which we take as given); the right panel shows the supply curve (which we are trying to derive). To get a



new point on the supply curve, imagine a new price—say \$60. Draw the corresponding flat demand curve ( $d'$  in the Exhibit) and read off the quantity where the price of \$60 is equal to the firm's marginal cost. In this case, that quantity is 5. Therefore, we can plot the point (\$60, 5) in the right-hand panel.

Proceeding in this way, we discover that each point on the supply curve in the right-hand panel is identical to a point on the marginal cost curve in the left-hand panel; in other words:

For a competitive firm with an upward sloping marginal cost curve, the supply curve and the marginal cost curve look exactly the same.

Although the supply and marginal cost curves in Exhibit 7.4 are identical as curves, their interpretations are quite different. To use the marginal cost curve, you “input” a quantity on the horizontal axis and read off the corresponding marginal cost on the vertical. To use the supply curve, you “input” a price on the vertical axis and read off the corresponding quantity on the horizontal. The way to make this distinction mathematically precise is to say that marginal cost ( $MC$ ) and supply ( $S$ ) are inverse functions. In Exhibit 7.4, we have:

$$MC(5 \text{ bicycles}) = \$60 \text{ per bicycle}$$

and

$$S(\$60 \text{ per bicycle}) = 5 \text{ bicycles}$$



Dangerous  
Curve

Notice that the marginal cost function  $MC$  is plotted just as it would be in a math class—with the input variable on the horizontal axis and the output variable on the vertical. By contrast, the supply function is plotted with the input on the vertical and the output on the horizontal—a reversal of the usual “math class” rules.

Another thing you might recall from math class is that the graph of an inverse function is the *mirror image* of the graph of the original function. Therefore you might expect the supply curve to be a mirror image of the marginal cost curve. But the graph of the supply curve is mirror imaged a *second* time because of the reversal of the axes. Thus, the supply curve is a *double* mirror image of the marginal cost curve—once because it is an inverse function and once because the axes are reversed. Of course, a double mirror image looks exactly like the original; that's why the supply curve looks exactly like the marginal cost curve. And in fact that's *why* we reverse the axes on the supply curve—so that we only have to draw one curve instead of two.

## The Short Run Versus the Long Run

In Chapter 6, we learned that firms face different marginal cost curves in the short run and the long run. Which marginal cost curve should we use when we construct the firm's supply curve? It depends on whether we want to study the firm's supply responses in the short run or in the long run. When the price of bicycles rises from \$50 apiece to \$70 apiece, bicycle manufacturers respond in the short run by hiring more workers and producing more bicycles. They respond in the long run by hiring more workers *and* expanding their factories *and* buying more machinery and producing even *more* bicycles. Thus the firm has two different supply curves: One illustrates the short-run response to a price change and the other illustrates the long-run response. If you want

to construct the short-run supply curve, use the short-run marginal cost curve; if you want to construct the long-run supply curve, use the long-run marginal cost curve.

### U-shaped Marginal Cost Curves

In Exhibit 7.4, the firm has an upward sloping marginal cost curve. But we saw in Chapter 6 that many marginal cost curves are actually cup-shaped (shown as U-shaped). How does this affect the analysis?

Exhibit 7.5 shows the U-shaped marginal cost curve of a competitive firm facing a market price of \$50. We know that such a firm, if it produces at all, produces a quantity at which marginal cost and the market price are equal. We can see from the graph that there are two quantities at which this occurs:  $Q_1$  and  $Q_2$ . Which does the firm choose?

Suppose that it produces  $Q_1$  items. Then the firm can produce an additional item at a marginal cost below the market price. (That is, if the firm goes a little past quantity  $Q_1$ , the marginal cost of production is below \$50.) It follows that the firm can do better by producing another item. It continues producing as long as price exceeds marginal cost, and then stops; that is, it produces  $Q_2$  items.

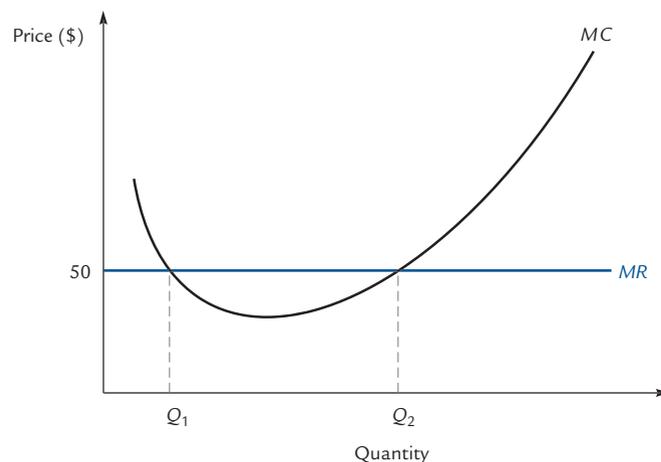
A competitive firm, if it produces at all, will always choose a quantity where price equals marginal cost *and* the marginal cost curve is upward sloping. Only the upward-sloping part of the marginal cost curve is relevant to the firm's supply decisions.

## Shutdowns

In Exhibits 7.3, 7.4, and 7.5, we asked how many bicycles the firm wants to produce. In asking that question, we implicitly assumed that the firm does want to produce bicycles. Now let's question that assumption. *Does the firm want to produce bicycles?*

### EXHIBIT 7.5

#### The Supply Decision with a U-Shaped Marginal Cost Curve



At a market price of \$50 the firm produces  $Q_2$  items (assuming it produces at all). It takes losses on the first  $Q_1$  of these, all of which are produced at a marginal cost of more than \$50, and it earns positive profits on the others. If those positive profits fail to outweigh the losses on the first  $Q_1$  items, the firm will shut down.

### Shutdown

A firm's decision to stop producing output. Firms that shut down continue to incur fixed costs.

### Exit

A firm's decision to leave the industry entirely. Firms that exit no longer incur any costs.

The answer, of course, depends on the alternative. In the short run, the alternative to producing bicycles might be to continue paying rent on an idle factory. In the long run, the alternative is to terminate your lease and get out of the bicycle business altogether.

We distinguish between a **shutdown**, which means that the firm stops producing bicycles but still has to pay fixed costs such as rent on the factory, and an **exit**, which means that the firm leaves the industry entirely. We make the following key assumption:

**In the short run, firms can shut down but can't exit. In the long run, firms can exit.**

Here we will investigate the firm's shutdown decision. In Section 7.4, we will investigate the firm's exit decision.

## The Shutdown Decision

If you run a bicycle firm, then in the short run you have to decide whether to operate or to shut down.

If you operate, you'll earn a profit equal to  $TR - TC$ , where  $TR$  stands for total revenue and  $TC$  stands for total cost. If this profit is positive, you'll certainly want to continue operating. If it's negative, you'll have to ask which is worse: the negative profit you're earning now, or the negative profit you'd earn by shutting down.

In other words, you must compare your profit from operating,  $TR - TC$ , with your profit from shutting down, which is  $-FC$ , where  $FC$  stands for fixed costs.

Operating beats shutting down if:

$$TR - TC > -FC$$

Substituting the identity  $TC = FC - VC$ , this condition becomes:

$$TR - FC - VC > -FC$$

or:

$$TR > VC$$

The latter inequality should make good intuitive sense. Fixed costs don't appear in this inequality because they are irrelevant to the shutdown decision; they are irrelevant to the shutdown decision because you've got to pay them whether you shut down or not. By contrast, variable costs are highly relevant to the shutdown decision, because the whole point of shutting down is to avoid paying variable costs. Staying in operation is a good idea precisely if the firm can earn sufficient revenue to cover these costs, in other words, if  $TR > VC$ .

Remembering now that  $TR = P \cdot Q$  (where  $P$  is price and  $Q$  is quantity), we can rewrite our inequality as:

$$P \cdot Q > VC$$

Then if we divide each side by  $Q$ , the inequality becomes:

$$P > AVC$$

where  $AVC$  is average variable cost.

In other words, the firm continues to operate in the short run if, at the profit-maximizing quantity, the price of output exceeds the average variable cost.

## The Competitive Firm's Short-Run Supply Curve

In Exhibit 7.4, we studied a firm with an upward-sloping marginal cost curve and concluded that the firm's supply and marginal cost curves are identical.

Now that we're studying firms with U-shaped marginal cost curves, we have to modify that discussion slightly. That's because we've just learned that when the price falls below average variable cost, the firm shuts down and produces nothing at all.

Exhibit 7.6 shows the cost curves of a typical competitive bicycle manufacturer. If the price of bicycles falls below  $P_0$ , the firm cannot cover its variable costs and shuts down, producing no bicycles. As long as the price is above  $P_0$ , the firm will want to produce bicycles and will supply quantities taken from the marginal cost curve just as in Exhibit 7.4. Therefore the firm's supply curve is equal not to the entire marginal cost curve, but just to that part of the marginal cost curve that lies above the price  $P_0$ . That is, the supply curve is the boldfaced portion of the marginal cost curve shown in the exhibit.

The competitive firm's short-run supply curve is identical to that part of the short-run marginal cost curve that lies above the average variable cost curve.

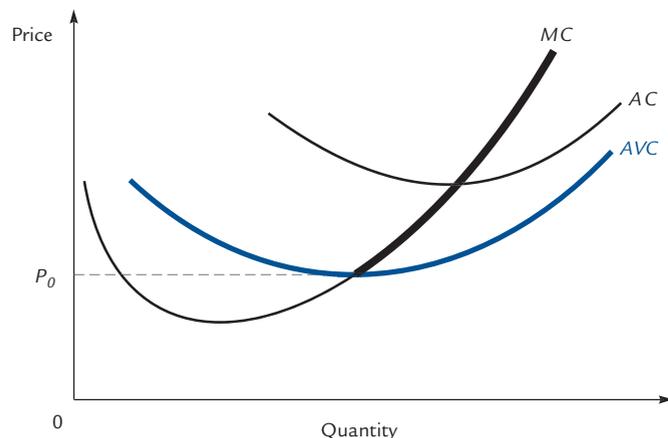
### Why Supply Curves Slope Up

When the competitive firm's marginal cost curve is U-shaped, its supply curve consists of that part of the marginal cost curve that lies above average variable cost. Because the marginal cost curve cuts the average variable cost curve from below, the entire supply curve is upward sloping.

To the question "Why do supply curves slope up?" we can answer "Because average and marginal cost curves are U-shaped." This is correct, but it raises another question: "Why are the cost curves U-shaped?" The answer, as we saw in Chapter 6, is that this is a consequence of diminishing marginal returns to the variable factors of production. The technological fact of diminishing marginal returns suffices to account for the upward-sloping supply curves of competitive firms.

EXHIBIT 7.6

### The Competitive Firm's Short-Run Supply Curve



As long as the price exceeds  $P_0$ , the firm's supply curve coincides with its marginal cost curve. At prices below  $P_0$ , the firm produces nothing. Therefore, the firm's supply curve is equal to the boldfaced portion of the marginal cost curve.

## The Elasticity of Supply

### Elasticity of supply

The percent change in quantity supplied resulting from a 1% increase in price.

We can compute the **elasticity of supply** at a firm using the same formula that we use to compute the elasticity of demand:

$$\begin{aligned}\text{Elasticity} &= \frac{\text{Percentage change in quantity}}{\text{Percentage change in price}} \\ &= \frac{100 \cdot \Delta Q/Q}{100 \cdot \Delta P/P} \\ &= \frac{P \cdot \Delta Q}{Q \cdot \Delta P}\end{aligned}$$

The elasticity of supply is positive because an increase in price brings forth an increase in the quantity supplied. Given two supply curves through the same point, the flatter one has the higher elasticity.

## 7.2 The Competitive Industry in the Short Run

### Competitive industry

An industry in which all firms are competitive.

In Section 7.1 we studied the short-run behavior of a single competitive firm. In this section, we will study the short-run behavior of a **competitive industry**; that is, an industry in which all firms are competitive.

### Defining the Short Run

We take the *short run* to be a period of time in which no firm can enter or exit the industry, so that the number of firms cannot change. By contrast, the *long run* is a period in which any firm that wants to can enter or leave the industry.

How long is the long run and how short is the short run? It depends. In the sidewalk flower vending industry, the short run is very short indeed (at least if there is no waiting time for a vendor's license). The time that it takes to acquire some flowers and walk down to the corner, or for an existing vendor to sell out his stock and go home, is already the long run. By contrast, if Barnes and Noble booksellers were to cease operations, it would face a lengthy process of selling off its inventory and negotiating ends to its store leases. For that matter, when the online pet-supply store *pets.com* went out of business in the year 2000, it had little inventory to dispose of, but its exit was nevertheless delayed while it sought a buyer for the rights to its popular sock puppet mascot. The long run does not arrive until this exiting process is complete.

As we've already mentioned (in Section 7.1), it is important not to confuse an *exit* with a *shutdown*. As soon as Barnes and Noble stops selling books, it has shut down, but as long as it remains in possession of valuable capital, it has still not left the industry. When a firm shuts down, it stops producing but continues to incur fixed costs (in Barnes and Noble's case, the opportunity cost of not yet having sold its inventory). An exit implies that the firm has divested itself of all its fixed costs and thereby severed all of its ties with the industry. Shutdowns are a short-run phenomenon; exits are long-run.



Dangerous Curve

## The Competitive Industry's Short-Run Supply Curve

In the short run, entry and exit are not possible, so the number of firms in the industry is fixed. Given the short-run supply curves of the individual firms, we simply add them to construct the short-run supply curve for the entire industry. At a given price, we ask what quantities each of the firms will provide; then we add these numbers to get the quantity supplied by the industry.

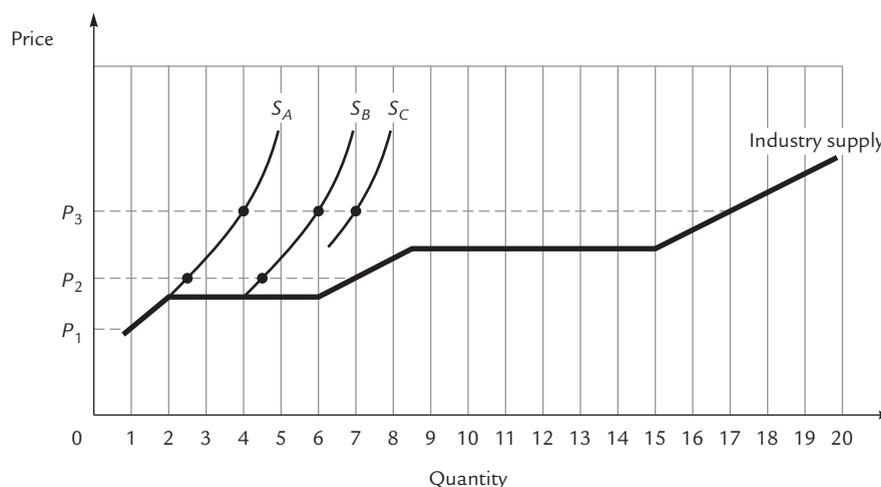
Because different firms have different cost curves, different firms have different shutdown prices. Therefore, the number of firms in operation tends to be small at low prices and large at high prices. As a result, the industry supply curve tends to be more elastic than the supply curves of the individual firms. This can be seen in Exhibit 7.7. Here firms A, B, and C have the individual supply curves shown. At price  $P_1$ , only firm A produces, so the quantity supplied by the industry is the same as the quantity supplied by firm A. At the higher price  $P_2$ , firm B produces as well, and the industry supplies the sum of firm A's output and firm B's output. (In fact, firm A produces  $2\frac{1}{2}$  units and firm B produces  $4\frac{1}{2}$ , for an industry total of 7.) At prices high enough for firm C to produce, industry output is correspondingly greater.

**Exercise 7.1** At price  $P_3$ , how much does each firm produce? How much does the industry produce?

The industry supply curve in Exhibit 7.7 jumps rightward each time it passes a firm's shutdown price. In an industry with many firms, the effect of this is to greatly flatten the industry supply curve relative to those of the individual firms.

EXHIBIT 7.7

### The Industry Supply Curve



As the price goes up, two things happen. First, each firm that is producing increases its output. Second, firms that were not previously producing start up their operations. As a result, industry output increases more rapidly than that of any given firm, so the industry supply curve is more elastic than that of any given firm.

