CHAPTER

# 14

# Firms in Competitive Markets


If your local gas station raised its price for gasoline by 20 percent, it would see a large drop in the amount of gasoline it sold. Its customers would quickly switch to buying their gasoline at other gas stations. By contrast, if your local water company raised the price of water by 20 percent, it would see only a small decrease in the amount of water it sold. People might water their lawns less often and buy more water-efficient showerheads, but they would be hard-pressed to reduce water consumption greatly and would be unlikely to find another supplier. The difference between the gasoline market and the water market is that many firms supply gasoline to the local market, but only one firm supplies water. As you might expect, this difference in market structure shapes the pricing and production decisions of the firms that operate in these markets.

In this chapter, we examine the behavior of competitive firms, such as your local gas station. You may recall that a market is competitive if each buyer and seller is small compared to the size of the market and, therefore, has little ability to influence market prices. By contrast, if a firm can influence the market price of the good it sells, it is said to have *market power*. Later in the book, we examine the behavior of firms with market power, such as your local water company.

Our analysis of competitive firms in this chapter sheds light on the decisions that lie behind the supply curve in a competitive market. Not surprisingly, we find that a market supply curve is tightly linked to firms' costs of production. Less obvious, however, is the question of which among a firm's many types of cost— fixed, variable, average, and marginal—are most relevant for its supply decisions. We see that all these measures of cost play important and interrelated roles.

# 14-1 What Is a Competitive Market?

Our goal in this chapter is to examine how firms make production decisions in competitive markets. As a background for this analysis, we begin by reviewing what a competitive market is.

## 14-1a The Meaning of Competition

A **competitive market**, sometimes called a *perfectly competitive market*, has two characteristics:

**competitive market** *a market with many buyers and sellers trading identical products so that each buyer and seller is a price taker*

- There are many buyers and many sellers in the market.
- The goods offered by the various sellers are largely the same.

As a result of these conditions, the actions of any single buyer or seller in the market have a negligible impact on the market price. Each buyer and seller takes the market price as given.

As an example, consider the market for milk. No single consumer of milk can influence the price of milk because each buys a small amount relative to the size of the market. Similarly, each dairy farmer has limited control over the price because many other sellers are offering milk that is essentially identical. Because each seller can sell all he wants at the going price, he has little reason to charge less, and if he charges more, buyers will go elsewhere. Buyers and sellers in competitive markets must accept the price the market determines and, therefore, are said to be *price takers*.

In addition to the previous two conditions for competition, a third condition is sometimes thought to characterize perfectly competitive markets:

- Firms can freely enter or exit the market.

If, for instance, anyone can decide to start a dairy farm, and if any existing dairy farmer can decide to leave the dairy business, then the dairy industry satisfies this condition. Much of the analysis of competitive firms does not need the assumption of free entry and exit because this condition is not necessary for firms to be price takers. Yet, as we see later in this chapter, when there is free entry and exit in a competitive market, it is a powerful force shaping the long-run equilibrium.

## 14-1b The Revenue of a Competitive Firm

A firm in a competitive market, like most other firms in the economy, tries to maximize profit (total revenue minus total cost). To see how it does this, we first consider the revenue of a competitive firm. To keep matters concrete, let's consider a specific firm: the Vaca Family Dairy Farm.

The Vaca Farm produces a quantity of milk, $Q$, and sells each unit at the market price, $P$. The farm's total revenue is $P \times Q$. For example, if a gallon of milk sells for $6 and the farm sells 1,000 gallons, its total revenue is $6,000.

Because the Vaca Farm is small compared to the world market for milk, it takes the price as given by market conditions. This means, in particular, that the price of milk does not depend on the number of gallons that the Vaca Farm produces and sells. If the Vacas double the amount of milk they produce to 2,000 gallons, the price of milk remains the same, and their total revenue doubles to $12,000. As a result, total revenue is proportional to the amount of output.

Table 1 shows the revenue for the Vaca Family Dairy Farm. The first two columns show the amount of output the farm produces and the price at which it sells its output. The third column is the farm's total revenue. The table assumes that the price of milk is $6 a gallon, so total revenue is $6 times the number of gallons.

Just as the concepts of average and marginal were useful in the preceding chapter when analyzing costs, they are also useful when analyzing revenue. To see what these concepts tell us, consider these two questions:

- How much revenue does the farm receive for the typical gallon of milk?
- How much additional revenue does the farm receive if it increases production of milk by 1 gallon?

The last two columns in Table 1 answer these questions.

The fourth column in the table shows **average revenue**, which is total revenue (from the third column) divided by the amount of output (from the first column). Average revenue tells us how much revenue a firm receives for the typical unit sold. In Table 1, you can see that average revenue equals $6, the price of a gallon of milk. This illustrates a general lesson that applies not only to competitive firms but to other firms as well. Average revenue is total revenue ($P \times Q$) divided by the quantity ($Q$). Therefore, *for all types affirms, average revenue equals the price of the good*.

**average revenue** *total revenue divided by the quantity sold*

## TABLE 1
### Total, Average, and Marginal Revenue for a Competitive Firm

| Quantity ($Q$) | Price ($P$) | Total Revenue ($TR = P \times Q$) | Average Revenue ($AR = TR / Q$) | Marginal Revenue ($MR = \Delta TR / \Delta Q$) |
|---|---|---|---|---|
| 1 gallon | $6 | $6 | $6 | |
| | | | | $6 |
| 2 | 6 | 12 | 6 | |
| | | | | 6 |
| 3 | 6 | 18 | 6 | |
| | | | | 6 |
| 4 | 6 | 24 | 6 | |
| | | | | 6 |
| 5 | 6 | 30 | 6 | |
| | | | | 6 |
| 6 | 6 | 36 | 6 | |
| | | | | 6 |
| 7 | 6 | 42 | 6 | |
| | | | | 6 |
| 8 | 6 | 48 | 6 | |

The fifth column shows **marginal revenue**, which is the change in total revenue from the sale of each additional unit of output. In Table 1, marginal revenue equals $6, the price of a gallon of milk. This result illustrates a lesson that applies only to competitive firms. Total revenue is $P \times Q$, and $P$ is fixed for a competitive firm. Therefore, when $Q$ rises by 1 unit, total revenue rises by $P$ dollars. *For competitive firms, marginal revenue equals the price of the good.*

**marginal revenue** *the change in total revenue from an additional unit sold*

**Quick Quiz** *When a competitive firm doubles the amount it sells, what happens to the price of its output and its total revenue?*

# 14-2 Profit Maximization and the Competitive Firm's Supply Curve

The goal of a firm is to maximize profit, which equals total revenue minus total cost. We have just discussed the competitive firm's revenue, and in the preceding chapter, we discussed the firm's costs. We are now ready to examine how a competitive firm maximizes profit and how that decision determines its supply curve.

## 14-2a A Simple Example of Profit Maximization

Let's begin our analysis of the firm's supply decision with the example in Table 2. In the first column of the table is the number of gallons of milk the Vaca Family Dairy Farm produces. The second column shows the farm's total revenue, which is \$6 times the number of gallons. The third column shows the farm's total cost. Total cost includes fixed costs, which are \$3 in this example, and variable costs, which depend on the quantity produced.

