chapter 9

Perfect Competition and the Supply Curve

Section 2: Production and Profits

Consider Jennifer and Jason, who run an organic tomato farm. Suppose that the market price of organic tomatoes is $18 per bushel and that Jennifer and Jason are price-takers—they can sell as much as they like at that price. Then we can use the data in Table 9-1 to find their profit-maximizing level of output by direct calculation.

The first column shows the quantity of output in bushels, and the second column shows Jennifer and Jason's total revenue from their output: the market value of their output. Total revenue, *TR*, is equal to the market price multiplied by the quantity of output:

(9-1) $TR = P \times Q$

In this example, total revenue is equal to $18 per bushel times the quantity of output in bushels.

The third column of Table 9-1 shows Jennifer and Jason's total cost. The fourth column of Table 9-1 shows their profit, equal to total revenue minus total cost:

(9-2) $\text{Profit} = TR - TC$

TABLE 9-1

Profit for Jennifer and Jason's Farm When Market Price Is $18

Quantity of tomatoes *Q* (bushels)	Total revenue of output *TR*	Total cost of output *TC*	Profit *TR* − *TC*
0	$0	$14	$–14
1	18	30	–12
2	36	36	0
3	54	44	10
4	72	56	16
5	90	72	18
6	108	92	16
7	126	116	10

As indicated by the numbers in the table, profit is maximized at an output of 5 bushels, where profit is equal to $18. But we can gain more insight into the profit-maximizing choice of output by viewing it as a problem of marginal analysis, a task we'll do next.

Using Marginal Analysis to Choose the Profit-Maximizing Quantity of Output

Recall from Chapter 7 the *principle of marginal analysis:* the optimal amount of an activity is the level at which marginal benefit is equal to marginal cost. To apply this principle, consider the effect on a producer's profit of increasing output by 1 unit. The

Marginal revenue is the change in total revenue generated by an additional unit of output.

marginal benefit of that unit is the additional revenue generated by selling it; this measure has a name—it is called the **marginal revenue** of that output. The general formula for marginal revenue is:

$$\textbf{(9-3)}\quad \text{Marginal revenue} = \frac{\text{Change in total revenue}}{\text{Change in output}} = \begin{array}{c}\text{Change in total revenue}\\ \text{generated by one}\\ \text{additional unit of output}\end{array}$$

or

$$MR = \Delta TR/\Delta Q$$

The **optimal output rule** says that profit is maximized by producing the quantity of output at which the marginal cost of the last unit produced is equal to its marginal revenue.

So Jennifer and Jason would maximize their profit by producing bushels up to the point at which the marginal revenue is equal to marginal cost. We can summarize this as the producer's **optimal output rule:** profit is maximized by producing the quantity at which the marginal revenue of the last unit produced is equal to its marginal cost. That is, $MR = MC$ at the optimal quantity of output.

We can learn how to apply the optimal output rule with the help of Table 9-2, which provides various short-run cost measures for Jennifer and Jason's farm. The second column contains the farm's variable cost, and the third column shows its total cost of output based on the assumption that the farm incurs a fixed cost of $14. The fourth column shows their marginal cost. Notice that, in this example, the marginal cost falls as output increases from a low level before rising, so that the marginal cost curve has the "swoosh" shape described in Chapter 8. (Shortly it will become clear that this shape has important implications for short-run production decisions.)

The fifth column contains the farm's marginal revenue, which has an important feature: Jennifer and Jason's marginal revenue is constant for every output level at $18. The sixth and final column of Table 9-2 shows the calculation of the net gain per bushel of tomatoes, which is equal to marginal revenue minus marginal cost—or, equivalently, market price minus marginal cost. As you can see, it is positive for

TABLE 9-2

Short-Run Costs for Jennifer and Jason's farm

Quantity of tomatoes *Q* (bushels)	Variable cost of output *VC*	Total cost of output *TC*	Marginal cost of bushel $MC = \Delta TC/\Delta Q$	Marginal revenue of bushel	Net gain of bushel = $MR - MC$
0	$0	$14			
			$16	$18	$2
1	16	30			
			6	18	12
2	22	36			
			8	18	10
3	30	44			
			12	18	6
4	42	56			
			16	18	2
5	58	72			
			20	18	−2
6	78	92			
			24	18	−6
7	102	116			

the 1st through 5th bushels; producing each of these bushels raises Jennifer and Jason's profit. For the 6th and 7th bushels, however, net gain is negative: producing them would decrease, not increase, profit. (You can verify this by examining Table 9-1.) So 5 bushels are Jennifer and Jason's profit-maximizing output; it is the level of output at which marginal cost is approximately equal to the market price, $18.