## Supply, Demand, and Equilibrium

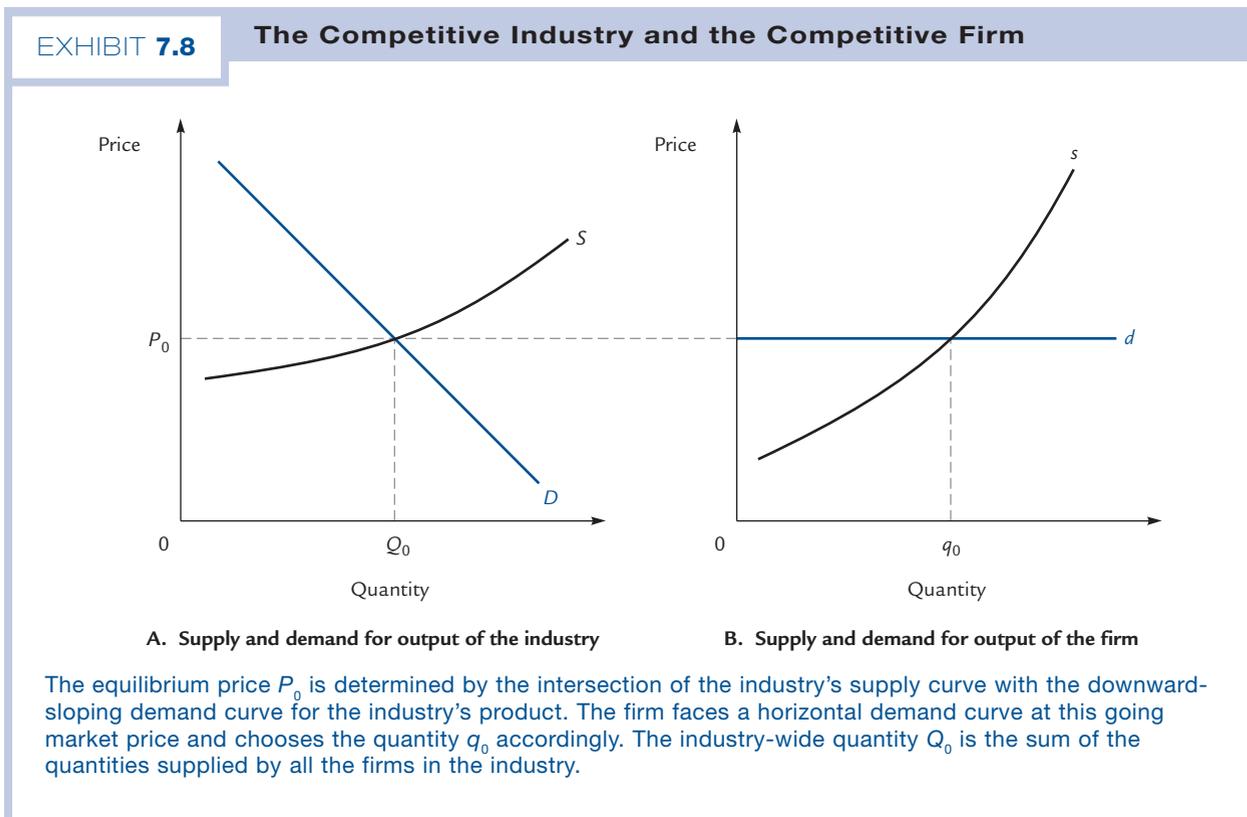
In Chapter 5 we learned that any supplier, if it produces at all, chooses to operate where marginal cost is equal to marginal revenue. In Section 7.1, we learned that for a competitive producer the marginal revenue curve is the same as the demand curve, and, in the region where it produces at all, the marginal cost curve is the same as the supply curve. Therefore, we can just as well say that a competitive supplier chooses to operate at the point where supply is equal to demand.

In an industry in which all of the firms are competitive, each firm operates where supply equals demand, and so the industry-wide supply (which is the sum of the individual firms' supplies) must equal the industry-wide demand (which is the sum of the demands from the individual firms). In other words, such an industry will be at equilibrium, simply as a consequence of optimizing behavior on the part of individuals and firms.

In Chapter 1 we gave some “plausibility arguments” for the notion that in many industries prices and quantities would be determined by the intersection of supply and demand. Now we have a much stronger reason to believe the same thing. If an industry is competitive, profit-maximizing firms will be led to the equilibrium outcome—as if by an invisible hand.

### Competitive Equilibrium

Exhibit 7.8 illustrates the relationship between the competitive industry and the competitive firm. The industry faces a downward-sloping demand curve for its product.



The price  $P_0$  is determined by industry-wide equilibrium, and this same price  $P_0$  is what appears to the individual firm as the “going market price,” at which it faces a flat demand curve. The firm then produces the quantity  $q_0$ , at which its supply curve  $S$  (that is, its marginal cost curve) crosses the horizontal line at  $P_0$ .

### Changes in Fixed Costs

Now we can investigate the effect of a change in costs. Suppose, first, that there is a rise in fixed costs, such as a general increase in the cost of large machinery or a new licensing fee for the industry. What happens to an individual firm’s supply curve? Nothing, because marginal cost is unchanged. What about the industry’s supply curve? It remains unchanged also, because industry supply is the sum of the individual firms’ supplies and these remain fixed. Thus, no curves shift in Exhibit 7.8, so both price and quantity remain unchanged.

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This analysis is correct and complete in the short run. However, we will see in Sections 7.5 and 7.6 that in the long run there is more to be said. The reason for this is that in the long run any increase in costs can drive firms from the industry; their exit can then affect prices and quantities.

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Dangerous  
Curve

### Changes in Variable Costs

Next consider a rise in variable costs, such as a rise in the price of raw materials or the imposition of an excise tax. Here’s what happens:

First, the firm’s supply curve shifts leftward. Here’s why: When variable costs rise, marginal costs rise; therefore, the firm’s marginal cost curve shifts vertically upward. But the firm’s supply and marginal cost curves coincide, so we can equally well say that the firm’s supply curve shifts vertically upward, and that’s the same thing as shifting to the left.

Second, the industry supply curve shifts leftward. That’s because the industry supply is the sum of the individual firms’ supplies. At any given price, each firm supplies less than before, so the industry in total supplies less than before.

Third, the supply shift causes the equilibrium price to rise from  $P_0$  to  $P_2$  in the first panel of Exhibit 7.9. Therefore, the demand curve facing the firm rises from  $d$  to  $d'$  in the second panel.

The firm’s output changes from  $q_0$  to  $q_2$ . In Exhibit 7.9,  $q_2$  is to the left of  $q_0$ , but if the curves had been drawn a little differently,  $q_2$  could equally well have been to the right of  $q_0$ . Thus the firm’s output could go either up or down.

Note, however, that the *industry’s* output unambiguously falls (from  $Q_0$  to  $Q_2$  in the first panel). Thus the *average* firm’s output must fall, even though not every firm’s output must fall.

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**Exercise 7.2** Draw graphs illustrating the effect of a fall in variable costs.

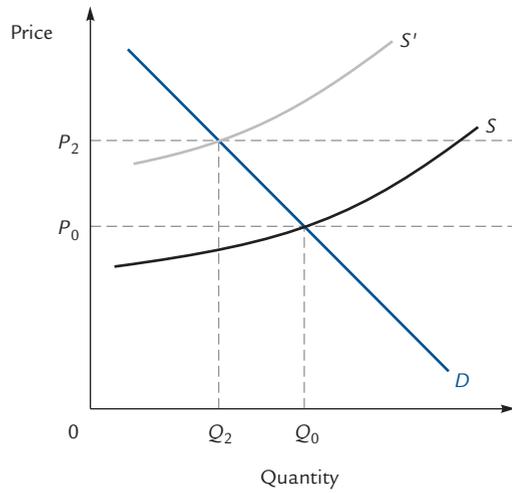
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### Changes in Demand

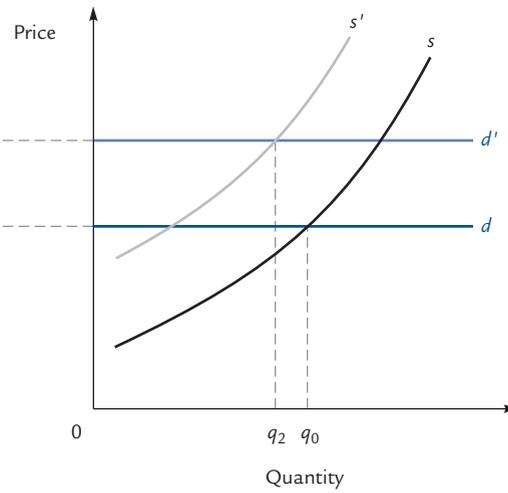
Exhibit 7.10 illustrates the effect of an increase in the demand for the industry’s product. The new market equilibrium price of  $P_3$  is taken as given by the firm, which increases its output to  $q_3$ .

## EXHIBIT 7.9

## A Rise in Variable Costs



A. Supply and demand for output of the industry

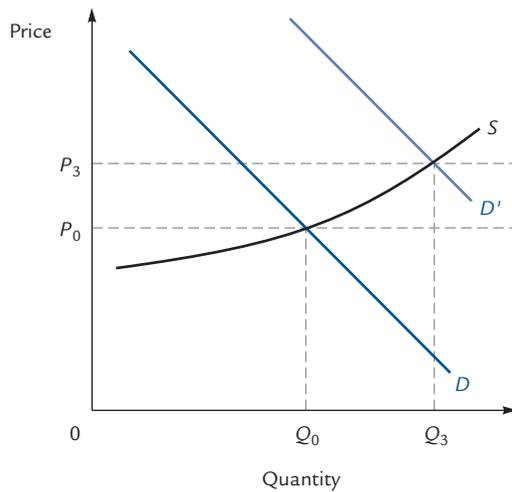


B. Supply and demand for output of the firm

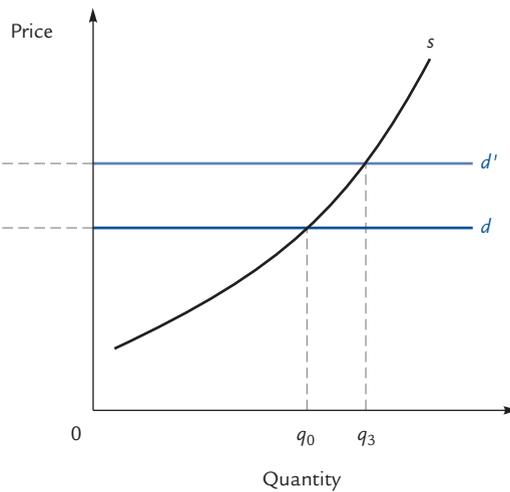
A rise in variable costs causes the firm's supply curve to shift left from  $s$  to  $s'$  in panel B. The industry supply curve shifts left from  $S$  to  $S'$  in panel A, both because each firm's supply curve does and because some firms may shut down. The new market price is  $P_2$ . The firm operates at the intersection of  $s'$  with its new horizontal demand curve at  $P_2$ . Depending on how the curves are drawn, the firm could end up producing either more or less than it did before the rise in costs. (That is,  $q_2$  could be either to the left or to the right of  $q_0$ .)

## EXHIBIT 7.10

## A Change in Demand



A. Supply and demand for output of the industry



B. Supply and demand for output of the firm

An increase in the demand for the industry's output raises the equilibrium price to  $P_3$  and the firm's output to  $q_3$ .

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**Exercise 7.3** Draw graphs illustrating the effect of a fall in demand for the industry's product.

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## The Industry's Costs

In the short run the competitive industry consists of a fixed number of firms. These firms collectively produce some quantity of output. The total cost of producing that output is the sum of the total costs of all the individual firms.

Suppose that you were appointed the czar of U.S. agriculture and given the power to tell each farmer how much to produce. You would like to maintain the production of wheat at its current level of 1 million bushels per year, but you would like to do this in such a way as to minimize the total costs of the industry. How would you go about this?

The equimarginal principle points the way to the answer. Suppose that the marginal cost of growing wheat is \$5 per bushel at Farmer Black's farm and \$3 per bushel at Farmer White's. Then here is something clever you can do: Order Black to produce one less bushel and White to produce one more. In that way, the industry's total cost is reduced by \$2, and the level of output is maintained. You should continue to do this until the marginal costs of production are just equal at both farms.

Indeed, as long as any two farms have differing marginal costs, you can use this trick to reduce total costs. Total costs are not minimized until marginal cost is the same at every farm.

Now, the miracle: In competitive equilibrium, every farmer chooses to produce a quantity at which price equals marginal cost. Because all farmers face the same market price, it follows that all farmers have the same marginal cost. From this we have the following result:

**In competitive equilibrium, the industry automatically produces at the lowest possible total cost.**

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Students sometimes think that this result follows from firms' attempts to minimize their costs. But no firm has any interest in the costs of the industry as a whole. The minimization of industry-wide costs is a feature of competitive equilibrium that is not sought by any individual firm.

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Dangerous  
Curve

What is the marginal cost to the industry of producing a unit of output? You might think that this question is unanswerable, because the industry consists of many firms, each with its own marginal cost curve. How are we to decide which firm to think of as producing the "last" unit of output in the industry?

The answer to the last question is that it doesn't matter. We have just seen that in competitive equilibrium, the cost of producing the last unit of output is the same at every firm. That cost is the industry's marginal cost of production.

At each point along its supply curve, the competitive industry produces a quantity that equates price with marginal cost. Therefore, the industry's supply curve is identical to the industry's marginal cost curve, just as each individual firm's supply curve can be identified with its own marginal cost curve.

## 7.3 The Competitive Firm in the Long Run

There are two differences between the short run and the long run:

First, some costs that are fixed in the short run become variable in the long run. It takes time for a restaurant to add grills to the kitchen; therefore, the cost of the grills is fixed in the short run but variable in the long run.

Second, and more importantly, firms can enter or exit from the industry in the long run.

In this section we will see how these factors determine the firm's long-run supply curve.

### Long-Run Marginal Cost and Supply

In the long run, just as in the short run, a competitive firm wants to operate where Price = Marginal Cost; the only difference is that in the long run we must interpret "marginal cost" to mean *long-run* marginal cost.

Thus at any given price, the firm chooses to supply a quantity that can be read off its long-run marginal cost curve. In other words:

*As long as the firm remains in the industry, its long-run supply curve is identical with its long-run marginal cost curve.*

### Comparing Short-Run and Long-Run Supply Responses

A restaurant produces hamburgers using inputs that include ground beef, short-order cooks, and kitchen grills. How does this restaurant respond to a rise in the price of hamburgers? In the short run, it can increase quantity by purchasing more beef and hiring more cooks. The resulting quantity of hamburgers is recorded on the short-run supply curve.

In the long run, however, the restaurant might decide to expand its operation by purchasing more grills. Typically, this means that quantity increases by more in the long run than it does in the short run. In other words, the long-run supply curve is more elastic than the short-run supply curve.

Exhibit 7.11 shows the picture. The restaurant has sold hamburgers at a going price of  $P_0$  for a long time and has thus adjusted the number of grills so as to produce  $Q_0$  hamburgers at the lowest possible cost. The quantity  $Q_0$  can be read from the long-run supply curve. Because the kitchen hardware is all in place,  $Q_0$  is the quantity read from the short-run supply curve as well.

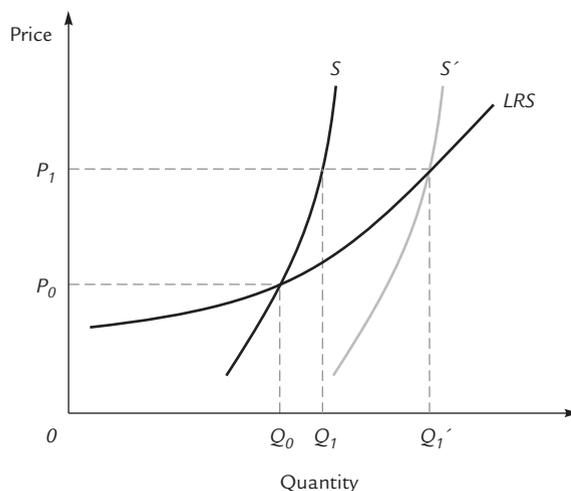
Now suppose that the price rises to  $P_1$ . In the short run, with the number of grills fixed, quantity rises to  $Q_1$ , which we can read off the short-run supply curve. In the long run, after the facilities are expanded, quantity rises further, to  $Q_1'$ . With its expanded kitchen equipment, the firm has a new short-run marginal cost curve and hence a new short-run supply curve, called  $S'$  in the exhibit. Notice that  $S'$  must go through the new supply point at  $(P_1, Q_1')$ .