The fourth column shows the farm's profit, which is computed by subtracting total cost from total revenue. If the farm produces nothing, it has a loss of \$3 (its fixed cost). If it produces 1 gallon, it has a profit of \$1. If it produces 2 gallons, it has a profit of \$4 and so on. Because the Vaca family's goal is to maximize profit, it chooses to produce the quantity of milk that makes profit as large as possible. In this example, profit is maximized when the farm produces either 4 or 5 gallons of milk, for a profit of \$7.

There is another way to look at the Vaca Farm's decision: The Vacas can find the profit-maximizing quantity by comparing the marginal revenue and marginal cost from each unit produced. The fifth and sixth columns in Table 2 compute marginal revenue and marginal cost from the changes in total revenue and total cost, and the last column shows the change in profit for each additional gallon produced. The first gallon of milk the farm produces has a marginal revenue of \$6 and a marginal cost of \$2; hence, producing that gallon increases profit by \$4 (from −\$3 to \$1). The second gallon produced has a marginal revenue of \$6 and a marginal cost of \$3, so that gallon increases profit by \$3 (from \$1 to \$4). As long as marginal revenue exceeds marginal cost, increasing the quantity produced raises profit. Once the Vaca Farm has reached 5 gallons of milk, however, the situation changes. The sixth gallon would have a marginal revenue of \$6 and a marginal cost of \$7, so producing it would reduce profit by \$1 (from \$7 to \$6). As a result, the Vacas would not produce beyond 5 gallons.

One of the *Ten Principles of Economics* in Chapter 1 is that rational people think at the margin. We now see how the Vaca Family Dairy Farm can apply this principle. If marginal revenue is greater than marginal cost—as it is at 1, 2, or 3 gallons—the

Vacas should increase the production of milk because it will put more money in their pockets (marginal revenue) than it takes out (marginal cost). If marginal revenue is less than marginal cost—as it is at 6,7, or 8 gallons—the Vacas should decrease production. If the Vacas think at the margin and make incremental adjustments to the level of production, they end up producing the profit-maximizing quantity.

## TABLE 2

### Profit Maximization: A Numerical Example

| Quantity (*Q*) | Total Revenue (*TR*) | Total Cost (*TC*) | Profit (*TR* – *TC*) | Marginal Revenue (*MR* = Δ*TR* / Δ*Q*) | Marginal Cost (*MC* = Δ*TC* / Δ*Q*) | Change in Profit (*MR* – *MC*) |
|---|---|---|---|---|---|---|
| 0 gallons | $ 0 | $ 3 | –$3 | | | |
| | | | | $6 | $2 | $4 |
| 1 | 6 | 5 | 1 | | | |
| | | | | 6 | 3 | 3 |
| 2 | 12 | 8 | 4 | | | |
| | | | | 6 | 4 | 2 |
| 3 | 18 | 12 | 6 | | | |
| | | | | 6 | 5 | 1 |
| 4 | 24 | 17 | 7 | | | |
| | | | | 6 | 6 | 0 |
| 5 | 30 | 23 | 7 | | | |
| | | | | 6 | 7 | –1 |
| 6 | 36 | 30 | 6 | | | |
| | | | | 6 | 8 | –2 |
| 7 | 42 | 38 | 4 | | | |
| | | | | 6 | 9 | –3 |
| 8 | 48 | 47 | 1 | | | |

## 14-2b The Marginal-Cost Curve and the Firm's Supply Decision

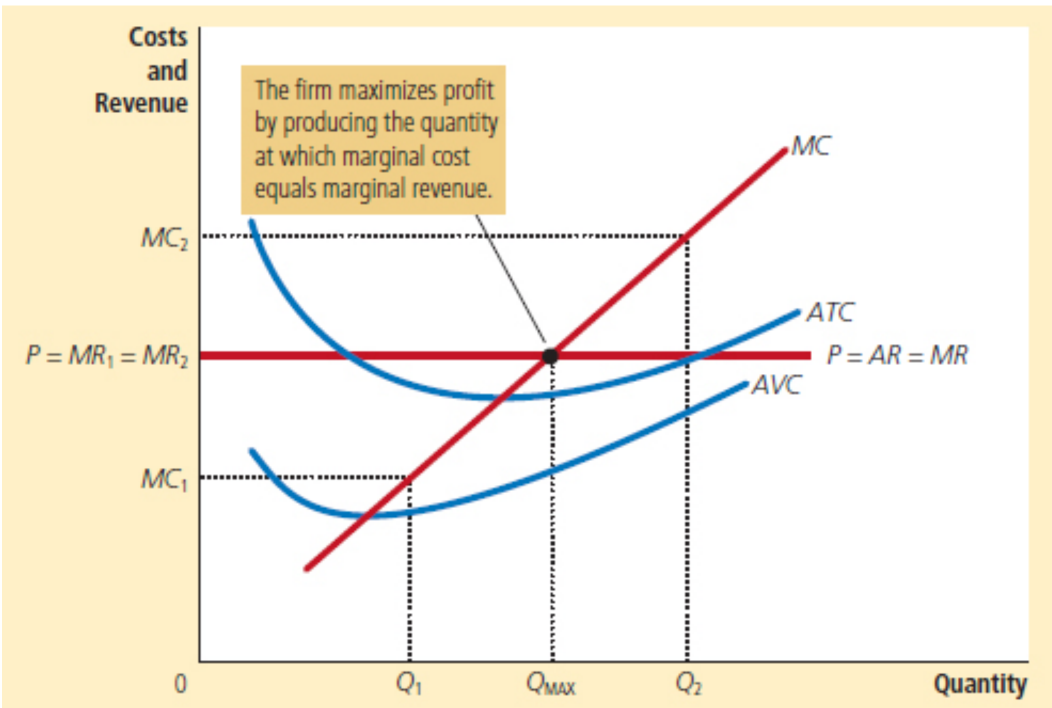
To extend this analysis of profit maximization, consider the cost curves in Figure 1. These cost curves have the three features that, as we discussed in the previous chapter, are thought to describe most firms: The marginal-cost curve (*MC*) is upward sloping. The average-total-cost curve (*ATC*) is U-shaped. And the marginal-cost curve crosses the average-total-cost curve at the minimum of average total cost. The figure also shows a horizontal line at the market price (P). The price line is horizontal because a competitive firm is a price taker: The price of the firm's output is the same regardless of the quantity that the firm decides to produce. Keep in mind that, for a competitive firm, the firm's price equals both its average revenue *(AR)* and its marginal revenue (*MR*).

We can use Figure 1 to find the quantity of output that maximizes profit. Imagine that the firm is producing at $Q_1$. At this level of output, the marginal-revenue curve is above the marginal-cost curve, showing that marginal revenue is greater than marginal cost. This means that if the firm were to raise production by 1 unit, the additional revenue ($MR_1$) would exceed the additional cost ($MC_1$). Profit, which equals total revenue minus total cost, would increase. Hence, if marginal revenue is greater than marginal cost, as it is at $Q_1$, the firm can increase profit by increasing production.