This example, in fact, illustrates another general rule derived from marginal analysis—the **price-taking firm's optimal output rule,** which says that a price-taking firm's profit is maximized by producing the quantity of output at which the marginal cost of the last unit produced is equal to the market price. That is, $P = MC$

The **price-taking firm's optimal output rule** says that a price-taking firm's profit is maximized by producing the quantity of output at which the marginal cost of the last unit produced is equal to the market price.

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WHAT IF MARGINAL REVENUE AND MARGINAL COST AREN'T EXACTLY EQUAL?

The optimal output rule says that to maximize profit, you should produce the quantity at which marginal revenue is equal to marginal cost. But what do you do if there is no output level at which marginal revenue equals marginal cost? In that case, you produce the largest quantity for which marginal revenue exceeds marginal cost. This is the case in Table 9-2 at an output of 5 bushels. The simpler version of the optimal output rule applies when production involves large numbers, such as hundreds or thousands of units. In such cases marginal cost comes in small increments, and there is always a level of output at which marginal cost almost exactly equals marginal revenue.

The **marginal revenue curve** shows how marginal revenue varies as output varies.

at the *price-taking firm's* optimal quantity of output. In fact, the price-taking firm's optimal output rule is just an application of the optimal output rule to the particular case of a price-taking firm. Why? Because in the case of a price-taking firm, *marginal revenue is equal to price*. A price-taking firm cannot influence the market price by its actions. It always takes the market price as given because it cannot lower the market price by selling more or raise the market price by selling less. So, for a price-taking firm, the additional revenue generated by producing one more unit is always the market price. We will need to keep this fact in mind in future chapters, where we will learn that marginal revenue is not equal to the market price if the industry is not perfectly competitive and, as a result, firms are not price-takers.

For the remainder of this chapter, we will assume that the firms in question are, like Jennifer and Jason's farm, perfectly competitive. Figure 9-1 shows that Jennifer and Jason's profit-maximizing quantity of output is, indeed, the number of bushels at which the marginal cost of production is equal to price. The figure shows the marginal cost curve, *MC*, drawn from the data in the last column of Table 9-1. As in Chapter 8, we plot the marginal cost of increasing output from 1 to 2 bushels halfway between 1 and 2, and so on. The horizontal line at $18 is Jennifer and Jason's **marginal revenue curve, *MR*.** Note that whenever a firm is a price-taker, its marginal revenue curve is a horizontal line at the market price: it can sell as much as it likes at the market price. Regardless of whether it sells more or less, the market price is unaffected. In effect, the individual firm faces a horizontal, perfectly elastic demand curve for its output—an individual demand curve for its output that is equivalent to its marginal revenue curve. The marginal cost curve crosses the marginal revenue curve at point *E*. Sure enough, the quantity of output at *E* is 5 bushels.