### Profit and the Exit Decision

These are two differences between the long run and the short run. First, as we've seen, the firm's long run and short run supply curves can be different. The second difference concerns the firm's decision whether to supply anything at all. In the short run firms

## EXHIBIT 7.11

## Long-Run and Short-Run Supply Responses



In long-run equilibrium at  $P_0$ , the firm is on both its long-run and short-run supply curves. A change in price, to  $P_1$ , has the immediate effect of causing the firm to move along its short-run supply curve  $S$  to the quantity  $Q_1$ . In the long run, the firm can vary its plant capacity (for example, a hamburger stand can install more grills) and move along its long-run supply curve,  $LRS$ , to  $Q_1'$ . With the new plant capacity, the firm has a new short-run supply curve  $S'$ . In the new equilibrium at price  $P_1$  and quantity  $Q_1'$ , the firm is again on both its long-run and short-run supply curves.

can *shut down* (without leaving the industry) but in the long run firms can *exit*. To understand long-run supply, we must understand the exit decision.

Firms leave the industry when their profits are too low to justify sticking around. So to understand the exit decision, we have to make sure we understand profit.

Profit is just revenue minus cost. But it's important to remember that to an economist (though not, perhaps, to an accountant), *cost* includes all forgone opportunities.

For example: Suppose you run a newspaper business, buying 100 newspapers a day for 15¢ each and reselling them for a quarter. Your accountant will calculate your revenue to be \$25 and your costs to be \$15, leaving a \$10 profit.

That's your **accounting profit**. But to calculate your **economic profit**, we've got to subtract the accounting profit you *could have* earned by pursuing your next best opportunity. If instead of delivering newspapers, you could have earned a \$7 accounting profit selling lemonade, then your economic profit is  $\$10 - \$7 = \$3$ .

Or, if you could have earned a \$12 accounting profit selling lemonade, then your economic profit in the newspaper business is  $\$10 - \$12$ , or *minus* \$2.

When noneconomists use the word *profit*, they usually mean *accounting profit*. But in an economics course or a book about economics, profit means economic profit.

You'll want to leave the newspaper business if selling lemonade (or some other activity) is more attractive than selling newspapers, and this happens exactly when your economic profit is negative. You'd be well advised to leave that business and sell lemonade instead. Therefore;

**Firms want to exit the industry when their economic profits are negative.**

### Accounting profit

Total revenue minus those costs that an accountant would consider.

### Economic profit

Total revenue minus all costs, including the opportunity cost of being in another industry.

Now imagine a world with 1,000 identical newspaper sellers, all earning negative economic profit. You might think that eventually they'll all leave the industry. But that's not necessarily true. As firms leave, the price of newspapers will rise—leading to higher profits for the remaining firms.

So negative economic profits lead to exit, which leads (eventually) to zero economic profit for the remaining firms.

Why are firms willing to stick around and earn zero profit? Because “zero economic profit” is not the same as “zero accounting profits.” Zero economic profit simply means that you're doing no better—but also no worse—than you could do in some other business.

### The Algebra of the Exit Decision

Firms want to exit when their economic profits are negative. Profit, of course, is total revenue ( $TR$ ) minus total cost ( $TC$ ) (where total cost includes the forgone opportunity to be in some other industry!). Total revenue, in turn, is price times quantity, or  $P \times Q$ . So firms want to exit when  $P \times Q - TC$  is negative.

Sometimes it's easier to think about the firm's profit *per item*, which we get by taking  $P \times Q - TC$  and dividing by the quantity produced. Because  $TC/Q = AC$ , this gives the expression

$$P - AC$$

and once again, firms want to exit when this quantity is negative, which happens when

$$P < AC$$

In other words:

**When price is below average cost, firms want to leave the industry.**

This should make perfect sense. If you sell your widgets at a price that is below the average cost of producing them, you're in the wrong business.

### The Firm's Long-Run Supply Curve

In the long run, as in the short run, firms maximize profit by choosing the quantity where price equals marginal cost. Of course, in the long run, “marginal cost” means “long-run marginal cost.” Therefore, as long as a firm wants to be in business at all, its long-run supply curve coincides with the upward sloping part of its long-run marginal cost curve.

And when does the firm *not* want to be in business? Answer: when profits are negative; that is, when price is below average cost. So those prices are excluded from the long-run supply curve.

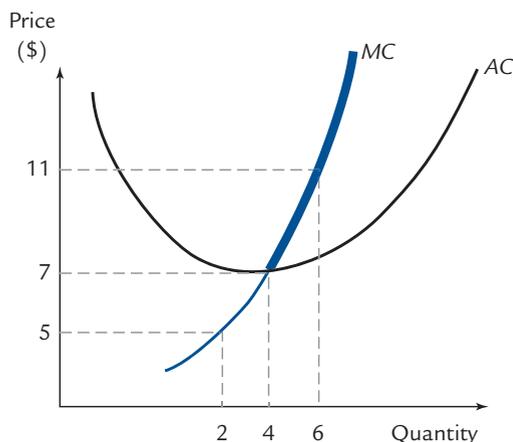
Exhibit 7.12 shows the long-run marginal and average cost curves at Sam's House of Widgets. If widgets sell for a going price of \$5, the best Sam can do is sell 2 widgets (the quantity where price equals marginal cost). Here the *average* cost of production exceeds \$5, so Sam's profit is negative and he wants to get out. Therefore, \$5 corresponds to no point at all on Sam's long-run supply curve.

But at a price of, say, \$11, Sam will produce 6 widgets and earn a positive profit (because at a quantity of 6, average cost is below \$11). Therefore, the point with price = \$11 and quantity = 6 is on his supply curve.

In general, the points on Sam's supply curve are those that lie above his average cost curve, which is to say they are the boldfaced points in Exhibit 7.12.

## EXHIBIT 7.12

## The Firm's Long-Run Supply Curve



At any given price, Sam's House of Widgets sells the quantity where price equals marginal cost. Therefore, as long as Sam wants to be in business at all, his (long-run) supply curve coincides with his (long-run) marginal cost curve.

But at sufficiently low prices (like \$5), Sam prefers to exit the industry. Therefore, the point corresponding to \$5 is excluded from the supply curve. The supply curve is the boldfaced portion of the marginal cost curve—the part that lies above average cost.

The firm's long-run supply curve is the part of its long-run marginal cost curve that lies above its average cost curve.

Note the twin distinctions between the short run and the long run. In the short run, the firm *shuts down* (without leaving the industry) if price falls below *average variable cost*. In the long run, the firm *exits* if price falls below *average cost*.



Dangerous  
Curve

## 7.4 The Competitive Industry in the Long Run

Before we study the competitive industry in the long run, let's briefly recall what we know about the competitive industry in the short run. The key picture is Exhibit 7.8, relating industry-wide supply and demand (in the left panel) to firm-specific supply and demand (in the right). By manipulating the four curves in that picture, we can solve a variety of problems (as in, for example, Exhibits 7.9 and 7.10).

Our goal is to construct a similar picture for the long run. Once again we will have four curves. There is an industry-wide demand curve, which slopes downward and reflects consumers' preferences. There is a firm-specific demand curve, which is flat at the going market price. There is a firm-specific supply curve, which slopes upward and coincides with the firm's marginal cost curve.

Actually, as we saw in Exhibit 7.12, the firm's supply curve coincides with only a *part* of its marginal cost curve, but it will do no harm for us to ignore that subtlety for now.



Dangerous  
Curve



Dangerous  
Curve

Because the firm might have different marginal cost curves in the short run and the long run (see Exhibit 7.11), it might have different supply curves in the long run and the short run. But the *theory* of the supply curve—that is, the fact that it coincides with the marginal cost curve—is the same in either case.

That accounts for three of our four curves. Next, we need to describe the industry-wide supply curve. That will take a little more work.

## The Long-Run Supply Curve

In the short run, we got the industry-wide supply curve by adding the supply curves of individual firms (see Exhibit 7.7). In the long run, that procedure won't work, because firms can enter and exit in the long run. If we were adding the individual firms' supply curves, which firms would we count? Those currently in the industry? Those that might be poised to enter? Those that might enter someday?

Rather than tackle that question, we proceed a different way: We construct the long-run industry supply curve from scratch, exactly as we would construct *any* supply or demand curve from scratch, namely, one point at a time. We hypothesize a price, figure out the corresponding quantity, and plot a point. Then we hypothesize another price and repeat the process.

First we need to know what the suppliers' cost curves look like. Exhibit 7.13 shows the cost curves of a typical barber, both graphically (in panel A) and numerically (in the chart directly below). *We will assume for now that all barbers have the same cost curves*; we express this assumption by saying that barbershops form a **constant-cost industry**. In Section 7.5, we will relax this assumption.

Now we are ready to begin constructing the supply curve. First, we hypothesize a price—say \$5 per haircut. How would Floyd the Barber respond to this price? As long as he's in business, Floyd maximizes profit by choosing the quantity where price equals marginal cost. You can see in the graph (or the chart) in Exhibit 7.13 that this occurs at quantity 2.

If this were a short-run problem, we'd be done. But because it's a long-run problem, we need to think about whether Floyd wants to go on barbering. That means we have to think about his profits.

First, Floyd's total revenue, when he sells 2 haircuts at \$5 each, is \$10. His total cost, which you can read off the chart in Exhibit 7.13, is \$15. So his profit is  $\$10 - \$15 = -\$5$ , a negative number. So Floyd wants to leave the industry, and in the long run, that's exactly what he'll do.

And so will every other barber, because we've assumed that all barbers are exactly like Floyd (or at least have exactly the same cost curves). Conclusion: When the price of a haircut is \$5, there is no such thing as a barber.

If the price of a haircut were \$5, it is not in fact true that all barbers would leave the industry. What would happen is this: Some barbers would leave, and as they left, the price of haircuts would get bid up. Eventually, the price would get bid up high enough to convince some barbers to stay in business.

However, and this is a key point, *none of that is relevant to the construction of the supply curve*. A point on the supply curve answers a hypothetical question: *If the price of haircuts were \$5 (and if it were stuck at \$5 and unable to change), then what would happen?* Answer: There would be no barbers. So on the supply curve, a price of \$5 goes with: nothing at all.

### Constant-cost industry

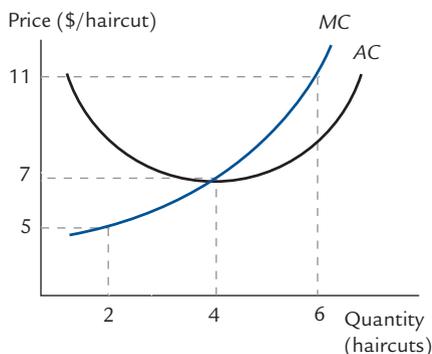
An industry in which all firms have identical costs.



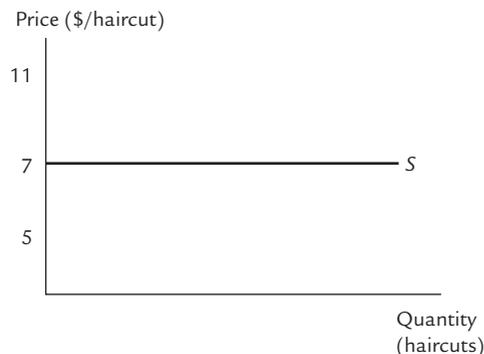
Dangerous  
Curve

EXHIBIT 7.13

Constructing the Long-Run Supply Curve



A. Cost curves for a typical barber



B. Long-run industry-wide supply

| Quantity | Total Cost (TC) | Marginal Cost (MC) | Average Cost (AC) |
|----------|-----------------|--------------------|-------------------|
| 1        | \$10            | \$2/haircut        | \$10/haircut      |
| 2        | 15              | 5                  | 7.50              |
| 3        | 21              | 6                  | 7.00              |
| 4        | 28              | 7                  | 7.00              |
| 5        | 37              | 9                  | 4.00              |
| 6        | 48              | 11                 | 8.00              |

Panel A shows the cost curves of a typical barber, which we take as given. In panel B, we construct the long-run industry supply curve, one point at a time.

If the going price of haircuts is \$5, each barber provides 2 haircuts, earning a profit of  $\$10 - \$15 = -\$5$ . Therefore each barber exits and the haircut industry disappears.

If the going price of haircuts is \$11, then each barber provides 6 haircuts and earns a positive profit of  $\$66 - \$48 = \$18$ . Now every firm in the world becomes a barbershop; the quantity of haircuts provided is equal to 6 per firm times an unlimited number of firms. The corresponding quantity is completely off the chart.

If the going price of haircuts is \$7, then each barber provides 4 haircuts and breaks even. The total quantity supplied is 4 haircuts per barber times any number of barbers; in other words, it is anything. So a price of \$7 goes with every quantity.

Let's try again. We hypothesize another price—say \$11 this time—and we see what happens. Now Floyd chooses the quantity where marginal cost is \$11—that is, the quantity 6. His total revenue is  $6 \times \$11 = \$66$  and his total cost is \$48 (read from the chart in Exhibit 7.13). His profit is \$18.

Remember that this is an *economic* profit. It means that Floyd can earn more as a barber than in any other industry. And therefore so can anyone else. (Here we are still making the strong assumption that everyone has the same cost curves Floyd does; we'll relax this assumption in later sections.) In other words, *every firm in the Universe wants to convert itself to a barbershop*, and in the long run, they all do.

Okay, now how many haircuts are provided? Answer: 6 per firm, times the number of firms, and the number of firms is essentially infinite. Therefore, an essentially infinite number of haircuts is supplied. The price of \$11 goes with the quantity “infinity”—or at least with a number so large it's way off our graph. There's no way to plot this point.



Dangerous  
Curve

In reality, when barbershops earn positive profits, firms enter, driving down the price of haircuts until the positive profits are bid away and the flow of entry stops. But once again, this has *no relevance* to the supply curve. The supply curve asks “What would happen *if* the price of a haircut were stuck at \$11?” And the answer is: In that purely hypothetical situation, all of the world’s resources would be devoted to barbering.

We have now tried twice to construct points on our industry supply curve. Let’s try once more. We’ll hypothesize that haircuts sell for \$7. Floyd chooses the quantity 4 (where price equals marginal cost) and earns a total revenue of  $4 \times \$7 = \$28$ . His total cost (read from the chart in Exhibit 7.13) is also \$28. His (economic) profit is zero.

Does Floyd stick with barbering or does he convert his shop into its next best alternative—say a lemonade stand? Answer: He might do either. Both activities are equally profitable (that’s what it means for economic profit to be zero), so there’s no reason for him to prefer one to another.

And likewise for other firms. Which will be barbershops and which will be lemonade stands, or gas stations, or whatever is next-best for them? We have absolutely no basis for prediction. So—how many barbershops will there be? Maybe none. Maybe one. Maybe ten, or a hundred, or a thousand, or ten thousand. Anything is possible.

And how many haircuts will be provided? Well, 4 per barbershop, times the number of barbershops, which could be anything. In other words, it could be 0, or 4, or 40, or 400, or 4,000, or 40,000, or anything at all. So on the long-run supply curve, *every quantity* is associated with a price of \$7. We’ve plotted this in panel B of Exhibit 7.13, where you can see that:

In a constant-cost industry, the long-run industry supply curve is flat.

### The Break-Even Price

In Exhibit 7.13, barbers who must sell haircuts at \$5 earn negative profits; therefore, they exit the industry. Barbers who must sell haircuts at \$11 earn positive profits, so at this price every firm in the Universe becomes a barbershop. Barbers who sell haircuts at \$7 just **break even**; that is, they earn zero economic profit. Therefore, the supply curve is flat at \$7, and \$7 is called the **break-even price** in this industry.