# FIGURE 1

**Profit Maximization for a Competitive Firm**

This figure shows the marginal-cost curve *(MC)*, the average-total-cost curve (*ATC*), and the average-variable-cost curve (*AVC*). It also shows the market price (P), which for a competitive firm equals both marginal revenue *(MR)* and average revenue (*AR*). At the quantity $Q_1$, marginal revenue $MR_1$ exceeds marginal cost $MC_1$, so raising production increases profit. At the quantity $Q_2$, marginal cost $MC_2$ is above marginal revenue $MR_2$, so reducing production increases profit. The profit-maximizing quantity $Q_{MAX}$ is found where the horizontal line representing the price intersects the marginal-cost curve.




A similar argument applies when output is at $Q_2$. In this case, the marginal-cost curve is above the marginal-revenue curve, showing that marginal cost is greater than marginal revenue. If the firm were to reduce production by 1 unit, the costs saved ($MC_2$) would exceed the revenue lost ($MR_2$). Therefore, if marginal revenue is less than marginal cost, as it is at $Q_2$, the firm can increase profit by reducing production.

Where do these marginal adjustments to production end? Regardless of whether the firm begins with production at a low level (such as $Q_1$) or at a high level (such as $Q_2$), the firm will eventually adjust production until the quantity produced reaches $Q_{MAX}$. This analysis yields three general rules for profit maximization:

- If marginal revenue is greater than marginal cost, the firm should increase its output.
- If marginal cost is greater than marginal revenue, the firm should decrease its output.

- At the profit-maximizing level of output, marginal revenue and marginal cost are exactly equal.

These rules are the key to rational decision making by any profit-maximizing firm. They apply not only to competitive firms but, as we will see in the next chapter, to other types of firms as well.

We can now see how the competitive firm decides what quantity of its good to supply to the market. Because a competitive firm is a price taker, its marginal revenue equals the market price. For any given price, the competitive firm's profit-maximizing quantity of output is found by looking at the intersection of the price with the marginal-cost curve. In Figure 1, that quantity of output is $Q_{MAX}$.

Suppose that the price prevailing in this market rises, perhaps because of an increase in market demand. Figure 2 shows how a competitive firm responds to the price increase. When the price is $P_1$, the firm produces quantity $Q_1$, the quantity that equates marginal cost to the price. When the price rises to $P_2$, the firm finds that marginal revenue is now higher than marginal cost at the previous level of output, so the firm increases production. The new profit-maximizing quantity is $Q_2$, at which marginal cost equals the new, higher price. *In essence, because the firm's marginal-cost curve determines the quantity of the good the firm is willing to supply at any price, the marginal-cost curve is also the competitive firm's supply curve*. There are, however, some caveats to that conclusion, which we examine next.

## 14-2c The Firm's Short-Run Decision to Shut Down

So far, we have been analyzing the question of how much a competitive firm will produce. In certain circumstances, however, the firm will decide to shut down and not produce anything at all.

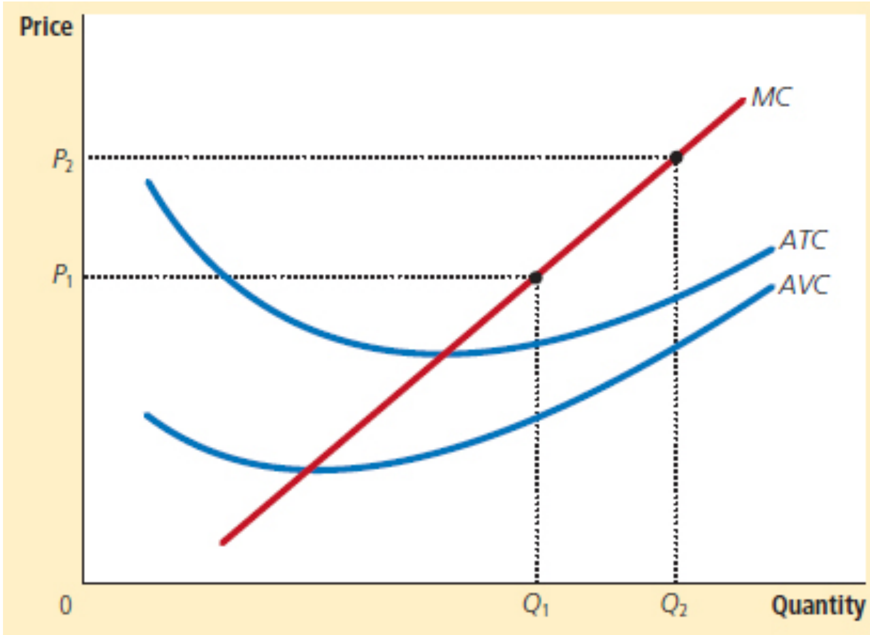
Here we need to distinguish between a temporary shutdown of a firm and the permanent exit of a firm from the market. A *shutdown* refers to a short-run decision not to produce anything during a specific period of time because of current market conditions. *Exit* refers to a long-run decision to leave the market. The short-run and long-run decisions differ because most firms cannot avoid their fixed costs in the short run but can do so in the long run. That is, a firm that shuts down temporarily still has to pay its fixed costs, whereas a firm that exits the market does not have to pay any costs at all, fixed or variable.

For example, consider the production decision that a farmer faces. The cost of the land is one of the farmer's fixed costs. If the farmer decides not to produce any crops one season, the land lies fallow, and he cannot recover this cost. When making the short-run decision of whether to shut down for a season, the fixed cost of land is said to be a *sunk cost*. By contrast, if the farmer decides to leave farming altogether, he can sell the land. When making the long-run decision of whether to exit the market, the cost of land is not sunk. (We return to the issue of sunk costs shortly.)

### FIGURE 2

**Marginal Cost as the Competitive Firm's Supply Curve**

An increase in the price from $P_1$ to $P_2$ leads to an increase in the firm's profit-maximizing quantity from $Q_1$ to $Q_2$. Because the marginal-cost curve shows the quantity supplied by the firm at any given price, it is the firm's supply curve.


Price
MC
$P_2$
ATC
$P_1$
AVC
0
$Q_1$
$Q_2$
Quantity

Now let's consider what determines a firm's shutdown decision. If the firm shuts down, it loses all revenue from the sale of its product. At the same time, it saves the variable costs of making its product (but must still pay the fixed costs). Thus, *the firm shuts down if the revenue that it would earn from producing is less than its variable costs of production*.