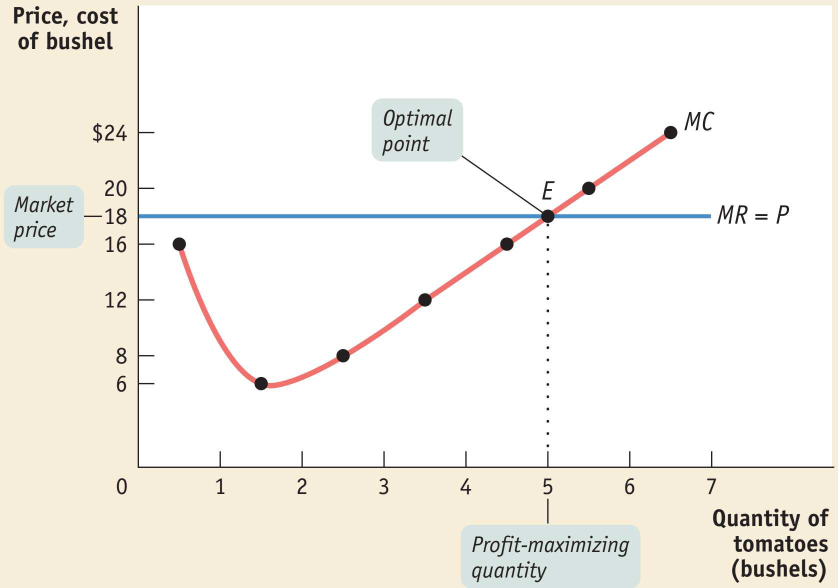
Does this mean that the firm's production decision can be entirely summed up as "produce up to the point where the marginal cost of production is equal to the price"?

No, not quite. Before applying the principle of marginal analysis to determine how much to produce, a potential producer must as a first step answer an "either–or" question: should it produce at all? If the answer to that question is yes, it then proceeds to the second step—a "how much" decision: maximizing profit by choosing the quantity of output at which marginal cost is equal to price.

Figure 9-1

The Price-Taking Firm's Profit-Maximizing Quantity of Output

At the profit-maximizing quantity of output, marginal cost is equal to the market price. It is located at the point where the marginal cost curve crosses the marginal revenue curve, which is a horizontal line at the market price. Here, the profit-maximizing point is at an output of 5 bushels of tomatoes, the output quantity at point *E*.



To understand why the first step in the production decision involves an "either–or" question, we need to ask how we determine whether it is profitable or unprofitable to produce at all.

When Is Production Profitable?

Recall from Chapter 7 that a firm's decision whether or not to stay in a given business depends on its *economic profit*—a measure based on the opportunity cost of resources used in the business. To put it a slightly different way: in the calculation of profit, a firm's total cost incorporates implicit costs—the benefits forgone in the next best use of the firm's resources—as well as explicit costs in the form of actual cash outlays.

We will assume that all costs, implicit as well as explicit, are included in the cost numbers given in Table 9-1; as a result, the profit numbers in Table 9-2 are economic profit. So what determines whether Jennifer and Jason's farm earns a profit or generates a loss? The answer is that, given the farm's cost curves, whether or not it is profitable depends on the market price of tomatoes—specifically, *whether the market price is more or less than the farm's minimum average total cost.*

Table 9-3 calculates short-run average variable cost and short-run average total cost for Jennifer and Jason's farm. These are short-run values, because we take fixed cost as given. (We'll turn to the effects of changing fixed cost shortly.) The short-run average total cost curve, *ATC*, is shown in Figure 9-2, along with the marginal cost curve, *MC*, from Figure 9-1. As you can see, average total cost is minimized at point *C*, corresponding to an output of 4 bushels—the *minimum-cost output*—and an average total cost of $14 per bushel.

To see how these curves can be used to decide whether production is profitable or unprofitable, recall that profit is equal to total revenue minus total cost, $TR - TC$. This means:

- If $TR > TC$, the firm is profitable.
- If $TR = TC$, the firm breaks even.
- If $TR < TC$, the firm incurs a loss.

We can also express this idea in terms of revenue and cost per unit of output. If we divide profit by the number of units of output, *Q*, we obtain the following expression for profit per unit of output:

$$\textbf{(9-4)}\quad \text{Profit}/Q = TR/Q - TC/Q$$

TR/Q is average revenue—that is, the market price. *TC/Q* is average total cost. So a firm is profitable if the market price for its product exceeds the average total cost of the quantity the firm produces; a firm loses money if the market price is less than average total cost of the quantity the firm produces. This means:

- If $P > ATC$, the firm is profitable.
- If $P = ATC$, the firm breaks even.
- If $P < ATC$, the firm incurs a loss.