We calculated the break-even price by trial and error, but there’s also a faster way: The break-even price occurs at the point where the marginal and average cost curves cross. At this price, barbers choose to supply a quantity where price and average cost are equal, so they earn zero profit. (This was essentially the point of Exhibit 7.12.)

We’ve gone through the trial and error process here because the author of your textbook believes it goes a long way toward clarifying the issues and the meaning of the supply curve. But the fast way to find the break-even price is to look for the intersection of the marginal and average cost curves.

### The Break-Even Price and the Supply Curve

Now that we’ve defined the break-even price, we can restate everything we’ve learned in a sentence:

In a constant-cost industry, the long-run industry supply curve is flat at the level of the break-even price.

#### Break-even price

The price at which a seller earns zero profit.

## Changes in the Break-Even Price

What could cause the break-even price to change? The answer is: any change in costs (whether it's a change in variable costs or in total costs). If you can just break even selling haircuts for \$7 apiece on Monday, and if your costs go up on Tuesday, then you can no longer break even selling haircuts for \$7 on Tuesday. When costs rise, the break-even price must rise also.

This is important to remember, because the long-run supply curve is flat *at the break-even price* and therefore shifts every time the break-even price changes. So:

Any increase in costs will cause the long-run industry supply curve to shift upward.  
Any decrease in costs will cause the long-run industry supply curve to shift downward.

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Notice that this is very different from what happens in the short run. In the short run, only variable costs matter. In the long run, fixed costs matter too.

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Take an example: Suppose you run a bubble gum company. Every day, you sell 100 sticks of bubble gum for \$1 a piece, and you just break even; \$1 is your break-even price. Now you are suddenly required to pay an excise tax of 20¢ per stick of bubble gum. What happens to your break-even price? Answer: You would need to charge an extra 20¢ per stick of gum to cover the cost of the tax. Your break-even price is now \$1.20.

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That doesn't mean demanders would pay \$1.20; it means only that \$1.20 is what you would have to charge to break even. Whether you *can* break even is a separate question.

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Or take another example: You sell 100 sticks of bubble gum for \$1 apiece and you just break even; once again your break-even price is \$1. Now you are subjected to an annual license fee of \$20. What is your new break-even price? Answer: To break even, you'd have to charge enough to cover your additional \$20 in costs. That comes to approximately an extra 20¢ per stick of gum, making your new break-even price approximately \$1.20.

Why *approximately*? Because at a price of \$1.20, you'd presumably choose to supply some quantity of gum other than 100. But as long as your quantity stays *close* to 100, your new break-even price is somewhere around \$1.20.

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**Exercise 7.4** In the example of Exhibit 7.13, suppose every barber must pay an annual license fee of \$18. What is the new break-even price?

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Dangerous  
Curve



Dangerous  
Curve

## Equilibrium

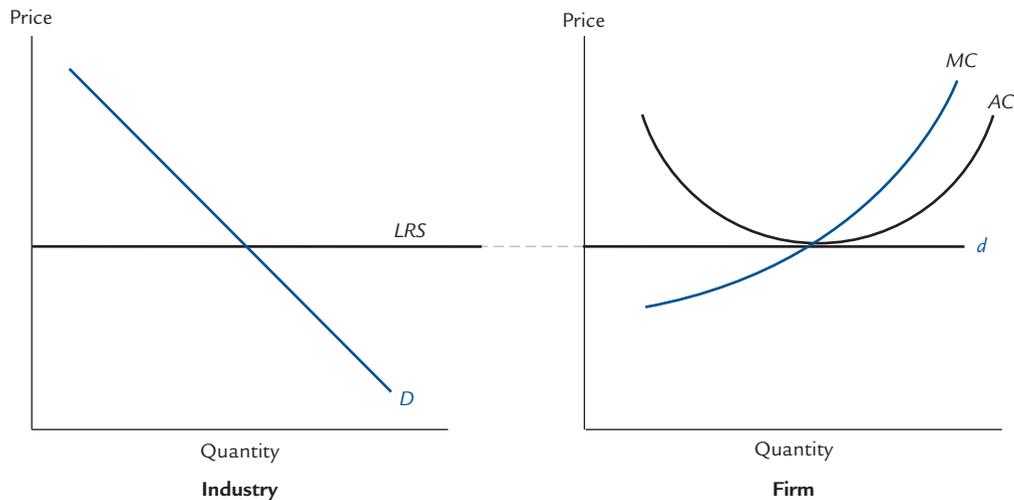
The relationship between the competitive industry and the competitive firm is the same in the long run as in the short run: The market price is determined by the intersection of the industry-wide supply and demand curves, and the firm faces a flat demand curve at the going market price. You can see the picture in Exhibit 7.14.

## The Zero-Profit Condition

As you can see in Exhibit 7.14, the long-run equilibrium price is always equal to the break-even price (because that's the level at which the industry supply curve is flat). If

## EXHIBIT 7.14

## Long-Run Competitive Equilibrium



The industry-wide equilibrium occurs at the break-even price. Firms face a demand curve that is flat at that price.

the break-even price for barbershops is \$7 per haircut, then the equilibrium price of a haircut will be \$7, regardless of where the demand curve lies. Thus, in the long-run equilibrium, all barbers earn exactly zero profit.

It's clear why this must be so. If the price of haircuts were below \$7, barbers would earn negative profits and begin leaving the industry. As they left, the price of haircuts would rise, and continue rising until the price reached \$7 and there was no reason for further exit. On the other hand, if the price of haircuts were above \$7, profits would be positive, firms would enter, and the price of haircuts would fall, driving the price back down to \$7.

**In a constant-cost industry, in long-run equilibrium, all firms earn zero economic profit.**

Remember, though, that entry and exit take time. In the real world, a firm cannot instantly convert itself from a clothing store to a barbershop. If the demand for haircuts rises, barbers might earn positive profits for quite awhile until enough firms enter the industry to drive profits back down to zero. During that time, the industry is not in long-run equilibrium.

Many economists argue that long-run zero-profit equilibrium is almost never reached, because demand curves and cost curves shift so often that the entry and exit process never settles down. Although this is arguably true in many industries, the zero-profit condition remains a useful approximation to the truth.

### Cost Minimization

The zero-profit condition has an interesting side effect: A firm earning zero profit must be operating at the point where its marginal and average cost curves cross. But we saw way back in Exhibit 6.5 that the marginal and average cost curves cross at the *bottom* of the average cost curve. Therefore:

In long-run equilibrium in a constant-cost industry, every firm produces at the lowest possible average cost.

No firm *sets out* to minimize average cost. Firms seek only to maximize profit. In Exhibit 7.13, if haircuts were selling for \$11 each, Floyd the Barber would cheerfully provide 6 haircuts a day at an average cost of \$8, which is well above the minimum of 7. Only when profit is zero—that is, when the price of haircuts falls back to \$7—does Floyd move to the bottom of his average cost curve.



## Changes in Equilibrium

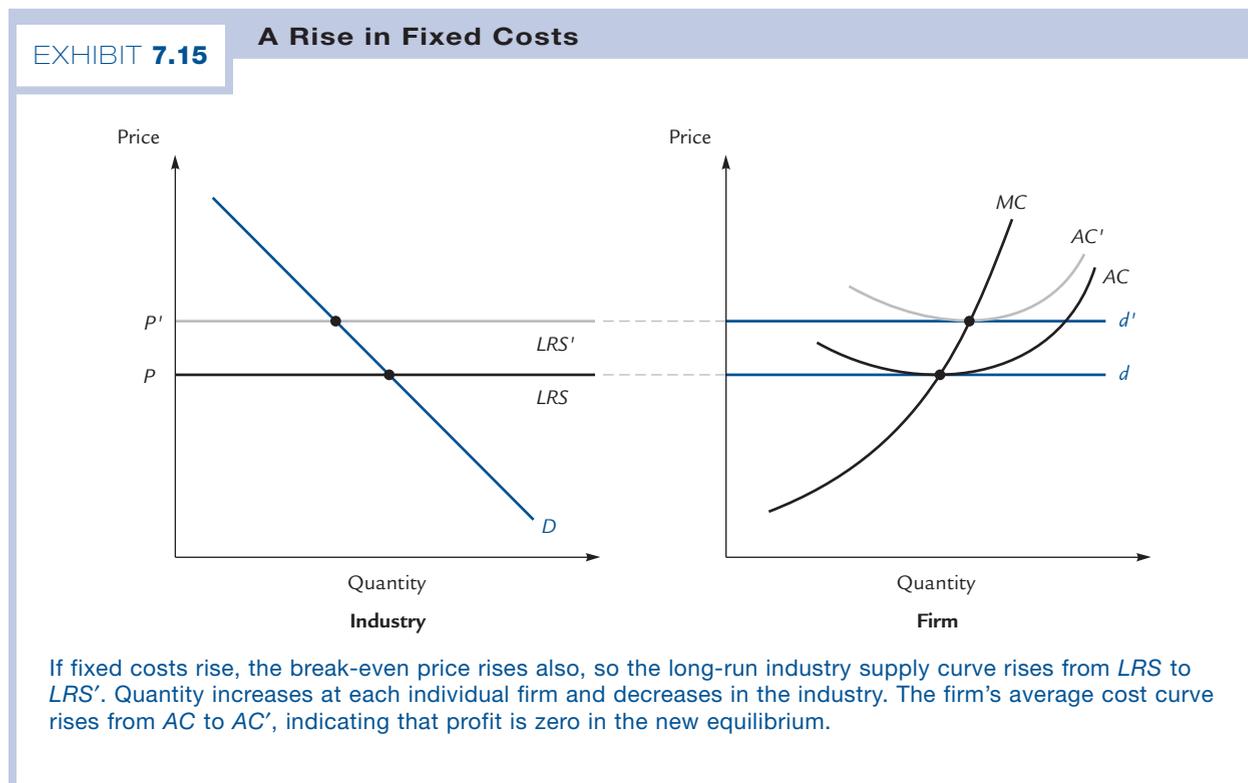
The analysis of long-run equilibrium differs from the analysis of short-run equilibrium in two important ways. First, the industry-wide supply curve is flat. Second, the industry-wide supply curve moves in response to any change in costs, whether fixed or variable.

Here are some examples.

### Changes in Fixed Costs

Suppose new legislation requires every barbershop to pay a daily license fee. What happens in the long run?

Exhibit 7.15 shows the answer. The firm's marginal cost curve is unaffected, but the break-even price rises. (Go back to Exercise 7.2 if you need to be reminded of why.) Thus, the industry supply curve shifts vertically upward to the level of the new break-even price. Each firm produces more haircuts than before; the industry as a whole now produces fewer.



If each barber cuts more hair, how can the total number of haircuts go down? The answer is that in the long run, the number of barbers must fall. In the short run, such an outcome would be impossible.

There is no way to predict which individual barbers will exit. All we know is that *some* barbers will exit, and exit continues until the price is bid up to its new break-even level. The right half of Exhibit 7.15 shows the situation at one of those barbershops that happens to remain.



Dangerous  
Curve

In Chapter 6, we argued that in the long run, firms have no fixed costs because they can vary their employment of any factor of production. As long as the firm's costs consist entirely of payments to factors, it is correct to say that the firm has no long-run fixed costs. However, the license fee we've just considered is in a separate category from those payments to factors. It does not vary with output and is therefore a fixed cost even in the long run.

It is important to distinguish a fixed cost from a sunk cost. Although the license fee is a fixed cost for any firm that decides to remain in the industry, it is not yet a sunk cost at the point when the entry/exit decision is being made. Thus, it is relevant to the decision. A cost that is truly sunk, in the sense that it cannot be avoided even by leaving the industry, will not affect anything.

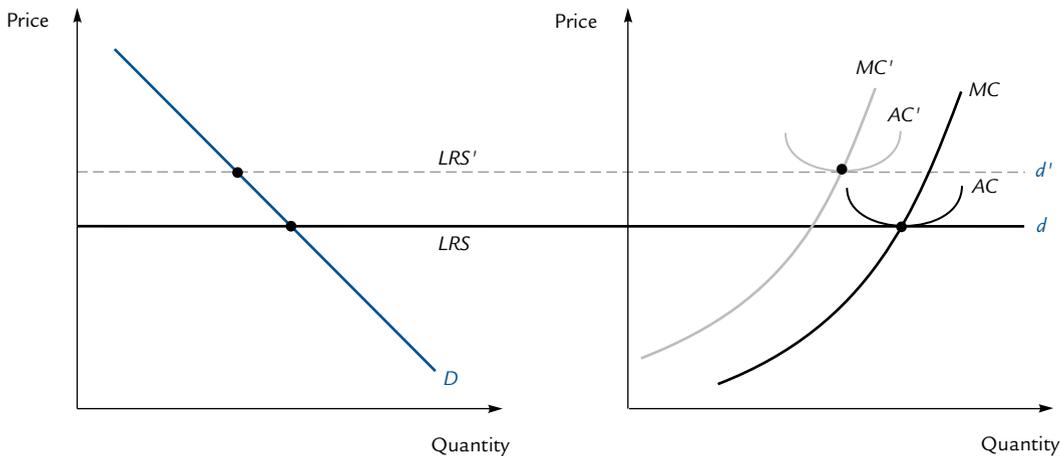
### Changes in Variable Costs

An increase in variable costs has two effects: First, the firm's marginal cost curve shifts upward. Second, the break-even price increases, so the industry supply curve shifts upward. Exhibit 7.16 shows the consequences. The quantity supplied by individual firms might either increase or decrease, while the quantity supplied by the industry must decrease.

There's one special case where we can say more: Suppose that marginal cost shifts upward by the same amount at every quantity (so that the marginal cost curve shifts upward

EXHIBIT 7.16

#### A Rise in Variable Costs

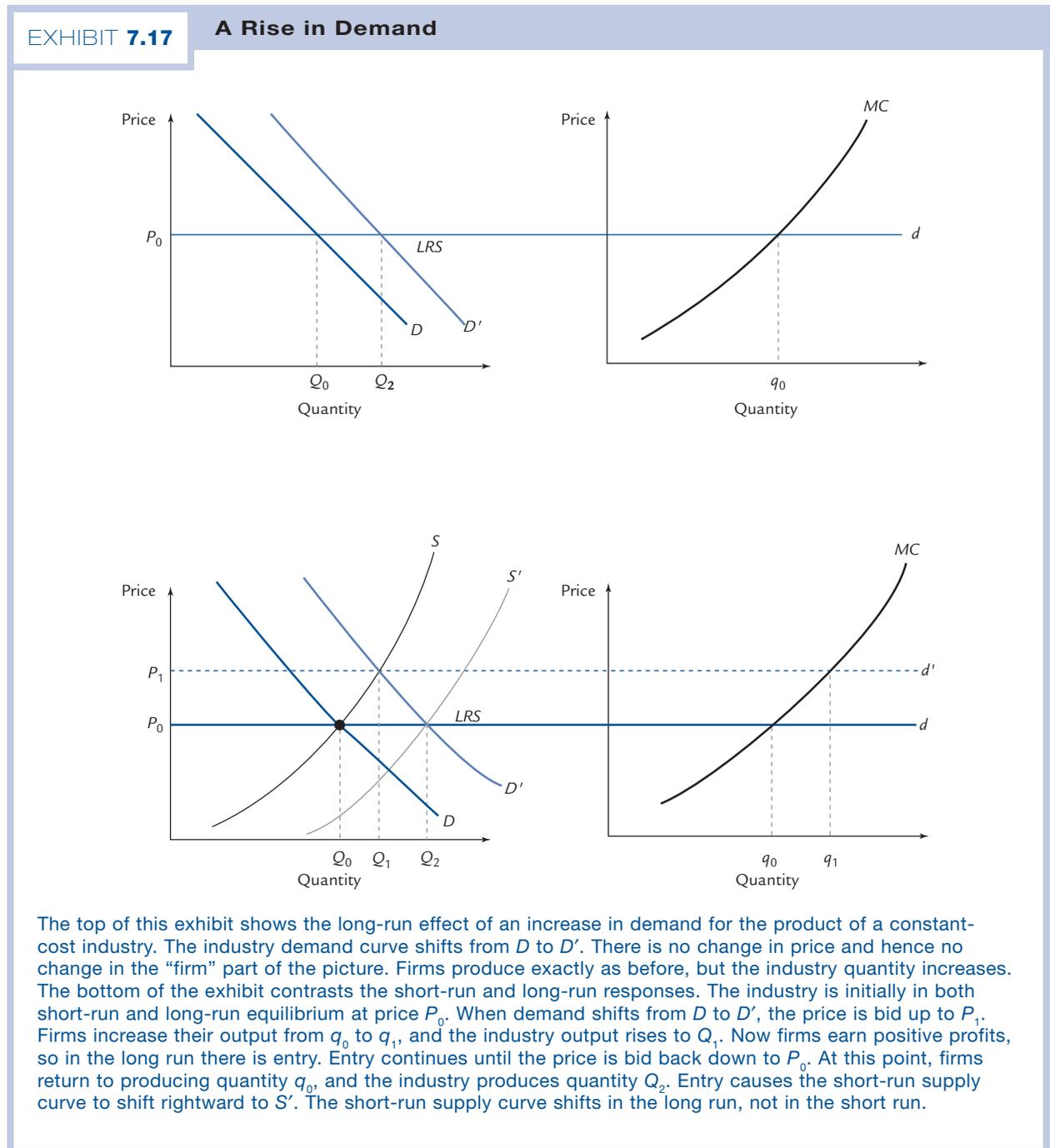


If variable costs rise, the firm's marginal cost curve rises from  $MC$  to  $MC'$ . The break-even price rises, so the long-run industry supply curve rises from  $LRS$  to  $LRS'$ . The industry quantity falls; the firm quantity can either fall or rise. The average cost curve shifts from  $AC$  to  $AC'$ , and the firm earns zero profit at the new equilibrium.

parallel to itself). Then the break-even price rises by that same amount (as does the average cost curve). Consequently, the new equilibrium quantity at the firm is unchanged.