A bit of mathematics can make this shutdown rule more useful. If *TR* stands for total revenue and *VC* stands for variable cost, then the firm's decision can be written as

$$\text{Shut down if } TR < VC.$$

The firm shuts down if total revenue is less than variable cost. By dividing both sides of this inequality by the quantity $Q$, we can write it as

$$\text{Shut down if } TR/Q < VC/Q.$$

The left side of the inequality, $TR/Q$, is total revenue $P \times Q$ divided by quantity $Q$, which is average revenue, most simply expressed as the good's price, $P$. The right side of the inequality, $VC/Q$, is average variable cost, *AVC*. Therefore, the firm's shutdown rule can be restated as

$$\text{Shut down if P} < AVC.$$

That is, a firm chooses to shut down if the price of the good is less than the average variable cost of production. This criterion is intuitive: When choosing to produce, the firm compares the price it receives for the typical unit to the average variable cost that it must incur to produce the typical unit. If the price doesn't cover the average variable cost, the firm is better off stopping production altogether. The firm still loses money (because it has to pay fixed costs), but it would lose even more money by staying open. The firm can reopen in the future if conditions change so that price exceeds average variable cost.

We now have a full description of a competitive firm's profit-maximizing strategy. If the firm produces anything, it produces the quantity at which marginal cost equals the good's price, which the firm takes as given. Yet if the price is less than average variable cost at that quantity, the firm is better off shutting down temporarily and not producing anything. These results are illustrated in Figure 3. *The competitive firm's short-run supply curve is the portion of its marginal-cost curve that lies above average variable cost*.

## 14-2d Spilt Milk and Other Sunk Costs

Sometime in your life you may have been told, "Don't cry over spilt milk," or "Let bygones be bygones." These adages hold a deep truth about rational decision making. Economists say that a cost is a **sunk cost** when it has already been committed and cannot be recovered. Because nothing can be done about sunk costs, you should ignore them when making decisions about various aspects of life, including business strategy.

**sunk cost** *a cost that has already been committed and cannot be recovered*

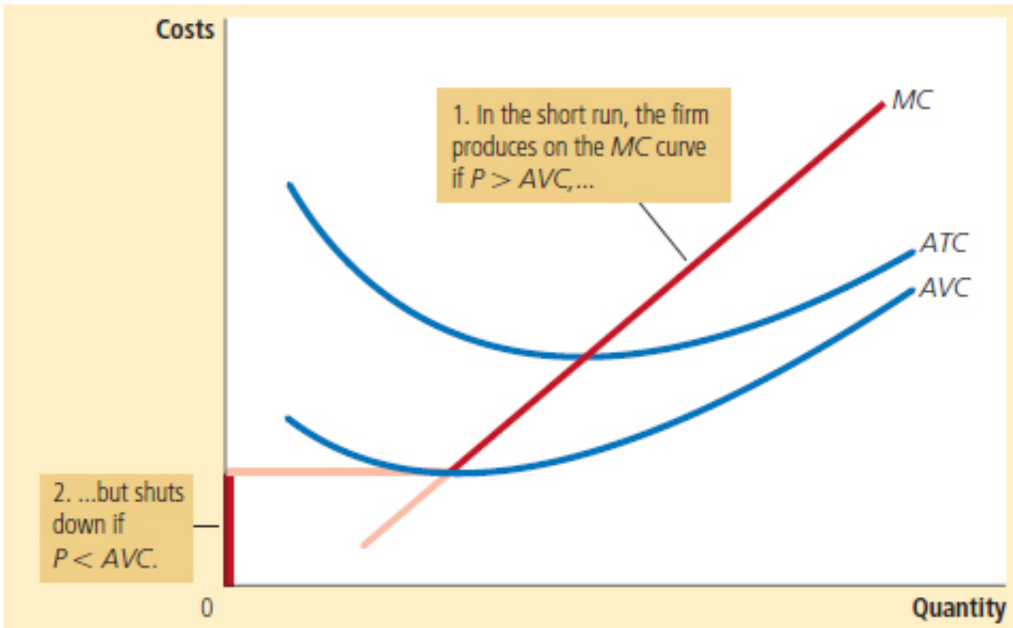
Our analysis of the firm's shutdown decision is one example of the irrelevance of sunk costs. We assume that the firm cannot recover its fixed costs by temporarily stopping production. That is, regardless of the quantity of output supplied (even if it is zero), the firm still has to pay its fixed costs.

As a result, the fixed costs are sunk in the short run, and the firm should ignore them when deciding how much to produce. The firm's short-run supply curve is the part of the marginal-cost curve that lies above average variable cost, and the size of the fixed cost does not matter for this supply decision.

## FIGURE 3

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

In the short run, the competitive firm's supply curve is its marginal-cost curve (*MC*) above average variable cost (*AVC*). If the price falls below average variable cost, the firm is better off shutting down temporarily.




The irrelevance of sunk costs is also important when making personal decisions. Imagine, for instance, that you place a $15 value on seeing a newly released movie. You buy a ticket for $10, but before entering the theater, you lose the ticket. Should you buy another ticket? Or should you now go home and refuse to pay a total of $20 to see the movie? The answer is that you should buy another ticket. The benefit of seeing the movie ($15) still exceeds the opportunity cost (the $10 for the second ticket). The $10 you paid for the lost ticket is a sunk cost. As with spilt milk, there is no point in crying about it.

## case study **Near-Empty Restaurants and Off-Season Miniature Golf**

Have you ever walked into a restaurant for lunch and found it almost empty? Why, you might have asked, does the restaurant even bother to stay open? It might seem that the revenue from so few customers could not possibly cover the cost of running the restaurant.

*Staying open can be profitable, even with many tables empty.*

© Alistair Heap/Alamy

In making the decision of whether to open for lunch, a restaurant owner must keep in mind the distinction between fixed and variable costs. Many of a restaurant's costs—the rent, kitchen equipment, tables, plates, silverware, and so on— are fixed. Shutting down during lunch would not reduce these costs. In other words, these costs are sunk in the short run. When the owner is deciding whether to serve lunch, only the variable costs—the price of the additional food and the wages of the extra staff—are relevant. The owner shuts down the restaurant at lunchtime only if the revenue from the few lunchtime customers fails to cover the restaurant's variable costs.

An operator of a miniature-golf course in a summer resort community faces a similar decision. Because revenue varies substantially from season to season, the firm must decide when to open and when to close. Once again, the fixed costs— the costs of buying the land and building the course—are irrelevant in making this short-run decision. The miniature-golf course should be open for business only during those times of year when its revenue exceeds its variable costs.

## 14-2e The Firm's Long-Run Decision to Exit or Enter a Market

A firm's long-run decision to exit a market is similar to its shutdown decision. If the firm exits, it will again lose all revenue from the sale of its product, but now it will save not only its variable costs of production but also its fixed costs. Thus, *the firm exits the market if the revenue it would get from producing is less than its total costs*.

We can again make this criterion more useful by writing it mathematically. If $TR$ stands for total revenue, and $TC$ stands for total cost, then the firm's exit rule can be written as

$$\text{Exit if } TR < TC.$$

The firm exits if total revenue is less than total cost. By dividing both sides of this inequality by quantity $Q$, we can write it as

$$\text{Exit if } TR/Q < TC/Q.$$

We can simplify this further by noting that $TR/Q$ is average revenue, which equals the price $P$, and that $TC/Q$ is average total cost, $ATC$. Therefore, the firm's exit rule is

$$\text{Exit if } P < ATC.$$

That is, a firm chooses to exit if the price of its good is less than the average total cost of production.