TABLE 9-3

Average Costs for Jennifer and Jason's Farm

Quantity of tomatoes *Q* (bushels)	Average variable cost of bushel *AVC*	Average total cost of bushel *ATC*	Average variable cost of tomatoes *AVC = VC/Q*	Average total cost of tomatoes *ATC = TC/Q*
1	$16.00	$30.00	$16.00	$30.00
2	22.00	36.00	11.00	18.00
3	30.00	44.00	10.00	14.67
4	42.00	56.00	10.50	14.00
5	58.00	72.00	11.60	14.40
6	78.00	92.00	13.00	15.33
7	102.00	116.00	14.57	16.57

Figure 9-2

Costs and Production in the Short Run

This figure shows the marginal cost curve, *MC*, and the short-run average total cost curve, *ATC*, which is minimized at point *C*. At point *C* (the minimum average total cost), the market price is $14 and output is 4 bushels of tomatoes (the minimum-cost output). Minimum average total cost is equal to the firm's *break-even price*. >web...

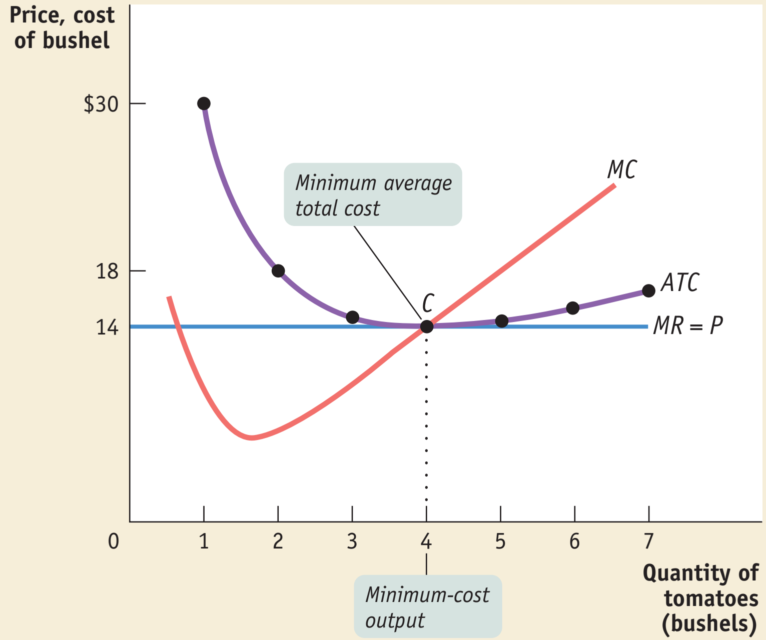
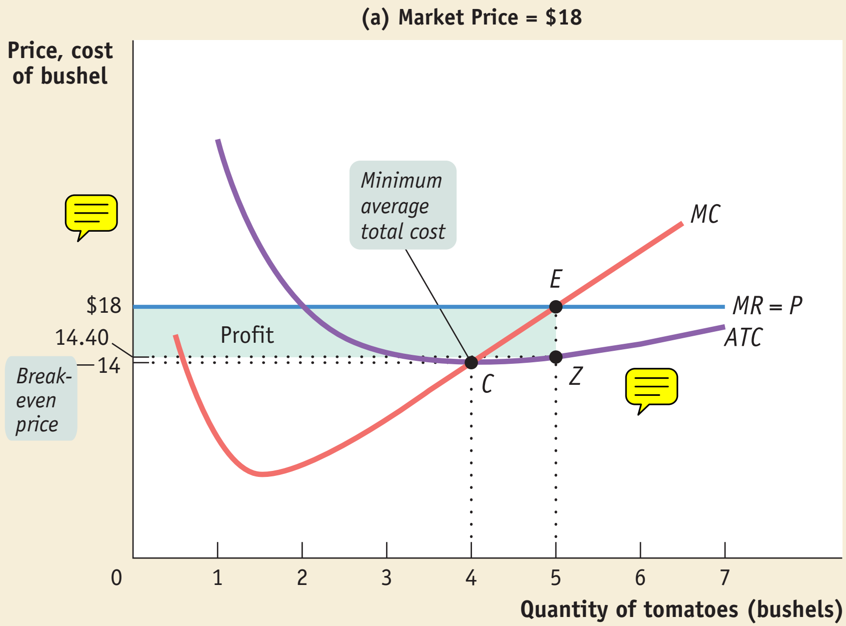


Figure 9-3 illustrates this result, showing how the market price determines whether a firm is profitable. It also shows how profits are depicted graphically. Each panel shows the marginal cost curve, *MC*, and the short-run average total cost curve, *ATC*.