### Changes in Demand

Suppose the demand for haircuts increases. At the top of Exhibit 7.17, you can see the long-run consequence. Industry-wide demand shifts rightward. The market price remains unchanged, so nothing changes in the “firm” part of the picture. Individual



barbershops continue producing just as before, but the industry-wide quantity of haircuts increases, because of entry.

It is instructive to compare the long run with the short run. At the bottom of Exhibit 7.17 you can see this comparison. The industry is initially in both short-run and long-run equilibrium at the price  $P_0$  and quantity  $Q_0$ . The increase in demand initially leads to a movement along the short-run supply curve  $S$  to the higher price  $P_1$ . Firms now provide  $q_1$  haircuts apiece, for an industry-wide total of  $Q_1$ . The higher price leads to positive profits and attracts entry in the long run. Thereupon the price is bid back down to  $P_0$  and the industry-wide quantity rises further to  $Q_2$ , although individual firms return to the original quantity  $q_0$ .



Dangerous  
Curve

In Exhibit 7.17, entry causes the short-run industry supply curve to shift rightward from  $S$  to  $S'$ . This shift takes place only in the long run; in the short run, there is no entry, so the short-run supply curve does not shift.

Notice that entry does *not* cause a shift in the *long-run* supply curve, because the consequences of entry are already *built in* to that curve. But the short-run supply curve ignores the effects of entry, and so it must shift to a new location after entry takes place.

### Application: The Government as a Supplier

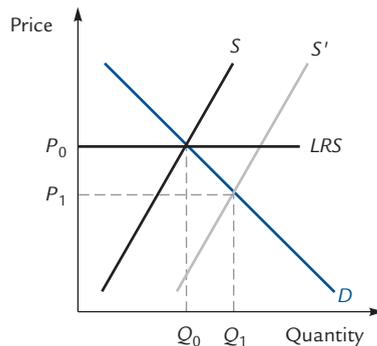
Suppose your city's government decides there is not enough housing available and decides to do something about it by building and operating a new apartment complex. Will this policy succeed in increasing the quantity of housing?

In the short run, yes. The new apartment complex causes the short-run housing supply curve to shift to the right. In Exhibit 7.18, you can see that the equilibrium price of housing falls from  $P_0$  to  $P_1$  and the quantity increases from  $Q_0$  to  $Q_1$ .

But the long-run supply curve does not shift. That's because the long-run supply curve is determined by the break-even price. For example, if it costs landlords \$400 a month to provide an apartment, then the long-run supply curve is flat at \$400 a month.

#### EXHIBIT 7.18

#### The Government as a Supplier



When the government builds an apartment complex, the short-run housing supply curve shifts rightward, but the long-run housing supply curve remains fixed. Thus, the quantity of housing increases from  $Q_0$  to  $Q_1$  in the short run, but returns to  $Q_0$  in the long run.

It follows that in the long run, the price of housing must return to  $P_0$  and the quantity must return to  $Q_0$ . That is, in the long run, the number of privately owned apartments withdrawn from the market must just equal the number of new apartments built by the government. (Otherwise, the price would remain below  $P_0$  and landlords would earn negative profits, prompting further exit.) Thus, in the long run, the government's new apartment complex adds exactly nothing to the supply of housing.

## Some Lessons Learned

Ask a non-economist why the price of cheddar cheese is, say, \$5 a pound, and you're likely to get an answer like "that's what the market will bear," which suggests that prices are explained by demand. But in fact, in competitive industries in the long run, prices are determined primarily by supply. We've just seen that—at least in certain ideal circumstances—the long-run supply curve is flat. Therefore, the supply curve alone determines price. Demand has nothing to do with it. (More precisely, a shift in demand has no effect on price, as we've seen in Exhibit 7.17.)

Another lesson is that changes in costs don't benefit suppliers in the long run, because in the long run profits are always zero. Therefore, when costs fall, all of the benefits are ultimately transferred to consumers. You might think that, if it became cheaper to feed cows, for example, dairy farmers would benefit. In the long run they won't, because the price of dairy products falls until profits return to zero. The winners are the consumers of milk and cheese.

What's true of cost reductions is also true of subsidies. A government subsidy to, say, corner grocery stores would not, in the long run, benefit the owners of grocery stores; because of the long-run flat supply curve, the full benefit of the subsidy would be transferred to consumers. And conversely, a tax on grocery stores (or on milk or cheese) would, in the long run, fall entirely on consumers.

One additional lesson to take from our analysis is that you'll never get rich by imitating the successes of others. If those successes were easy to imitate, everybody would imitate them and they'd garner no rewards. If you want to get rich, you have to break out of the model (which assumes all firms are identical) by identifying needs nobody else has identified, or by finding solutions nobody else has thought of, or by finding genuinely new ways to make people understand that your solutions are worth adopting.

## 7.5 Relaxing the Assumptions

When you travel by car, the other drivers on the road are both a blessing and a curse. On the one hand, they compete with you for resources: They take up space on the road, and they bid up the price of gasoline. On the other hand, those other drivers are a large part of the reason why it was worth someone's while to pave the road, and worth someone else's while to set up gas stations and roadside rest stops.

Likewise, if you start, say, a printing business, competing firms are both a blessing and a curse. On the one hand, they might bid up the price of ink. On the other hand, they might entice inkmakers into existence.

Our analysis so far has ignored these effects. We've assumed that all firms are identical, so that the break-even price is the same at every firm. In this section, we will see what happens when we relax these assumptions.

## The Break-Even Price

The cornerstone of our theory is that in long-run equilibrium, firms must earn zero profit and therefore must sell their output at the break-even price. For such a theory to make sense, there must be a single break-even price that applies to all firms and that does not change as a result of entry and exit. In other words, we need to assume:

Assumption 1: All firms are identical; that is, all firms have identical cost curves.

Assumption 2: Those cost curves do not change as the industry expands or contracts.

Assumption 1 is probably true for sidewalk flower vendors and false for breeders of world-class orchids. There are a lot of people who can run sidewalk flower stands about equally well; thus, all of them have the same cost curves. But only very few people have the delicate skills to breed orchids efficiently. Those with fewer skills will find it substantially more costly to produce a given quantity of orchids. (If  $\frac{1}{2}$  of your flowers die before you can bring them to market, that adds substantially to the average cost of producing a marketable orchid.)

In general, Assumption 1 will be true in industries that do not require unusual skills, and false in industries where unusual skills are required. Hamburger stands satisfy Assumption 1; gourmet restaurants do not.

Assumption 2 is also probably true for sidewalk flower vendors. If you're selling flowers, there's no reason why the arrival of new competitors should affect your costs. (New arrivals can affect your *profits* by competing for customers, but that's not the same thing as affecting your costs.) However, Assumption 2 is probably false for farmers. Here's why: An influx of new farmers bids up the rental price of *land*, and the rental price of land is one of the costs of farming.

The key difference is this: Sidewalk flower vendors cannot significantly bid up the wholesale price of flowers, because sidewalk flower vendors, taken as a whole, do not use a significant fraction of the world's flowers. Farmers, by contrast, *can* bid up the price of land, because farmers, taken as a whole, *do* use a significant fraction of the world's arable land.



Dangerous  
Curve

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When you think about flower vendors, be sure to distinguish between the retail price of sidewalk flowers (the price at which the vendors *sell* their wares) and the wholesale price of flowers (the price at which vendors *buy* their wares). To affect costs, competitors must affect the wholesale price of flowers.

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Dangerous  
Curve

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Here's an exception: Suppose that instead of buying their flowers from reputable dealers, the flower vendors pick their flowers from a small public park. Then the arrival of new competitors will make it harder to find flowers in the park, which increases the cost of acquiring flowers. In this case, sidewalk flower vending does not satisfy Assumption 2.

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In general, Assumption 2 will be true in industries that are not large enough to affect the price of any input (where inputs are things like wholesale flowers or arable land), and false in industries that are large enough to affect the price of some input. Here the phrase "large enough" must be interpreted relative to the size of the market for the input in question. For example, the jewelry industry is large enough to affect the price of diamonds, because a substantial fraction of the world's diamonds are used

in jewelry. By contrast, hamburger stands use a lot of meat, but probably not enough to affect its price: Only a small fraction of the world's meat is used to make fast food hamburgers. Thus, hamburger stands, like sidewalk flower vendors, are likely to satisfy Assumptions 1 and 2.

### The Significance of the Assumptions

Assumptions 1 and 2 make it possible to talk unambiguously about *the* break-even price. Without Assumption 1, different firms would have different cost curves and therefore different break-even prices. Without Assumption 2, a given firm's cost curves—and hence its break-even price—would change as other firms entered or left the industry. But given both assumptions, all firms have the same break-even price and that break-even price is unaffected by entry or exit; it is *the* break-even price for the industry.

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Even though we have stressed that there is just one break-even price for the industry, that break-even price can change if cost curves change for some reason other than entry or exit—such as an increase in the cost of some raw material, or a new annual license fee that every firm in the industry must pay.

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### Constant-Cost Industries

An industry is called a **constant-cost industry** if it satisfies Assumptions 1 and 2. Constant-cost industries are the industries to which the analysis of Section 7.4 applies. In the remainder of this section, we will examine some alternative types of competitive industry.

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In Section 7.4, we said that an industry is **constant-cost** if all firms have the same cost curves. Here we are calling an industry constant-cost if all firms have the same cost curves *and* those cost curves are unaffected by entry and exit. In fact, the analysis of Section 7.4 used both assumptions, though we didn't state them explicitly.

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### Increasing-Cost Industries

An **increasing-cost industry** is a competitive industry where the break-even price for new entrants increases as the industry expands.

There are two reasons why an industry might be increasing-cost. First, some firms might have higher break-even prices because they are less efficient. Second, an expansion of the industry might bid up the price of some factor of production and thereby raise the break-even price for everyone—as when an expansion of the farming industry bids up the price of land (this is the *factor-price effect*, which we also encountered in the short run). In either case, we shall see that the long-run industry supply curve slopes upward.

### Less-Efficient Firms

Suppose that Floyd the barber can break even selling haircuts at \$7 apiece. His less-efficient cousin Lloyd has to charge \$9 per haircut to break even. In this case, Assumption 1 is violated.



Dangerous  
Curve

#### Constant-cost industry

A competitive industry in which all firms have identical cost curves, and those cost curves do not change as the industry expands or contracts.



Dangerous  
Curve

#### Increasing-cost industry

A competitive industry where the break-even price for new entrants increases as the industry expands.

When the market price of haircuts is \$7, Floyd cuts hair but Lloyd does something else. If the price rises to \$9, Lloyd enters the barbering industry. Between them, Floyd and Lloyd cut more hair than Floyd alone. Thus, a higher price of haircuts leads to a greater quantity of haircuts supplied. In other words, the long-run supply curve slopes upward.

### The Factor-Price Effect

Suppose instead that Floyd and Lloyd are equally efficient. Either one can break even selling haircuts at \$7 apiece.

But suppose also that if Floyd and Lloyd *both* become barbers, they bid up the price of razors—because two barbers demand more razors than one barber. This adds to their costs and makes it impossible for them to continue breaking even at \$7. Thus, as long as haircuts sell for \$7, only one barber can survive. If the price of haircuts rises to \$9, it becomes possible for Floyd and Lloyd to break even simultaneously. In this case, Assumption 2 is violated.

Once again, a higher price of haircuts leads to more haircuts being supplied. Once again, the long-run supply curve slopes upward.



Dangerous  
Curve

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This example is entirely unrealistic, because in reality barbers cannot bid up the price of razors. That's because the entire world population of barbers accounts for only a small fraction of the world's demand for sharpened steel. We've used this example only for easy contrast with earlier examples.

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The moral of both Floyd/Lloyd examples is this:

In an increasing-cost industry, the long-run supply curve slopes upward.

### An Intermediate Case: A Few Super-Efficient Firms

One case of interest is that in which a few firms are especially efficient and a great number of other firms are essentially identical. In this case, a few efficient firms will be willing to enter the industry even when the price is low, yielding a small but nonzero quantity supplied. When the price rises high enough for the “ordinary” firms to break even, any quantity can be supplied. Thus, the long-run supply curve slopes upward for a short while and then becomes flat, as in Exhibit 7.19. In such an industry, when there is sufficient demand for equilibrium to occur on the flat part of the supply curve, it is usually harmless to assume (for simplicity) that the entire supply curve is flat.

### Example: The Motel Industry

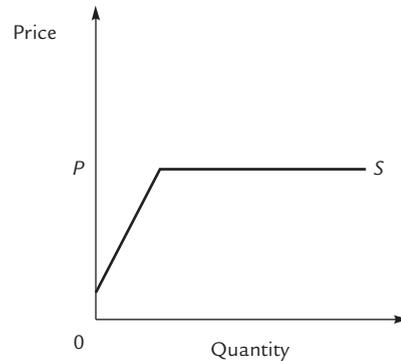
In the motel industry, there might well be a few super-efficient firms, but there are also a vast number of essentially interchangeable motels with (it is reasonable to assume) pretty much the same cost curves. Therefore, to a reasonable approximation, Assumption 1 is satisfied. What about Assumption 2?

Assumption 2 is violated if there is a factor-price effect—in other words, if the price of some input changes when the motel industry expands or contracts. Should we expect to see such a violation?

One of the major inputs into the motel industry is land. Motels take up space, and that space has to be paid for. (Of course, it doesn't matter whether the motel owns the land it sits on or rents it from a landlord. Rent paid to the landlord is a cost; rent forgone by using your own land is equally a cost.)

## EXHIBIT 7.19

## Long-Run Supply with a Few Efficient Firms



Suppose there are a few exceptionally efficient firms and a great number of identical “ordinary” firms. At low prices, only the efficient firms enter and the quantity supplied is small. At the break-even price of the ordinary firms ( $P$ ), the supply curve becomes flat.

So: Does the expansion (or contraction) of the motel industry change the price of land?

It depends. If we’re talking about the industry consisting of motels in, say, downtown Dayton, Ohio, probably not. Most of downtown Dayton is populated by shopping malls, office buildings, and parking lots. Motels use a very small fraction of the land, so even a substantial expansion of the motel industry won’t have a noticeable effect on land prices. New motels can enter without changing the break-even price (say \$70 per motel room per night). These motels form a constant-cost industry.