A parallel analysis applies to an entrepreneur who is considering starting a firm. He will enter the market if starting a firm would be profitable, which occurs if the price of the good exceeds the average total cost of production. The entry rule is

$$\text{Enter if } P > ATC.$$

The rule for entry is exactly the opposite of the rule for exit.

We can now describe a competitive firm's long-run profit-maximizing strategy. If the firm produces anything, it chooses the quantity at which marginal cost equals the price of the good. Yet if the price is less than the average total cost at that quantity, the firm chooses to exit (or not enter) the market. These results are illustrated in Figure 4. *The competitive firm's long-run supply curve is the portion of its marginal-cost curve that lies above average total cost*.

## 14-2f Measuring Profit in Our Graph for the Competitive Firm

As we study exit and entry, it is useful to analyze the firm's profit in more detail. Recall that profit equals total revenue ($TR$) minus total cost ($TC$):

$$\text{Profit} = TR - TC.$$

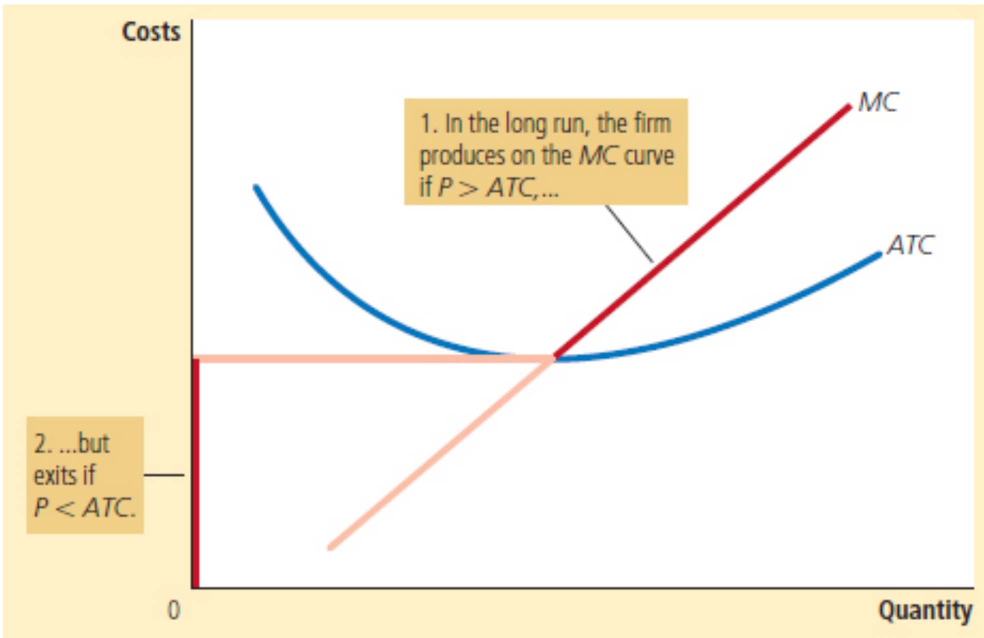
We can rewrite this definition by multiplying and dividing the right side by $Q$:

$$\text{Profit} = (TR/Q - TC/Q) \times Q.$$

# FIGURE 4

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

In the long run, the competitive firm's supply curve is its marginal-cost curve (*MC*) above average total cost (*ATC*). If the price falls below average total cost, the firm is better off exiting the market.




But note that *TR*/*Q* is average revenue, which is the price, *P*, and *TC*/*Q* is average total cost, *ATC*. Therefore,

$$\text{Profit} = (P \times ATC) \times Q.$$

This way of expressing the firm's profit allows us to measure profit in our graphs.

Panel (a) of Figure 5 shows a firm earning positive profit. As we have already discussed, the firm maximizes profit by producing the quantity at which price equals marginal cost. Now look at the shaded rectangle. The height of the rectangle is $P - ATC$, the difference between price and average total cost. The width of the rectangle is $Q$, the quantity produced. Therefore, the area of the rectangle is $(P - ATC) \times Q$, which is the firm's profit.

Similarly, panel (b) of Figure 5 shows a firm with losses (negative profit). In this case, maximizing profit means minimizing losses, a task accomplished once again by producing the quantity at which price equals marginal cost. Now consider the shaded rectangle. The height of the rectangle is $ATC - P$, and the width is $Q$. The area is $(ATC - P) \times Q$, which is the firm's loss. Because a firm in this situation is not making enough revenue on each unit to cover its average total cost, it would choose to exit the market in the long run.

**Quick Quiz** *How does a competitive firm determine its profit-maximizing level of output? Explain.* • *When does a profit-maximizing competitive firm decide to shut down? When does it decide to exit a* *market?*

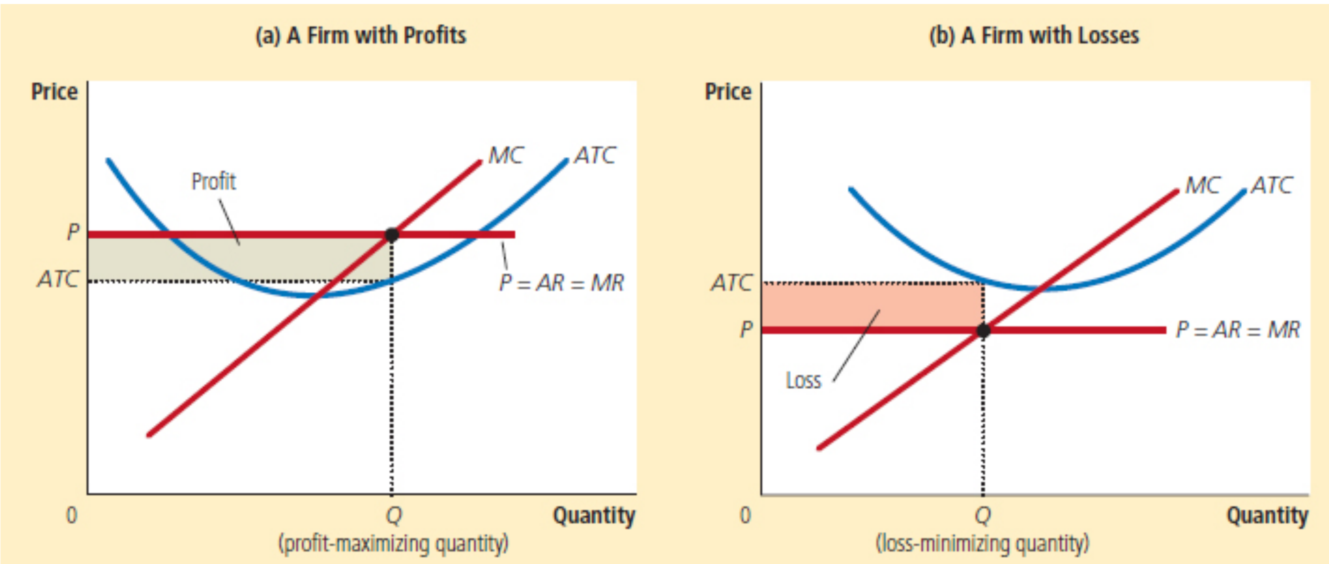
## 14-3 The Supply Curve in a Competitive Market

Now that we have examined the supply decision of a single firm, we can discuss the supply curve for a market. There are two cases to consider. First, we examine a market with a fixed number of firms. Second, we examine a market in which the number of firms can change as old firms exit the market and new firms enter. Both cases are important, for each applies to a specific time horizon. Over short periods of time, it is often difficult for firms to enter and exit, so the assumption of a fixed number of firms is appropriate. But over long periods of time, the number of firms can adjust to changing market conditions.