Figure 9-3

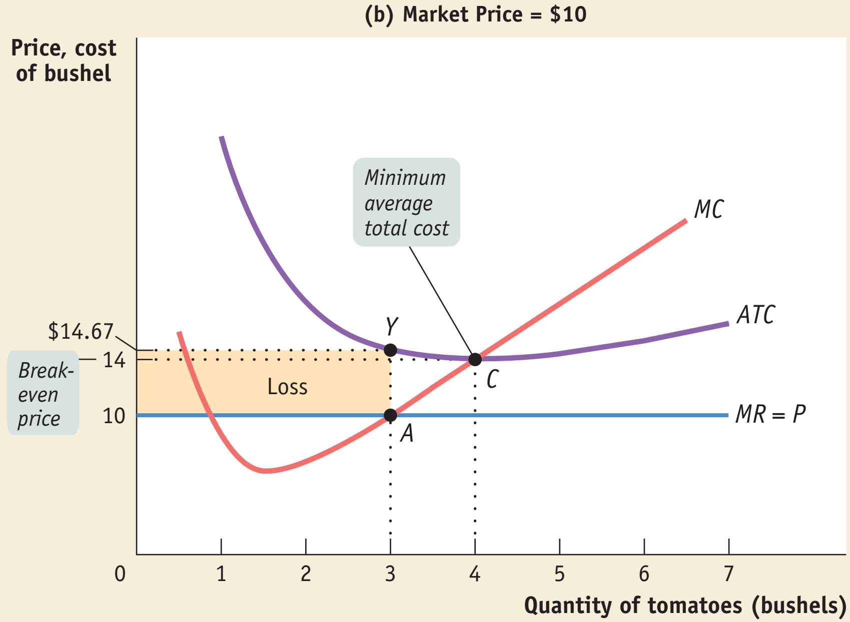
Profitability and the Market Price



In panel (a) the market price is $18. The farm is profitable because price exceeds minimum average total cost, the break-even price, $14. The farm's optimal output choice is indicated by point *E*, corresponding to an output of 5 bushels. The average total cost of producing 5 bushels is indicated by point *Z* on the *ATC* curve, corresponding to an amount of $14.40. The vertical distance between *E* and *Z* corresponds to the farm's per-unit profit, $18.00 − $14.40 = $3.60. Total profit is given by the area of the shaded rectangle, 5 × $3.60 = $18.00.

In panel (b) the market price is $10; the farm is unprofitable because the price falls below the minimum average total cost, $14. The farm's optimal output choice when producing is indicated by point *A*, corresponding to an output of three bushels. The farm's per-unit loss, $14.67 − $10.00 = $4.67, is represented by the vertical distance between *A* and *Y*. The farm's total loss is represented by the shaded rectangle, 3 × $4.67 = $14.00 (adjusted for rounding error). >web...

Figure 9-3 (continued)



Average total cost is minimized at point *C*. Panel (a) shows the case we have already analyzed, in which the market price of tomatoes is $18 per bushel. Panel (b) shows the case in which the market price of tomatoes is lower, $10 per bushel.

In panel (a), we see that at a price of $18 per bushel the profit-maximizing quantity of output is 5 bushels, indicated by point *E* where the marginal cost curve, *MC*, intersects the marginal revenue curve—which for a price-taking firm is a horizontal line at the market price. At that quantity of output, average total cost is \$14.40 per bushel, indicated by point *Z*. Since the price per bushel exceeds average total cost per bushel, Jennifer and Jason's farm is profitable.