But if we’re talking about the industry consisting of motels clustered around a particular highway exit, the story is very different. It’s not uncommon for half the land near a highway exit to be populated by motels. Expand the motel industry and the rental price of land goes up. When a new motel enters the market, existing motels might find that they can no longer break even selling rooms for \$70 a night; maybe the new break-even price is \$80 instead. Assumption 2 is violated, the industry is increasing-cost, and the long-run supply curve slopes upward.

## Decreasing-Cost Industries

In 2001, the average laptop computer sold for \$1,640; in 2004 it sold for \$1,250 and by 2005 the price was down to \$1,000—though by then you could get a perfectly usable machine, complete with the latest wireless technology, for as little as \$650.

The reason, according to an article in the *Wall Street Journal*,<sup>1</sup> was increasing demand. For years, laptops were used pretty much exclusively by businesspeople, a relatively small market that prevented manufacturers from achieving economies of scale. Now that most college students have laptops, the market has expanded, laptops are produced more efficiently, and prices have fallen.

<sup>1</sup> Gary McWilliams, “Laptop Prices Hit New Lows,” *Wall Street Journal*, August 31, 2005.

### Decreasing-cost industry

A competitive industry where the break-even price for new entrants falls as the industry expands.

The computer industry is an example of a **decreasing-cost industry** where costs (and therefore break-even prices) fall as the industry expands. At one time, manufacturers like Dell and Gateway produced many of their own internal components. Nowadays, components (like disk drives) tend to be supplied by specialists, freeing up Dell and Gateway to concentrate on the things they do best. But a drive manufacturer can survive only when the industry is big enough to support it, so the growth of the industry drives down break-even prices. Thus, on the industry supply curve, a greater quantity is associated with a lower price; that is:

**In a decreasing-cost industry, the long-run supply curve slopes downward.**

At the end of Chapter 2, we briefly discussed the gains from trade that are due simply to the scale of operations, as opposed to those that are due to comparative advantage. Decreasing-cost industries provide examples of such gains. Suppose that each of two isolated countries has a small computer industry, insufficient to support a specialized drive manufacturer. If these two countries begin to trade with each other, the combined market for computers might suffice to bring a drive manufacturer into the market. By concentrating on the production of drives in large quantities, the drive manufacturer can produce at a lower average cost than any of the computer manufacturers can, thereby reducing the average cost of a laptop computer. Residents of both countries can benefit from the savings.

## Equilibrium

The analysis of long-run equilibrium in the increasing-cost and decreasing-cost cases is just as in the constant-cost case; the only thing that differs is the shape of the long-run industry supply curve. Several examples are provided in Exhibit 7.20 and Exhibit 7.21.

## 7.6 Applications

### Removing a Rent Control

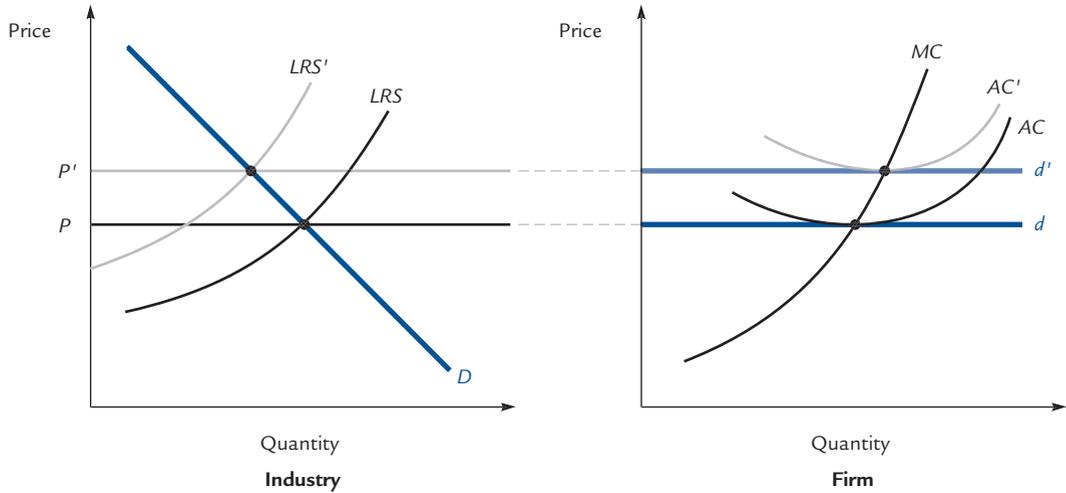
In the town of Llaeggub, apartments rent for \$400 per month. The town passes a law setting a maximum rent of \$200 a month. Some years later, the law is repealed. Nothing changes in the interim. Does the rent on apartments return all the way up to its old level of \$400 per month?

To analyze this problem, look at Exhibit 7.22. The market is initially in both short-run and long-run equilibrium at a price of \$400 and a quantity of  $Q_0$ . When the price is artificially lowered to \$200, landlords' short-run response is to provide fewer apartments. The new quantity can be read off the short-run supply curve  $S$  at a price of \$200. (This quantity is not marked on the graph.) In the long run, as landlords seize additional opportunities to convert apartments to commercial or other uses, or just decide not to keep some existing apartments in adequate repair, the quantity falls still further, to  $Q_1$ , which is read off the long-run supply curve at a price of \$200.

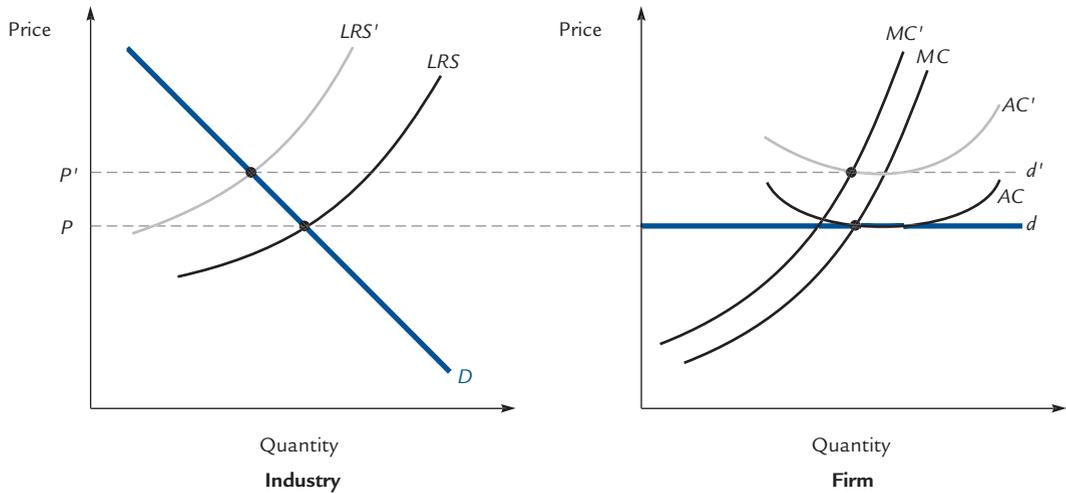
EXHIBIT 7.20

An Increase in Costs in an Increasing-Cost Industry

A. An increase in fixed costs



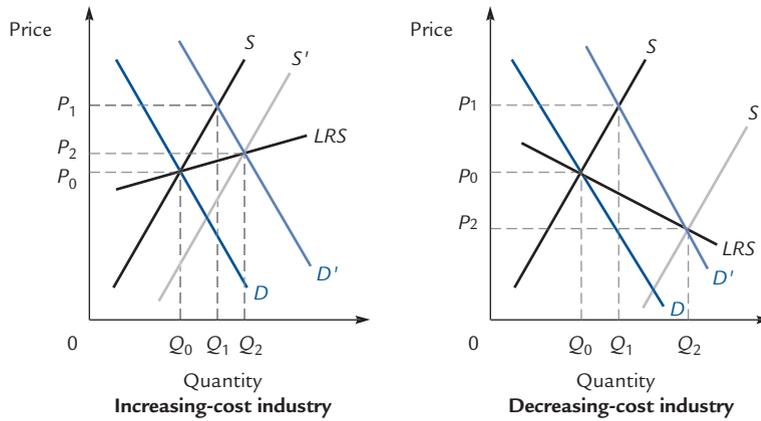
B. An increase in variable costs



The top panels show an increase in fixed costs and the bottom panels show an increase in marginal costs. In both cases, the break-even price increases, so the long-run industry supply curve shifts. The firm's marginal cost curve shifts only in the second of the two examples. In both examples, the price rises and the industry supplies a smaller quantity. In the first example, the firm's quantity surely increases; in the second, the firm's quantity could increase or decrease.

## EXHIBIT 7.21

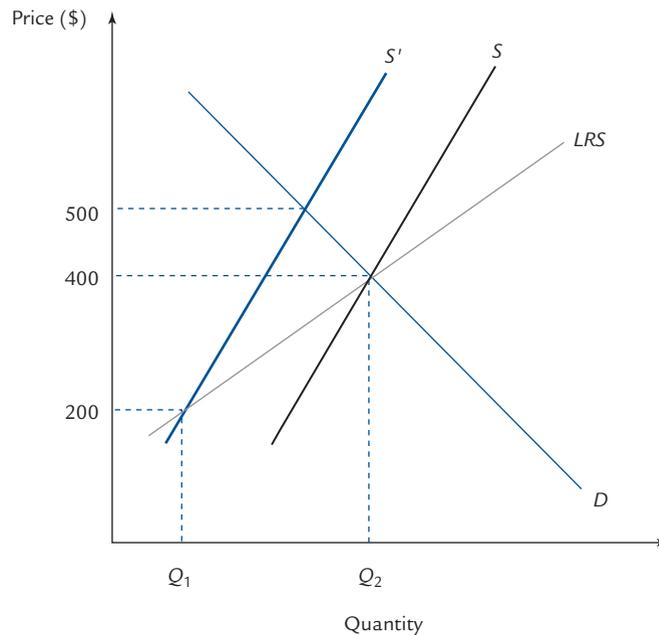
## A Change in Demand



When demand increases, price rises in an increasing-cost industry, but it falls in a decreasing-cost industry. In both cases, the industry-wide quantity increases.

## EXHIBIT 7.22

## Removing a Rent Control



The market is initially in both short-run and long-run equilibrium at a price of \$400. A maximum legal rent of \$200 is imposed. Eventually, quantity falls to  $Q_1$  and the short-run supply curve falls from  $S$  to  $S'$ .

When the rent control is removed, the market moves to a new short-run equilibrium at a price of \$500, above the original uncontrolled price. Eventually, it returns to the long-run equilibrium.

With the stock of apartments reduced, there is a new short-run supply curve  $S'$ . When the rent control is lifted, the new equilibrium is at \$500 and a quantity somewhere between  $Q_0$  and  $Q_1$ . Thus, the answer to the question “Does the rent return all the way up to \$400?” is no; actually, it goes *above* \$400.

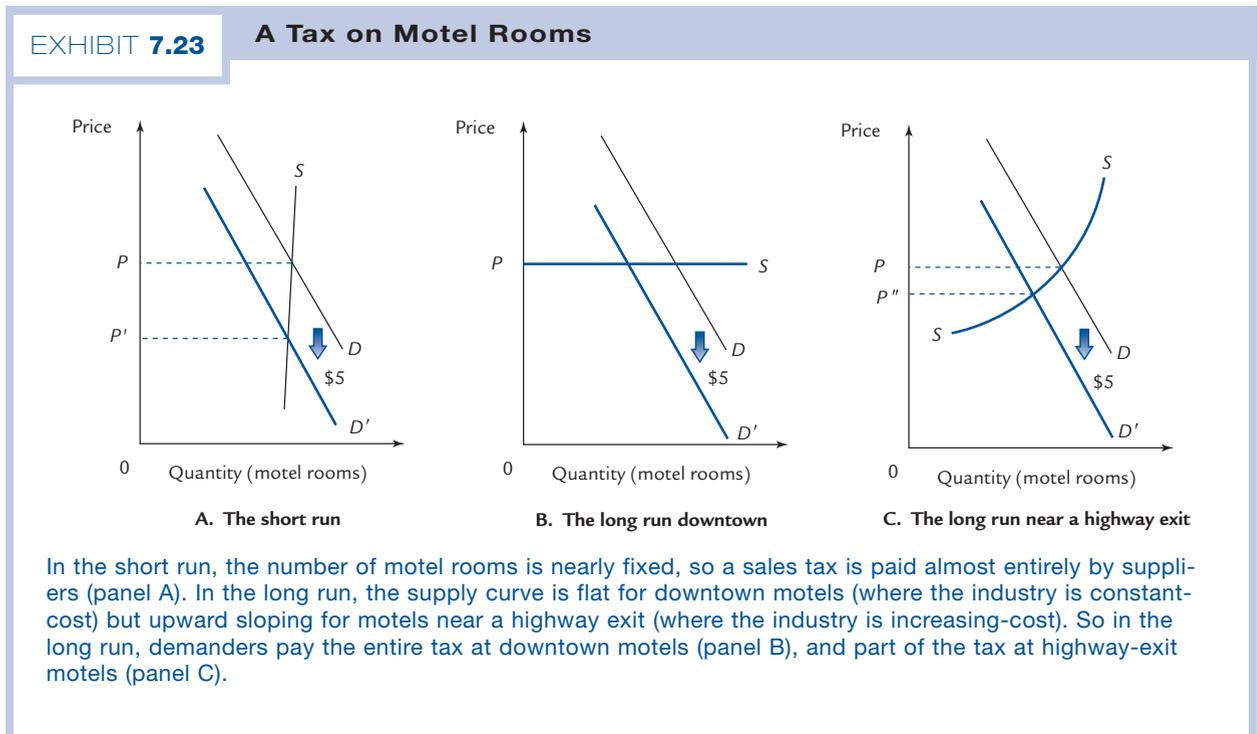
At \$500, landlords earn positive profits and slowly they reconvert commercial buildings to use as apartments. Eventually, the market does return to the old long-run equilibrium at a price of \$400 and a quantity of  $Q_0$ . The reason for this is quite simple: Neither the demand curve nor the long-run supply curve has shifted, so the equilibrium can't change.

### A Tax on Motel Rooms

Suppose your town imposes a \$5-per-night sales tax on motel rooms. Who pays the tax?

In the short run, the number of motel rooms is nearly fixed so the supply curve is nearly vertical. (It is not completely vertical because, for example, a motel owner might be able to provide more clean rooms per night by hiring a larger maintenance staff.) Therefore, the tax is paid almost entirely by suppliers (i.e., motel owners) as you can see in panel A of Exhibit 7.23, where the price falls from  $P$  to  $P'$ , almost the full amount of the tax.

In the long run, the answer depends on exactly which motel industry we're talking about. We saw on page 203 that downtown motels are likely to form a constant-cost industry and motels near a highway exit are likely to form an increasing-cost industry. So for downtown motels, the long-run supply curve is flat, the price of a room is unaffected by the tax, and therefore the tax is paid entirely by demanders. You can see this



in Exhibit 7.23B. For highway-exit motels, the relevant picture is Exhibit 7.23C, where in the long run, the tax is split between suppliers and demanders.

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**Exercise 7.5** Illustrate the short-run and long-run effects of a government program that subsidizes motel visits.

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## Tipping the Busboy

Let us return to the Brotherhood for the Respect, Elevation, and Advancement of Dishwashers (bread), mentioned in the introduction to this chapter. The organization's purpose is to encourage people to give tips to busboys. Who will benefit if they succeed in establishing this custom?

A partial answer is: not busboys. The talents required of a busboy are reasonably widespread in society. A grocery bagger or a parking lot attendant can easily decide to become a busboy. Because there are no (or very few) individuals with special "busboy skills," busboys' services are provided at a constant cost.

It follows that the total compensation of busboys cannot change. If tips increase, wages must decrease by the same amount. The increase in tips causes positive profits; the positive profits cause grocery baggers to become busboys; the entry of the grocery baggers causes wages to fall; and the whole process continues until grocery bagging and busing tables are again equally attractive.