## FIGURE 5

**Profit as the Area between Price and Average Total Cost**

The area of the shaded box between price and average total cost represents the firm's profit. The height of this box is price minus average total cost (*P* – *ATC*), and the width of the box is the quantity of output (*Q*). In panel (a), price is above average total cost, so the firm has positive profit. In panel (b), price is less than average total cost, so the firm incurs a loss.




## 14-3a The Short Run: Market Supply with a Fixed Number of Firms

Consider first a market with 1,000 identical firms. For any given price, each firm supplies a quantity of output so that its marginal cost equals the price, as shown in panel (a) of Figure 6. That is, as long as price is above average variable cost, each firm's marginal-cost curve is its supply curve. The quantity of output supplied to the market equals the sum of the quantities supplied by each of the 1,000 individual firms. Thus, to derive the market supply curve, we add the quantity supplied by each firm in the market. As panel (b) of Figure 6 shows, because the firms are identical, the quantity supplied to the market is 1,000 times the quantity supplied by each firm.

## 14-3b The Long Run: Market Supply with Entry and Exit

Now consider what happens if firms are able to enter or exit the market. Let's suppose that everyone has access to the same technology for producing the good and access to the same markets to buy the inputs for production. Therefore, all current and potential firms have the same cost curves.

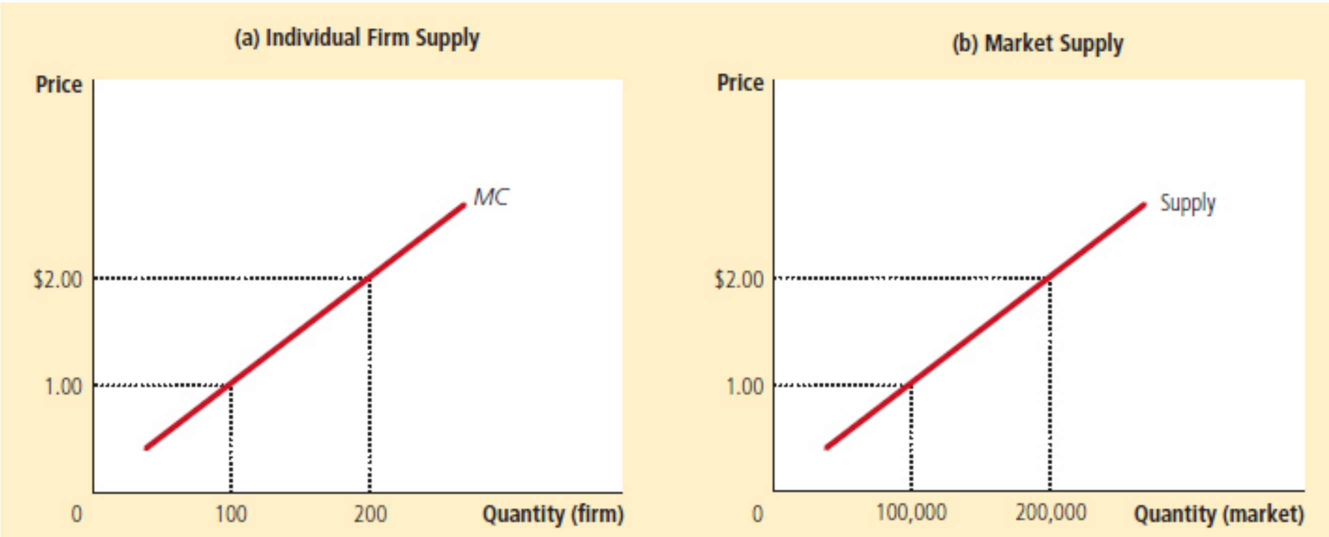
Decisions about entry and exit in a market of this type depend on the incentives facing the owners of existing firms and the entrepreneurs who could start new firms. If firms already in the market are profitable, then new firms will have an incentive to enter the market. This entry will expand the number of firms, increase the quantity of the good supplied, and drive down prices and profits. Conversely, if firms in the market are making losses, then some existing firms will exit the market.

Their exit will reduce the number of firms, decrease the quantity of the good supplied, and drive up prices and profits. *At the end of this process of entry and exit, firms that remain in the market must be making zero economic profit*.

# FIGURE 6

**Short-Run Market Supply**

In the short run, the number of firms in the market is fixed. As a result, the market supply curve, shown in panel (b), reflects the individual firms' marginal-cost curves, shown in panel (a). Here, in a market of 1,000 firms, the quantity of output supplied to the market is 1,000 times the quantity supplied by each firm.




Recall that we can write a firm's profit as

$$\text{Profit} = (P - ATC) \times Q.$$

This equation shows that an operating firm has zero profit if and only if the price of the good equals the average total cost of producing that good. If price is above average total cost, profit is positive, which encourages new firms to enter. If price is less than average total cost, profit is negative, which encourages some firms to exit. *The process of entry and exit ends only when price and average total cost are driven to equality*.