Jennifer and Jason's total profits when the market price is \$18 are represented by the area of the shaded rectangle in panel (a). To see why, notice that total profit can be expressed in terms of profit per unit:

(9-5) $$\text{Profit} = TR - TC = (TR/Q - TC/Q) \times Q$$

or, equivalently,

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

since *P* is equal to *TR*/Q and *ATC* is equal to *TC*/Q. The height of the shaded rectangle in panel (a) corresponds to the vertical distance between points *E* and *Z*. It is equal to *P* – *ATC* = \$18.00 – \$14.40 = \$3.60 per bushel. The shaded rectangle has a width equal to the output: Q = 5 bushels. So the area of that rectangle is equal to Jennifer and Jason's profit: 5 bushels × \$3.60 profit per bushel = \$18—the same number we calculated in Table 9-2.

What about the situation illustrated in panel (b)? Here the market price of tomatoes is \$10 per bushel. Setting price equal to marginal cost leads to a profit-maximizing output of 3 bushels, indicated by point *A*. At this output, Jennifer and Jason have an average total cost of \$14.67 per bushel, indicated by point *Y*. At their profit-maximizing output quantity—3 bushels—average total cost exceeds the market price. This means that Jennifer and Jason's farm generates losses, not profits.

How much do they lose by producing when the market price is \$10? On each bushel they lose *ATC* – *P* = \$14.67 – \$10.00 = \$4.67, an amount corresponding to the vertical distance between points *A* and *Y*. And, they would produce 3 bushels, which corresponds to the width of the shaded rectangle. So, the total value of the losses is $4.67 × 3 = $14.00 (adjusted for rounding error), an amount that corresponds to the area of the shaded rectangle in panel (b).

But how does a producer know, in general, whether or not its business will be profitable? It turns out that the crucial test lies in a comparison of the market price to the producer's *minimum average total cost*. On Jennifer and Jason's farm, minimum average total cost, which is equal to $14, occurs at an output quantity of 4 bushels. Whenever the market price exceeds minimum average total cost, the producer can find some output level for which the average total cost is less than the market price. That means that the producer can find a level of output at which the firm makes a profit. Jennifer and Jason's farm will be profitable whenever the market price exceeds $14. And they will achieve the highest profit by producing the quantity at which marginal cost equals the market price.

On the other hand, if the market price is less than minimum average total cost, there is no output level at which price exceeds average total cost. As a result, the firm will be unprofitable at any quantity of output. As we saw, at a price of $10—an amount less than minimum average total cost—Jennifer and Jason did indeed lose money. By producing the quantity at which marginal cost equals the market price, Jennifer and Jason did the best they could, but the best that they could do was a loss of $14. Any other quantity would have increased the size of their loss.

The **break-even price** of a price-taking firm is the market price at which it earns zero profits.

The minimum average total cost of a price-taking firm is called its **break-even price,** the price at which it earns zero profits. A firm will earn positive profits when the market price is above the break-even price, and it will suffer losses when the market price is below the break-even price. Jennifer and Jason's break-even price of $14 is the price at point *C* in Figures 9-2 and 9-3.

So the rule for determining whether a producer of a good is profitable depends on a comparison of the market price of the good to the producer's break-even price—its minimum average total cost:

- Whenever market price exceeds minimum average total cost, the producer is profitable.
- Whenever the market price equals minimum average total cost, the producer breaks even.
- Whenever market price is less than minimum average total cost, the producer is unprofitable.