Dangerous  
Curve

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Students sometimes argue that as grocery baggers leave their own industry to become busboys, the wage of baggers will rise. This would be true if bagging were the only other unskilled occupation. But because the new busboys come from many other industries, the number coming from any one other industry is negligibly small.

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Another way to make the same point is this: Because potential busboys are all pretty much identical, the supply curve of busboys is a horizontal line at the entry price determined by the condition that busing be just as attractive as bagging. If the supply curve for a good is horizontal, then changes in demand cannot change its price.

If busboys don't gain, who does? Tipping reduces the costs of restaurant owners, who now pay lower wages. Suppose that customers leave a tip of size  $T$  at each meal. Then busboys' wages are reduced by  $T$  per meal served, which lowers the industry's supply curve by the amount  $T$ . The short-run effect is illustrated in panel A of Exhibit 7.24. The fall in costs leads to a fall in the price of restaurant meals, to  $P_1$ . Who benefits? The restaurateurs and, ironically, the customers themselves.<sup>2</sup>

In the long run, there are two possibilities to consider, both of which are shown in Exhibit 7.24. In each case, the long-run supply curve falls by  $T$ . If the restaurant industry has constant costs, as in panel B, then the price of a meal drops by exactly  $T$ , the full amount of the tip. Although the customers would like to tip the busboys, the entire value of their tips is returned to them in the form of lower meal prices!

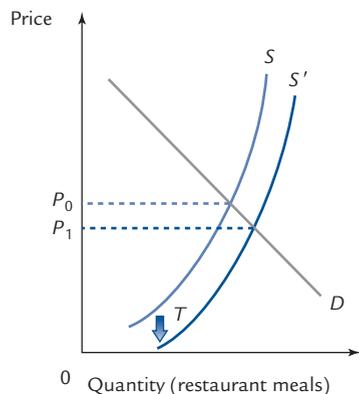
The other possibility is that there are increasing costs in the restaurant industry. This would be the case, for example, if the potential entrants have varying aptitudes for restaurant management. That case is shown in panel C. Here the price of restaurant meals drops, but not by the full amount of the tips. The tips are split between the

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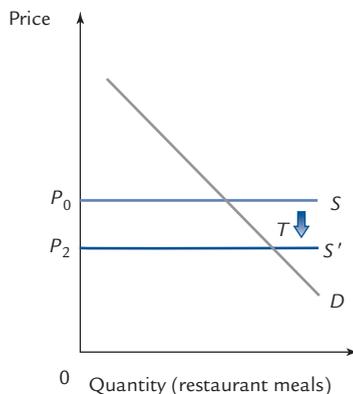
<sup>2</sup> There may be an additional effect as restaurateurs decide to hire a larger number of busboys at the lower wage. This effect is irrelevant to anything we are considering in this example.

EXHIBIT 7.24

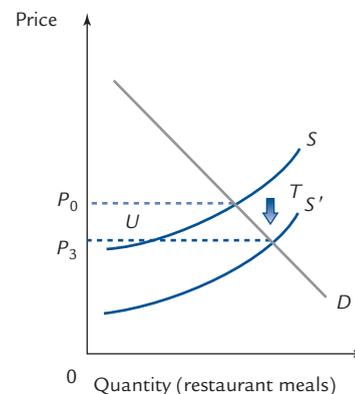
Tipping the Busboy



A. The short run



B. The long run if all restaurateurs are identical



C. The long run if restaurateurs have varying abilities

Suppose that people decide to start tipping busboys. Because busing services are provided at constant cost (there are many essentially identical busboys), the total compensation of busboys cannot change. Therefore, wages are reduced by the amount of the tip,  $T$ . The marginal cost of serving meals falls by this amount.

In the short run (panel A), price falls, but by less than  $T$ . Part of the tip is returned to the customer through the lower price, and the rest goes to the restaurant owner.

In the long run, if all restaurateurs are identical (panel B), entry bids profits back down to zero only when the price of meals falls by the full amount  $T$ . We can see this geometrically: The horizontal supply curve falls by  $T$ , and the price falls by this full amount.

If not all restaurateurs are identical, then entry by less-efficient firms can drive profits to zero even though the price is reduced by less than the full amount of the tip. This is shown in panel C, where the upward-sloping long-run supply curve drops by the amount  $T$ , but the price of meals falls by something less, which we label  $U$ . Those restaurateurs who were in the industry originally gain  $T - U$  per meal served (their marginal costs fall by  $T$  but their price falls by  $U$ , so they gain the difference), while customers get back  $U$  in the form of a lower price. The tip is split between the restaurateur and the customer; the busboy gets nothing.

restaurateurs and their customers, with the customers getting back more in the long run than they do in the short run.

Our analysis assumes that BREAD is successful in making diners feel good about tipping the busboy. An alternative assumption is that BREAD makes diners feel guilty about not tipping the busboy. In that case, the tip is essentially a tax on diners, and the demand for restaurant meals falls by the amount of the tip.



Dangerous Curve

## 7.7 Using the Competitive Model

Exhibits 7.9 and 7.10 illustrate changes in short-run competitive equilibrium; Exhibits 7.15, 7.16, and 7.17 illustrate changes in long-run competitive equilibrium for a constant-cost industry; and Exhibits 7.20 and 7.21 illustrate changes in long-run competitive equilibrium for other sorts of industries. Problems 4, 10, 11, and 12 at the end of the chapter call for you to provide a large number of similar analyses. Here we will list the most important principles to keep in mind when you work problems of this type.

As in the exhibits, you should begin by drawing supply and demand curves for both the industry and the firm. The industry supply curve is always upward sloping in the short run. In the long run, it can be either flat (if the industry is constant-cost) or upward sloping (if the industry is increasing-cost). There is also the possibility of a downward-sloping long-run industry supply curve, but we will not discuss that case here. The firm's demand curve should be drawn flat at the price determined by industry-wide equilibrium.

To analyze a change in equilibrium, you must decide how the curves shift. Usually this means thinking about each curve separately. Here are the fundamental principles to keep in mind.

**Shifts in the Firm's Supply Curve** The firm's supply curve coincides with its marginal cost curve. Therefore, only a change in marginal costs can affect it. A cost is marginal only if it varies with output. In the short run, marginal costs include labor and raw materials. In the long run, they also include those items of capital equipment that can be varied in the long run. For example, if a restaurant decides to serve more hamburgers, it will use more meat and more waiters in the short run and will expand its kitchen facilities in the long run. Therefore, a change in the price of meat or the wages of waiters causes the firm's supply curve to shift in both the short-run analysis and the long-run analysis, whereas a change in the price of kitchen facilities causes the supply curve to shift only in the long-run analysis. Some costs (e.g., annual license fees) do not vary with output even in the long run and so do not shift the firm's supply curve even in the long run (unless they cause the firm to exit altogether).

**Shifts in the Short-Run Industry Supply Curve** In the short run, the industry supply curve is the sum of the individual firm's supply curves. Therefore, it shifts only if there is a change in supply at the individual firms.

**Shifts in the Long-Run Industry Supply Curve** The long-run industry supply curve shifts in response to any change in profitability—unless the change in profitability is due to a change in the price of output, in which case it is reflected by a movement *along*, rather than *of*, the long-run supply curve. However, remember that sunk costs are sunk, so only future costs are relevant. Costs that have been paid and are irretrievable do not affect future profits; therefore, they do not affect entry and exit decisions, and therefore they do not affect the industry supply curve.

**The Individual Firm's Exit Decision: The Constant-Cost Case** In a constant-cost industry, every firm is completely indifferent about whether to remain in the industry. Thus, anything that reduces profits at just one firm must drive that firm from the industry. For example, suppose that newsstands constitute a constant-cost industry and a single newsstand owner is notified of a rent increase. The owner will certainly leave the industry. On the other hand, if *all* newsstand owners are notified of rent increases, then the industry supply curve shifts, some firms exit, the industry-wide price of newspapers rises until zero profits are restored, and any *particular* newsstand might very well remain in business. There is no way to predict which firms exit under these circumstances.

Note again that sunk costs are sunk. A fire at an individual newsstand is not like a rent increase. The costs of the fire are sunk (even if the firm exits, it continues to bear the costs via a reduction in the resale value of its merchandise); the rent increase can be avoided by exit and is therefore not sunk. The fire, therefore, has no effect, while the rent increase drives the firm from the industry.

In an increasing-cost industry, some firms might be particularly efficient and therefore prefer this industry over any of the alternatives. Such a firm might decide to remain in the industry even following an individual rent increase.

**Demand Curves** After shifting the firm's and the industry's supply curves, and after deciding whether the firm remains in the industry, determine whether there is any shift in the industry demand curve. Then if there has been a shift in industry equilibrium (due to shifts in either industry supply, industry demand, or both), draw the new firm demand curve as horizontal at the new industry equilibrium price.

**Exceptions** The rules listed here will serve you well most of the time. As you work the problems at the end of the chapter, you will find a few exceptions due to unusual circumstances. As always, each problem needs to be considered individually.

## Summary

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A perfectly competitive firm is one that faces a horizontal demand curve for its product; that is, it can sell any quantity it wants to at the going market price. The total revenue curve for such a firm is a straight line through the origin, and the marginal revenue curve is a horizontal line at the going market price. Thus, the marginal revenue curve is identical to the demand curve.

Like any producer, competitive or not, the competitive firm produces, if it produces at all, where marginal cost equals marginal revenue. Because marginal revenue equals price for a competitive firm, we can say that such a firm produces, if it produces at all, where marginal cost equals price. To see what the firm will produce in the short run, we use its short-run marginal cost curve; and to see what it will produce in the long run, we use its long-run marginal cost curve.

In the short run, the firm operates only if its revenue exceeds its variable costs. This is the same as saying that the firm operates only if the market price exceeds its average variable cost. Thus, the firm's short-run supply curve is that portion of its marginal cost curve that lies above average variable cost.

A competitive industry is one in which all firms are competitive.

To derive the short-run industry supply curve, we assume a fixed number of firms and add their quantities supplied at each price.

The competitive industry operates at the point where supply and demand are equal, because each individual firm maximizes profits at this point. In competitive equilibrium, the total cost of producing any quantity of output is minimized. This is because each firm has the same marginal cost (equal to the market price).

In the long run, the firm operates where price is equal to long-run marginal cost, provided that it earns positive profits. If profits are negative (which happens when price falls below average cost) the firm leaves the industry. Therefore, the firm's long-run supply curve is that part of its long-run marginal cost curve that lies above its long-run average cost curve.

To study long-run equilibrium, we must account for the possibility of entry and exit. Entry and exit are driven by profit. If all firms are identical, then all firms must earn zero profit in long-run equilibrium.

In the simplest analysis, we assume that all firms share a single break-even price, and that the break-even price is unaffected by entry and exit. In that case, the break-even price is the only price that can prevail in long-run equilibrium; therefore, the long-run supply curve is flat at the break-even price.

A second possibility is that the industry is increasing-cost, which means that the break-even price for new entrants increases as the industry expands. This could happen either because new entrants are less efficient than existing firms or because new entrants bid up the price of inputs, causing everyone's costs to increase. In this case, the industry supply curve slopes upward.

A third possibility is that the industry is decreasing-cost, which means that the break-even price for new entrants falls as the industry expands. For example, when the industry reaches a certain size, specialized sub-industries can be formed. In this case, there is a downward-sloping long-run supply curve.

## Author Commentary

[www.cengage.com/economics/landsburg](http://www.cengage.com/economics/landsburg)

**AC1.** In a perfectly competitive market, there is a single going market price that everyone takes as given. In many markets, prices are determined by bargaining and through auctions—for example, eBay. Read this article for a discussion of eBay bidding strategy.

## Review Questions

- R1.** Which of the following are true for all firms? Which are true for competitive firms only? Which are false for all firms?
- The firm faces a flat demand for its product.
  - The firm faces a flat marginal revenue curve.
  - The firm seeks to operate where marginal revenue equals marginal cost.
  - The firm seeks to operate where price equals marginal cost.
- R2.** If a competitive firm *fails* to maximize profits, which of the following statements are true and which are false?
- Price equals marginal cost.
  - Price equals marginal revenue.
  - Marginal cost equals marginal revenue.
- R3.** What is the difference between a shutdown and an exit?
- R4. True or False:** A firm shuts down whenever its profits are negative.
- R5.** Suppose a competitive widget firm has an upward-sloping marginal cost curve, and that the marginal cost of producing 6 items is \$12 per widget. Explain carefully why the point with coordinates (\$12, 6 widgets) must be on the firm's supply curve.
- R6.** What determines the short-run industry-wide supply curve in a competitive industry?

- R7.** In short-run competitive equilibrium, what happens to output at an individual firm following an industry-wide rise in fixed costs?
- R8.** In short-run competitive equilibrium, what happens to output at an individual firm following an industry-wide rise in variable costs?
- R9.** In short-run competitive equilibrium, what happens to output at an individual firm following an industry-wide rise in demand?
- R10.** What is the difference between accounting profit and economic profit?
- R11.** Assuming that all firms are identical, explain why all firms must earn zero profit in long-run equilibrium.
- R12.** Explain why the long-run industry supply curve must be flat in a constant-cost industry.
- R13.** In long-run competitive equilibrium, what happens to output at an individual firm following an industry-wide rise in fixed costs? (Assume a constant-cost industry if necessary.)
- R14.** In long-run competitive equilibrium, what happens to output at an individual firm following an industry-wide rise in variable costs? (Assume a constant-cost industry if necessary.)
- R15.** In long-run competitive equilibrium, what happens to output at an individual firm following an industry-wide rise in demand? (Assume a constant-cost industry if necessary.)
- R16.** What are the two key assumptions in the definition of a constant-cost industry?
- R17.** What is the shape of the long-run industry supply curve in an increasing-cost industry? Why?
- R18.** What is the shape of the long-run industry supply curve in a decreasing-cost industry? Why?

## Numerical Exercises

- N1.** Every firm in the widget industry has fixed costs of \$6 and faces the following marginal cost curve:

| Quantity | Marginal Cost |
|----------|---------------|
| 1        | \$2           |
| 2        | 4             |
| 3        | 6             |
| 4        | 8             |
| 5        | 10            |

- a.** Suppose the price of widgets is \$10. How many widgets does each firm produce? How much profit does the firm earn? Is the industry in long-run equilibrium? How do you know?
- b.** In the long run, will there be entry or exit from this industry? What will be the price of widgets in the long run? How many widgets will each firm produce?

- N2.** Moose-nose pies are produced by a constant-cost industry where all firms are identical and each firm has fixed costs of \$15. The following chart shows the industry-wide demand curve and the marginal cost curve of a typical firm:

| Industry-Wide Demand |          | Firm's Marginal Cost Curve |               |
|----------------------|----------|----------------------------|---------------|
| Price                | Quantity | Quantity                   | Marginal Cost |
| \$5                  | 750      | 1                          | \$5           |
| 10                   | 600      | 2                          | 10            |
| 15                   | 450      | 3                          | 15            |
| 20                   | 300      | 4                          | 20            |
| 25                   | 150      | 5                          | 25            |

Suppose the industry is in long-run equilibrium.

- What is the price of moose-nose pies?
  - What is the number of firms in the industry?
  - On the industry-wide short-run supply curve, what quantity corresponds to a price of \$10?
- N3.** Widgets are produced by a constant-cost industry. The following chart shows the industry-wide demand curve and the marginal cost curve of each firm.

| Demand |          | Firm's Marginal Cost Curve |               |
|--------|----------|----------------------------|---------------|
| Price  | Quantity | Quantity                   | Marginal Cost |
| \$5    | 1500     | 1                          | \$5           |
| 10     | 1200     | 2                          | 10            |
| 15     | 900      | 3                          | 15            |
| 20     | 600      | 4                          | 20            |
| 25     | 300      | 5                          | 25            |

There are currently 600 firms in the industry. Each firm has fixed costs of \$30.