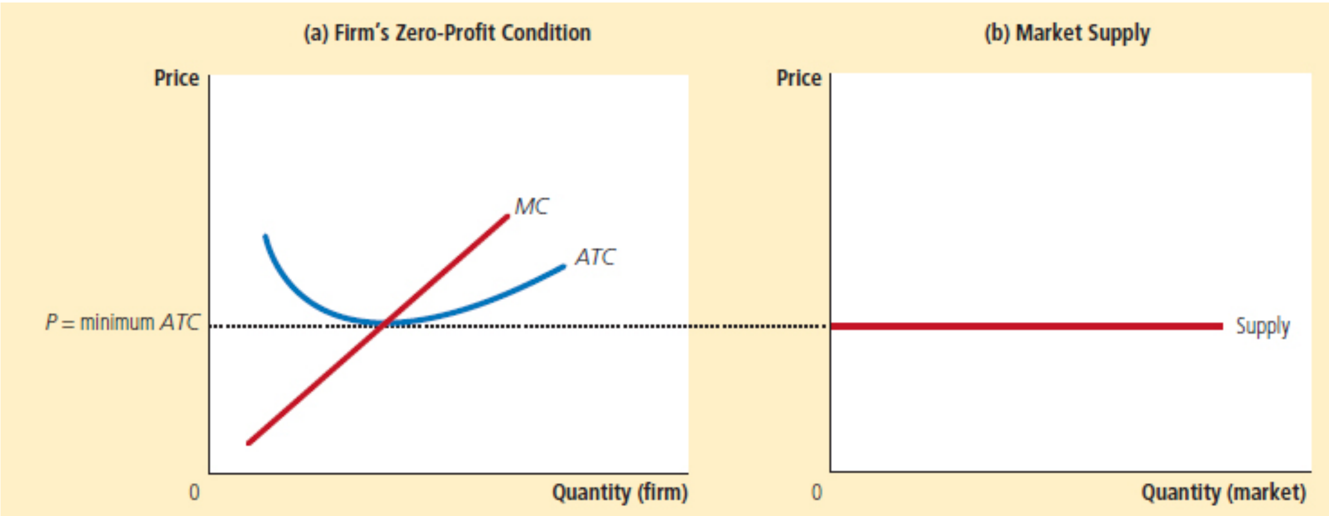
This analysis has a surprising implication. We noted earlier in the chapter that competitive firms maximize profits by choosing a quantity at which price equals marginal cost. We just noted that free entry and exit force price to equal average total cost. But if price is to equal both marginal cost and average total cost, these two measures of cost must equal each other. Marginal cost and average total cost are equal, however, only when the firm is operating at the minimum of average total cost. Recall from the preceding chapter that the level of production with lowest average total cost is called the firm's *efficient scale*. Therefore, *in the long-run equilibrium of a competitive market with free entry and exit, firms must be operating at their efficient scale*.

Panel (a) of Figure 7 shows a firm in such a long-run equilibrium. In this figure, price *P* equals marginal cost *MC*, so the firm is maximizing profit. Price also equals average total cost *ATC*, so profit is zero. New firms have no incentive to enter the market, and existing firms have no incentive to leave the market.

# FIGURE 7

**Long-Run Market Supply**

In the long run, firms will enter or exit the market until profit is driven to zero. As a result, price equals the minimum of average total cost, as shown in panel (a). The number of firms adjusts to ensure that all demand is satisfied at this price. The long-run market supply curve is horizontal at this price, as shown in panel (b).




From this analysis of firm behavior, we can determine the long-run supply curve for the market. In a market with free entry and exit, there is only one price consistent with zero profit—the minimum of average total cost. As a result, the long-run market supply curve must be horizontal at this price, as illustrated by the perfectly elastic supply curve in panel (b) of Figure 7. Any price above this level would generate profit, leading to entry and an increase in the total quantity supplied. Any price below this level would generate losses, leading to exit and a decrease in the total quantity supplied. Eventually, the number of firms in the market adjusts so that price equals the minimum of average total cost, and there are enough firms to satisfy all the demand at this price.

## 14-3c Why Do Competitive Firms Stay in Business If They Make Zero Profit?

At first, it might seem odd that competitive firms earn zero profit in the long run. After all, people start businesses to make a profit. If entry eventually drives profit to zero, there might seem to be little reason to stay in business.

To understand the zero-profit condition more fully, recall that profit equals total revenue minus total cost and that total cost includes all the opportunity costs of the firm. In particular, total cost includes the time and money that the firm owners devote to the business. In the zero-profit equilibrium, the firm's revenue must compensate the owners for these opportunity costs.

Consider an example. Suppose that, to start his farm, a farmer had to invest $1 million, which otherwise he could have deposited in a bank and earned $50,000 a year in interest. In addition, he had to give up another job that would have paid him $30,000 a year. Then the farmer's opportunity cost of farming includes both the interest he could have earned and the forgone wages—a total of $80,000. Even if his profit is driven to zero, his revenue from farming compensates him for these opportunity costs.

Keep in mind that accountants and economists measure costs differently. As we discussed in the previous chapter, accountants keep track of explicit costs but not implicit costs. That is, they measure costs that require an outflow of money from the firm, but they do not include the opportunity costs of production that do not involve an outflow of money. As a result, in the zero-profit equilibrium, economic profit is zero, but accounting profit is positive. Our farmer's accountant, for instance, would conclude that the farmer earned an accounting profit of $80,000, which is enough to keep the farmer in business.

*"We're a nonprofit organization—we don't intend to be, but we are!"*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## 14-3d A Shift in Demand in the Short Run and Long Run

Now that we have a more complete understanding of how firms make supply decisions, we can better explain how markets respond to changes in demand. Because firms can enter and exit in the long run but not in the short run, the response of a market to a change in demand depends on the time horizon. To see this, let's trace the effects of a shift in demand over time.

Suppose the market for milk begins in a long-run equilibrium. Firms are earning zero profit, so price equals the minimum of average total cost. Panel (a) of Figure 8 shows this situation. The long-run equilibrium is point A, the quantity sold in the market is $Q_1$, and the price is $P_1$.

Now suppose scientists discover that milk has miraculous health benefits. As a result, the quantity of milk demanded at every price increases, and the demand curve for milk shifts outward from $D_1$ to $D_2$, as in panel (b) of Figure 8. The short-run equilibrium moves from point A to point B; as a result, the quantity rises from $Q_1$ to $Q_2$, and the price rises from $P_1$ to $P_2$. All of the existing firms respond to the higher price by raising the amount they produce. Because each firm's supply curve reflects its marginal-cost curve, how much each firm increases production is determined by the marginal-cost curve. In the new short-run equilibrium, the price of milk exceeds average total cost, so the firms are making positive profit.

Over time, the profit generated in this market encourages new firms to enter. Some farmers may switch to producing milk instead of other farm products, for example. As the number of firms grows, the quantity supplied at every price increases, the short-run supply curve shifts to the right from $S_1$ to $S_2$, as in panel (c) of Figure 8, and this shift causes the price of milk to fall. Eventually, the price is driven back down to the minimum of average total cost, profits are zero, and firms stop entering. Thus, the market reaches a new long-run equilibrium, point C. The price of milk has returned to $P_1$, but the quantity produced has risen to $Q_3$. Each firm is again producing at its efficient scale, but because more firms are in the dairy business, the quantity of milk produced and sold is higher.

## 14-3e Why the Long-Run Supply Curve Might Slope Upward

So far, we have seen that entry and exit can cause the long-run market supply curve to be perfectly elastic. The essence of our analysis is that there are a large number of potential entrants, each of which faces the same costs. As a result, the long-run market supply curve is horizontal at the minimum of average total cost. When the demand for the good increases, the long-run result is an increase in the number of firms and in the total quantity supplied, without any change in the price.