The Short-Run Production Decision

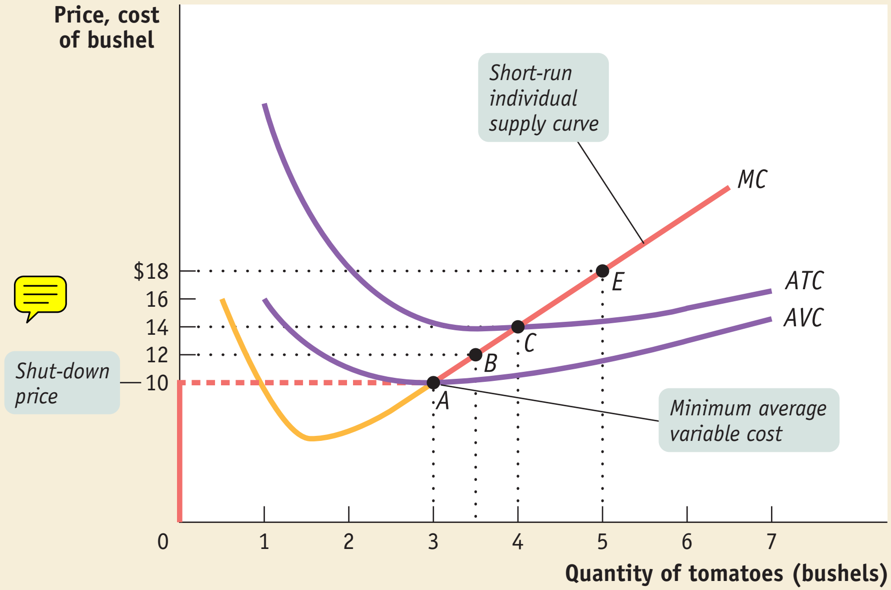
You might be tempted to say that if a firm is unprofitable because the market price is below its minimum average total cost, it shouldn't produce any output. In the short run, however, this conclusion isn't right. In the short run, sometimes the firm should produce even if price falls below minimum average total cost. The reason is that total cost includes *fixed cost*—cost that does not depend on the amount of output produced. In the short run, fixed cost must still be paid, regardless of whether or not a firm produces. For example, if Jennifer and Jason have rented a tractor for the year, they have to pay that rent regardless of whether they produce any tomatoes. Since it cannot be changed in the short run, their fixed cost is irrelevant to their decision about whether to produce or shut down in the short run. Although fixed cost should play no role in the decision about whether to produce at all in the short run, other costs—variable costs—do matter. An example of variable costs is the wages of workers who must be hired to help with planting and harvesting. Variable costs can be saved by *not* producing; so they should play a role in determining whether or not to produce in the short run.

Let's turn to Figure 9-4: it shows both the short-run average total cost curve, *ATC*, and the short-run average *variable* cost curve, *AVC*, drawn from the information in Table 9-3. Recall that the difference between the two curves—the vertical distance between them—represents average fixed cost, the fixed cost per unit of output, *FC/Q*. Because the marginal cost curve has a "swoosh" shape—falling at first before rising—the short-run average variable cost curve is U-shaped: the initial fall in marginal cost causes average variable cost to fall as well, before rising marginal cost eventually pulls it up again. The short-run average variable cost curve reaches its minimum value of $10 at point *A*, at an output of 3 bushels.

Figure 9-4

The Short-Run Individual Supply Curve

When the market price exceeds Jennifer and Jason's *shut-down price* of $10, the minimum average variable cost indicated by point *A*, they will produce the output quantity at which marginal cost is equal to price. So at any price above minimum average *variable* cost, the short-run individual supply curve is the firm's marginal cost curve; this corresponds to the upward-sloping segment of the individual supply curve. When market price falls below minimum average variable cost, the firm ceases operation in the short run. This corresponds to the segment of the individual supply curve along the vertical axis.



We are now prepared to fully analyze the optimal production decision in the short run. We need to consider two cases:

- When the market price is below minimum average *variable* cost
- When the market price is greater than or equal to minimum average *variable* cost

A firm will cease production in the short run if the market price falls below the **shut-down price**, which is equal to minimum average variable cost.

When the market price is below minimum average variable cost, the price the firm receives is not covering its variable cost per unit. A firm in this situation should cease production immediately. Why? Because there is no level of output at which the firm's total revenue covers its variable costs—the costs it can avoid by not operating. In this case the firm maximizes its profits by not producing at all—by, in effect, minimizing its losses. It will still incur a fixed cost in the short run, but it will no longer incur any variable cost. This means that the minimum average variable cost is equal to the **shut-down price,** the price at which the firm ceases production in the short run.