- What is the price of widget today?
  - What is the profit of a widget firm today?
  - In the long run, what is the price of a widget?
  - In the long run, how many firms exit the industry?
- N4.** Widgets are provided by a competitive constant-cost industry where each firm has fixed costs of \$30. The following chart shows the industry-wide demand curve and the marginal cost curve of a typical firm.

| Industry-Wide Demand |          | Firm's Marginal Cost Curve |               |
|----------------------|----------|----------------------------|---------------|
| Price                | Quantity | Quantity                   | Marginal Cost |
| \$5                  | 1500     | 1                          | \$5           |
| 10                   | 1200     | 2                          | 10            |
| 15                   | 900      | 3                          | 15            |
| 20                   | 600      | 4                          | 20            |
| 25                   | 300      | 5                          | 25            |
| 30                   | 200      | 6                          | 30            |
| 35                   | 140      | 7                          | 35            |
| 40                   | 50       | 8                          | 40            |

- a. What is the price of a widget?
- b. How many firms are in the industry?  
For the remaining four parts of this problem, suppose the government imposes an excise tax of \$15 per widget.
- c. In the short run, what is the new price of widgets?
- d. In the short run, how many firms leave the industry?
- e. In the long run, what is the new price of widgets?
- f. In the long run, how many firms leave the industry?

**N5.** In the widget industry, each firm has fixed costs of \$10 and faces the following marginal cost curve:

| Quantity | Marginal Cost  |
|----------|----------------|
| 1        | \$2 per widget |
| 2        | 4              |
| 3        | 5              |
| 4        | 7              |
| 5        | 11             |
| 6        | 13             |

The industry-wide demand curve is given by the following chart:

| Price | Quantity      |
|-------|---------------|
| \$2   | 60 per widget |
| 4     | 48            |
| 5     | 36            |
| 7     | 24            |
| 11    | 12            |
| 13    | 0             |

Assume the industry is in long-run equilibrium.

- a. What is the price of a widget?
- b. What quantity is produced by each firm?
- c. How many firms are in the industry?

Now suppose that the demand curve shifts outward as follows:

| Price | Quantity      |
|-------|---------------|
| \$2   | 96 per widget |
| 4     | 84            |
| 5     | 72            |
| 7     | 60            |
| 11    | 48            |
| 13    | 36            |

- d. In the short run, what is the new price of widgets, and how many does each firm produce?
- e. In the long run, what is the new price of widgets and how many does each firm produce? How many firms will enter or leave the industry?

- N6.** In the gadget industry, each firm must have one gadget press, regardless of how many gadgets it produces. The cost of a gadget press is the only fixed cost that firms face in this industry. Entry by gadget firms can bid up the cost of gadget presses. The following charts show (1) the demand for gadgets; (2) the marginal cost of producing gadgets at each individual firm; and (3) the cost of a gadget press as a function of the number of firms in the industry:

| Price | Quantity Demanded |
|-------|-------------------|
| 1     | 800               |
| 2     | 700               |
| 3     | 600               |
| 4     | 500               |
| 5     | 400               |
| 6     | 300               |

| Quantity | Marginal Cost |
|----------|---------------|
| 1        | \$1           |
| 2        | 2             |
| 3        | 3             |
| 4        | 4             |
| 5        | 5             |
| 6        | 6             |

| Number of Firms | Cost of Gadget Press |
|-----------------|----------------------|
| 0–75            | \$6                  |
| 76–150          | 10                   |
| 151–225         | 15                   |
| 226–300         | 18                   |
| >300            | 21                   |

What is the long-run equilibrium price of gadgets? (*Hint:* Start by figuring out, for each price, the number of firms and the profits at each firm.)

- N7.** Kites are manufactured by identical firms. Each firm's long-run average and marginal costs of production are given by:

$$AC = Q + \frac{100}{Q} \quad \text{and} \quad MC = 2Q$$

where  $Q$  is the number of kites produced.

- In long-run equilibrium, how many kites will each firm produce? Describe the long-run supply curve for kites.
- Suppose that the demand for kites is given by the formula:

$$Q = 8,000 - 50P$$

where  $Q$  is the quantity demanded and  $P$  is the price. How many kites will be sold? How many firms will there be in the kite industry?

- Suppose that the demand for kites unexpectedly goes up to:

$$Q = 9,000 - 50P$$

In the short run, it is impossible to manufacture any more kites than those already in existence. What will the price of kites be? How much profit will each kitemaker earn?

- d. In the long run, what will the price of kites be? How many new firms will enter the kite-making industry? How much profit will they earn?

**N8.** Suppose that a law is passed requiring each kite maker to have one fire extinguisher on the premises. (These are the same kite makers we met in the preceding exercise.) The supply curve of fire extinguishers to kitemakers is

$$Q = P$$

For example, at a price of \$3, 3 fire extinguishers would be provided. Suppose that the kite industry reaches a new long-run equilibrium.

- a. Let  $F$  be the number of firms in the kite industry. Explain why each now has long-run cost curves given by

$$AC = Q + \frac{100}{Q} + \frac{F}{Q} \text{ and } MC = 2Q$$

- b. How many kites will each firm produce? (You will have to express your answer in terms of  $F$ .) How many kites will the entire industry produce? (Again, you will have to express your answer in terms of  $F$ .) What will the price of kites be?
- c. If the price of kites is  $P$ , what is the number of firms  $F$ ? How many kites will the industry produce in terms of  $P$ ? Write a formula for the long-run industry supply curve.
- d. Suppose, as in Exercise N6, that the demand for kites is

$$Q = 8,000 - 50P$$

What will be the price of kites? How many kites will be produced? By how many firms?

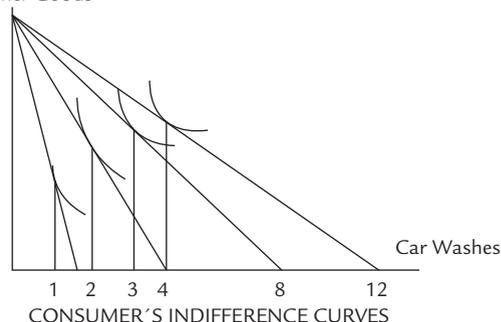
How much profit does each firm earn?

## Problem Set

- 1.** Gus the cab driver rents a cab and pays for gas. In each of the following circumstances, describe the short-run effect on the price and quantity of rides Gus offers.
- The price of gas falls.
  - The rental price of cabs falls.
  - Word gets out that Gus is a really lousy driver.
  - A new bus company opens up.
  - Gus gets the bill for the new upholstery he installed in his back seat last month and discovers it's 15% more than he expected.
  - The wages of factory workers go up, though this ends up having no effect on the demand for cab rides.
  - A huge fire destroys half the cabs in town, not including Gus's.

- h. The city imposes a \$1 excise tax on cab rides, but exempts Gus from the tax because he is a good friend of the mayor.
- i. The city imposes a \$100 annual license fee on cab drivers, but gives Gus a free license because he is a good friend of the mayor.
- j. The city starts a new free taxi service, which offers free rides to 500 customers per day.
- k. The city offers to subsidize gas purchases for every cab driver except Gus because he is a special enemy of the mayor.
- l. The city announces that it will start fining cab drivers who play loud music; Gus (unlike most cab drivers) loves loud music, so he has to pay a lot of fines.
- m. A customer who was almost killed by Gus's recklessness agrees to accept a large payment in exchange for keeping quiet about the incident.
2. **True or False:** If a firm in a competitive industry discovers a cheaper way to produce output, it might lower its price in order to steal its competitors' customers.
3. **True or False:** When price equals marginal cost, profit equals zero.
4. **True or False:** In the short run, any firm earning a negative profit will shut down.
5. In the Woody Allen film *Radio Days*, a character who has never been successful in business decides to start a career engraving gold jewelry. He argues that this should be especially lucrative, because the engraver gets to keep the gold dust from other people's jewelry. Comment.
6. Books with many mathematical formulas are generally more expensive than similar books written entirely in prose. **True or False:** Because typesetting is not part of the marginal cost of producing a book, the cost of typesetting mathematical formulas cannot explain this price difference.
7. **True or False:** In a competitive constant-cost industry, an excise tax is partly passed on to demanders in the short run but completely passed on to demanders in the long run.
8. If New York City provides better shelters for the homeless, then in the long run homeless New Yorkers will be better off.
9. The town of Whoville has 100 identical consumers and 50 identical car washes. Each consumer has an income of \$24. The diagram and chart below show the

All Other Goods



CONSUMER'S INDIFFERENCE CURVES

Quantity MC

|   |     |
|---|-----|
| 1 | \$3 |
| 2 | 4   |
| 3 | 5   |
| 4 | 6   |
| 5 | 7   |
| 6 | 8   |
| 7 | 9   |
| 8 | 10  |

FIRM'S MARGINAL COSTS

indifference curves of a typical consumer and the marginal cost curve of a typical car wash.

- a. What is the price of a car wash today?
  - b. Suppose that in the long run there is no entry or exit from the car wash industry. What can you conclude about the fixed costs at an individual car wash?
- 10.** Redo all the parts of Problem 1, describing the long-run effects instead of the short-run effects. Assume that cab driving is a constant-cost industry.
- 11.** Redo all the parts of Problem 1, describing the long-run effects instead of the short-run effects. Assume that cab driving is an increasing-cost industry.
- 12.** Redo all the parts of Problem 1, describing the long-run effects instead of the short-run effects. Assume that cab driving is a decreasing-cost industry.
- 13.** Suppose the government institutes a new sales tax on shoes, which are provided by a competitive constant-cost industry.
- a. Does the price of shoes change by more in the short run or in the long run?
  - b. Does the industry-wide quantity change by more in the short run or in the long run?
  - c. Does the quantity provided by each shoemaker change by more in the short run or in the long run?
  - d. Do the profits of shoemakers change by more in the short run or in the long run?
- 14.** Suppose that shoes are provided by a competitive constant-cost industry. Suppose the government starts requiring each shoemaker to pay an annual license fee.
- a. Does the price of shoes change by more in the short run or in the long run?
  - b. Does the industry-wide quantity change by more in the short run or in the long run?
  - c. Does the quantity provided by each shoemaker change by more in the short run or in the long run?
  - d. Do the profits of shoemakers change by more in the short run or in the long run?
- 15.** Suppose there is a fall in the demand for shoes, which are provided by a competitive constant-cost industry.
- a. Does the price of shoes change by more in the short run or in the long run?
  - b. Does the industry-wide quantity change by more in the short run or in the long run?
  - c. Does the quantity provided by each individual shoemaker change by more in the short run or in the long run?
  - d. Do the profits of shoemakers change by more in the short run or in the long run?
- 16.** Widgets are provided by a constant-cost industry. Each firm employs one executive and a variable number of workers. Consider the following two scenarios:
- Scenario A.** Executive salaries rise, causing the price of a widget to rise by \$5 in the long run.
- Scenario B.** Workers' salaries rise, causing the price of a widget to rise by \$5 in the long run.

Of the two scenarios, which leads to a larger quantity of *widgets per firm* in the long run?

17. Suppose the government imposes an excise tax of \$10 per pair of shoes, but simultaneously launches a program of giving a gift of \$10,000 per year to each shoestore.
- In the short run, what happens to the price of shoes, the number of shoes sold in total, and the number of shoes at any particular shoestore?
  - Suppose that by coincidence, the long-run effect of the two programs combined is to return the price of shoes right back to its original level. In the long run, what happens to the number of shoes sold in total, the number sold at any given store, and the number of stores in the industry?
18. Suppose health clinics form a competitive constant-cost industry. One day, the government unexpectedly opens a new clinic, which treats 800 patients a day for free.
- In the short run, what happens to the number of patients served by private clinics? Does it rise or fall? By more or less than 800 per day?
  - In the long run, what happens to the number of patients served by private clinics? Does it rise or fall? By more or less than 800 per day?
19. The widget industry is a constant-cost industry, so that all firms are identical. The following chart shows the industry-wide demand curve and the marginal cost curve of a typical firm:

| Industry-Wide Demand |          | Firm's Marginal Cost Curve |               |
|----------------------|----------|----------------------------|---------------|
| Price                | Quantity | Quantity                   | Marginal Cost |
| \$2                  | 500      | 1                          | \$2           |
| 3                    | 400      | 2                          | 3             |
| 5                    | 300      | 3                          | 5             |
| 6                    | 200      | 4                          | 6             |
| 8                    | 100      | 5                          | 8             |
| 9                    | 50       | 6                          | 9             |
| 12                   | 25       | 7                          | 12            |
| 15                   | 10       | 8                          | 15            |

The industry is in long-run equilibrium and there are a hundred firms.

- What are the fixed costs at each firm?
  - What is the price of a widget?
20. In Problem 19, suppose that the city imposes a license fee of \$11 per firm.
- In the short run, what is the new price of a widget?
  - In the long run, what is the new price of a widget?
  - In the long run, how many firms leave the industry?
21. In problem 19, suppose the city imposes a sales tax of \$6 per widget.
- In the short run, what is the new price of a widget?
  - In the long run, what is the new price of a widget?
  - In the long run, how many firms leave the industry?

- 22.** In Problem 19, suppose the city imposes an excise subsidy of \$3 per widget. (That is, widget manufacturers receive \$3 from the government for each widget they produce.)
- In the short run, what is the new price of a widget?
  - In the long run, what is the new price of a widget?
  - In the long run, how many firms enter the industry?
- 23.** In Problem 19, suppose that the demand for widgets doubles (so that, for example, on the new demand curve, prices of \$2, \$3, and \$5 go with quantities of 1,000, 800, and 600).
- In the short run, what is the new price of a widget?
  - In the long run, what is the new price of a widget?
- 24.** Widgets are made only in America. They are provided by a constant-cost industry, which is in long-run equilibrium. The following charts show the American demand curve for widgets, the foreign demand curve for widgets, and the marginal cost curve of a typical American widget firm.

| American Demand |          | Foreign Demand |          | Firm's Marginal Cost Curve |               |
|-----------------|----------|----------------|----------|----------------------------|---------------|
| Price           | Quantity | Price          | Quantity | Quantity                   | Marginal Cost |
| \$3             | 200      | \$3            | 150      | 1                          | \$2           |
| 5               | 160      | 5              | 140      | 2                          | 5             |
| 7               | 75       | 7              | 120      | 3                          | 7             |
| 9               | 60       | 9              | 100      | 4                          | 9             |
| 11              | 45       | 11             | 90       | 5                          | 11            |
| 13              | 30       | 13             | 80       | 6                          | 13            |
| 15              | 15       | 15             | 70       | 7                          | 15            |
| 17              | 10       | 17             | 60       | 8                          | 17            |

Initially, American firms are not allowed to sell to foreigners. (Thus, the foreign demand curve is irrelevant.) In the United States, the industry is in long-run equilibrium and widgets sell for \$7 apiece. Now the government decides to issue 10 export licenses; a firm with an export license can sell as many widgets to foreigners as it wants to. The export licenses are sold at auction to the highest bidders.

- What is the price of an American widget sold on the foreign market?
- What is the price of an export license?
- In the short run, what is the new price of a widget sold in America? Be sure to justify your answer.
- In the long run, what is the new price of a widget sold in America?

(Hint: A firm that can sell as much as it wants to foreigners at a high price will not choose to sell anything at all to Americans at a low price.)

- 25. True or False:** In the long run, profit-maximizing firms seek to minimize their average cost.
- 26.** Suppose the wholesale price of gasoline falls by 50¢ a gallon. Does the retail price fall by more than 50¢, by 50¢, or by less than 50¢?

- a. Answer assuming that gas stations constitute a competitive constant-cost industry.
  - b. Answer assuming that gas stations constitute a competitive increasing-cost industry.
27. Upper, Middle, and Lower Slobbovia are distant countries that do not trade with each other or the rest of the world. In Upper Slobbovia, kites are provided by a competitive constant-cost industry. In Middle Slobbovia, kites are provided by a competitive increasing-cost industry. In Lower Slobbovia, kites are provided by a single monopolist. All three countries have just imposed a new tax on kite producers of \$1,000 per firm per year. Rank the three countries in terms of what fraction of this tax is passed on to consumers in the long run. Justify your answer carefully.
28. **True or False:** An excise tax on the product of a decreasing-cost industry would raise the price by more than the amount of the tax.
29. Suppose the demand for seafood increases one year and then unexpectedly returns to its former level the following year. **True or False:** As soon as the demand returns to its former level, price and quantity will return to their former levels too.