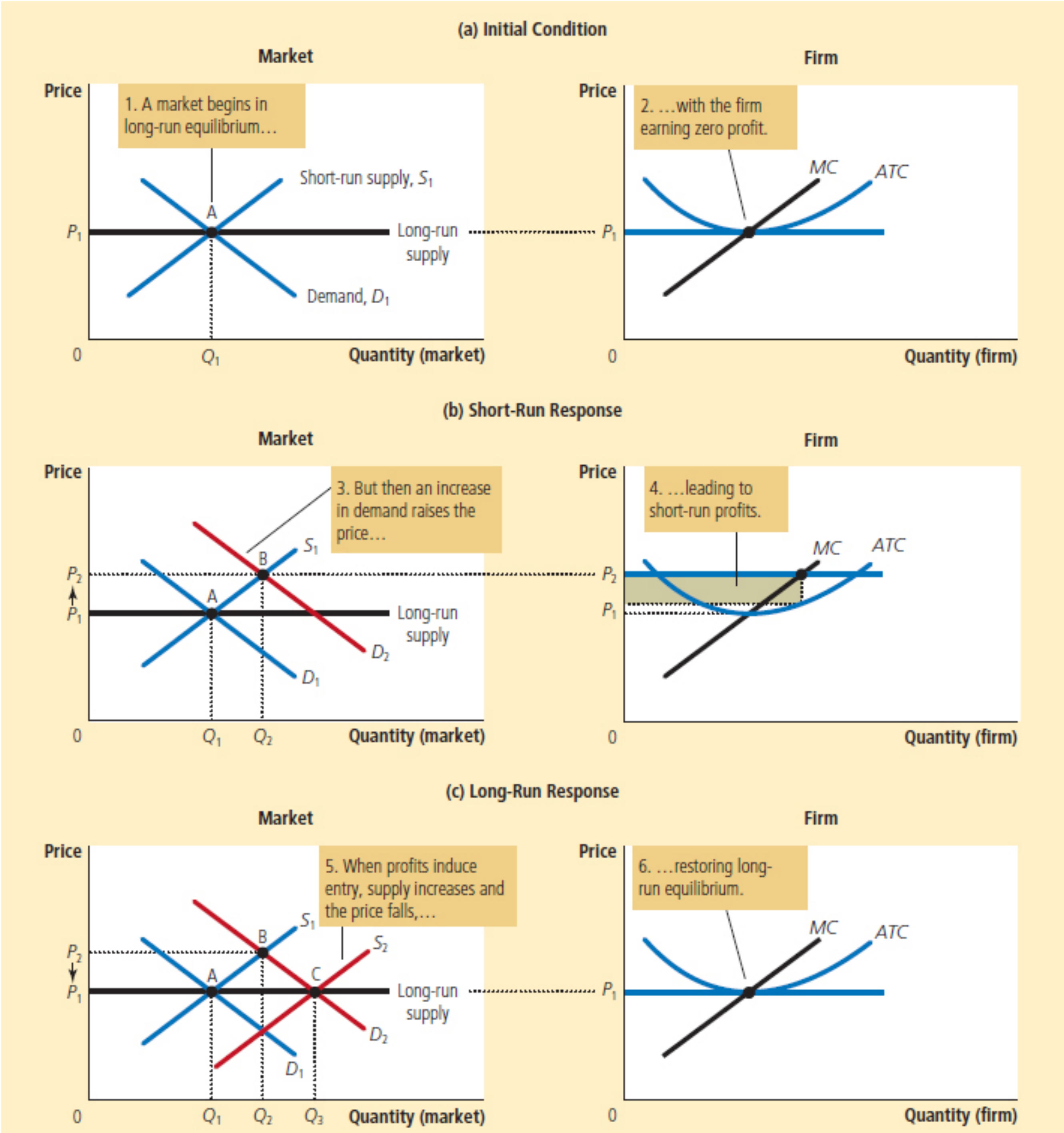
There are, however, two reasons that the long-run market supply curve might slope upward. The first is that some resources used in production may be available only in limited quantities. For example, consider the market for farm products.

Anyone can choose to buy land and start a farm, but the quantity of land is limited. As more people become farmers, the price of farmland is bid up, which raises the costs of all farmers in the market. Thus, an increase in demand for farm products cannot induce an increase in quantity supplied without also inducing a rise in farmers' costs, which in turn means a rise in price. The result is a long-run market supply curve that is upward sloping, even with free entry into farming.

# FIGURE 8

**An Increase in Demand in the Short Run and Long Run**

The market starts in a long-run equilibrium, shown as point A in panel (a). In this equilibrium, each firm makes zero profit, and the price equals the minimum average total cost. Panel (b) shows what happens in the short run when demand rises from $D_1$ to $D_2$. The equilibrium goes from point A to point B, price rises from $P_1$ to $P_2$, and the quantity sold in the market rises from $Q_1$ to $Q_2$. Because price now exceeds average total cost, each firm now makes a profit, which over time encourages new firms to enter the market. This entry shifts the short-run supply curve to the right from $S_1$ to $S_2$, as shown in panel (c). In the new long-run equilibrium, point C, price has returned to $P_1$ but the quantity sold has increased to $Q_3$. Profits are again zero, and price is back to the minimum of average total cost, but the market has more firms to satisfy the greater demand.




A second reason for an upward-sloping supply curve is that firms may have different costs. For example, consider the market for painters. Anyone can enter the market for painting services, but not everyone has the same costs. Costs vary in part because some people work faster than others and in part because some people have better alternative uses of their time than others. For any given price, those with lower costs are more likely to enter than those with higher costs. To increase the quantity of painting services supplied, additional entrants must be encouraged to enter the market. Because these new entrants have higher costs, the price must rise to make entry profitable for them. Thus, the long-run market supply curve for painting services slopes upward even with free entry into the market.

Notice that if firms have different costs, some firms earn profit even in the long run. In this case, the price in the market reflects the average total cost of the *marginal firm*—the firm that would exit the market if the price were any lower. This firm earns zero profit, but firms with lower costs earn positive profit. Entry does not eliminate this profit because would-be entrants have higher costs than firms already in the market. Higher-cost firms will enter only if the price rises, making the market profitable for them.

Thus, for these two reasons, a higher price may be necessary to induce a larger quantity supplied, in which case the long-run supply curve is upward sloping rather than horizontal. Nonetheless, the basic lesson about entry and exit remains true. *Because firms can enter and exit more easily in the long run than in the short run, the long-run supply curve is typically more elastic than the short-run supply curve*.

**Quick Quiz** *In the long run with free entry and exit, is the price in a market equal to marginal cost, average total cost, both, or neither? Explain with a diagram.*

# 14-4 Conclusion: Behind the Supply Curve

We have been discussing the behavior of profit-maximizing firms that supply goods in perfectly competitive markets. You may recall from Chapter 1 that one of the *Ten Principles of Economics* is that rational people think at the margin. This chapter has applied this idea to the competitive firm. Marginal analysis has given us a theory of the supply curve in a competitive market and, as a result, a deeper understanding of market outcomes.

We have learned that when you buy a good from a firm in a competitive market, you can be assured that the price you pay is close to the cost of producing that good. In particular, if firms are competitive and profit maximizing, the price of a good equals the marginal cost of making that good. In addition, if firms can freely enter and exit the market, the price also equals the lowest possible average total cost of production.

Although we have assumed throughout this chapter that firms are price takers, many of the tools developed here are also useful for studying firms in less competitive markets. We now turn to examining the behavior of firms with market power. Marginal analysis will again be useful, but it will have quite different implications for a firm's production decisions and for the nature of market outcomes.

## Summary