When price is greater than minimum average variable cost, however, the firm should produce in the short run. In this case, the firm maximizes profit—or minimizes its loss—by choosing the output quantity at which its marginal cost is equal to the market price. For example, if the market price of tomatoes is $18 per bushel, Jennifer and Jason should produce at point *E* in Figure 9-4, corresponding to an output of 5 bushels. Note that point *C* in Figure 9-4 corresponds to the farm's break-even price of $14 per bushel. Since *E* lies above *C*, Jennifer and Jason's farm will be profitable; they will generate a per-bushel profit of $18.00 – $14.40 = $3.60 when the market price is $18.

But what if the market price lies between the shut-down price and the break-even price—that is, between minimum average *variable* cost and minimum average *total* cost? In the case of Jennifer and Jason's farm, this corresponds to prices anywhere between $10 and $14—say, a market price of $12. At $12, Jennifer and Jason's farm is not profitable; since the market price is below minimum average total cost, the farm is losing the difference between price and average total cost per unit produced. Yet, even if it isn't covering its total cost per unit, it is covering its variable cost per unit and some—but not all—of the fixed cost per unit. If a firm in this situation shuts down, it would incur no variable cost but would incur the *full* fixed cost. As a result, shutting down generates an even greater loss than continuing to operate.

This means that whenever price falls between minimum average total cost and minimum average variable cost, the firm is better off producing some output in the short run. The reason is that by producing, it can cover its variable cost per unit and at least some of its fixed cost, even though it is incurring a loss. In this case, the firm maximizes profit—that is, minimizes its loss—by choosing the quantity of output at which its marginal cost is equal to the market price. So if Jennifer and Jason face a market price of $12 per bushel, their profit-maximizing output is given by point *B* in Figure 9-4, corresponding to an output of 3.5 bushels.

It's worth noting that the decision to produce when the firm is covering its variable costs but not all of its fixed cost is similar to the decision to ignore *sunk costs,* a concept we studied in Chapter 7. You may recall that a sunk cost is a cost that has already been incurred and cannot be recouped; and because it cannot be changed, it should have no effect on any current decision. In the short-run production decision, fixed cost is, in effect, like a sunk cost—it has been spent, and it can't be recovered in the short run. This comparison also illustrates why variable cost does indeed matter in the short run: it can be avoided by not producing.

And what happens if market price is exactly equal to the shut-down price, minimum average variable cost? In this instance, the firm is indifferent between producing 3 units or 0 units. As we'll see shortly, this is an important point when looking at the behavior of an industry as a whole.

The **short-run individual supply curve** shows how an individual producer's optimal output quantity depends on the market price, taking fixed cost as given.

Putting everything together, we can now draw the **short-run individual supply curve** of Jennifer and Jason's farm; it shows how the optimal quantity of output in the short run depends on the price, the red line in Figure 9-4. As you can see, the curve is in two segments. The upward-sloping red segment starting at point *A* shows the short-run optimal output when market price is above the shut-down price of $10

PITFALLS

ECONOMIC PROFIT, AGAIN

Some readers may wonder why firms would enter an industry when they will do little more than break even. Wouldn't people prefer to go into other businesses that yield a better profit?

The answer is that here, as always, when we calculate cost, we mean *opportunity cost*—that is, cost that includes the return a business owner could get by using his or her resources elsewhere. And so the profit that we calculate is *economic profit*; if the market price is above the break-even level, potential business owners can earn more in this industry than they could elsewhere.

per bushel. As long as the market price is above the shut-down price, Jennifer and Jason produce the quantity of output at which marginal cost is equal to the market price. That is, at market prices above the shut-down price, the firm's short-run supply curve corresponds to its marginal cost curve. But at any market price below minimum average variable cost—in this case, $10 per bushel—the firm shuts down and output drops to zero in the short run. This corresponds to the segment of the curve that lies on top of the vertical axis.

Do firms really shut down temporarily without going out of business? Yes. In fact, in some businesses temporary shut-downs are routine. The most common examples are industries in which demand is highly seasonal, like outdoor amusement parks in climates with cold winters. Such parks would have to offer very low prices to entice customers during the colder months—prices so low that the owners would not cover their variable costs (principally wages and electricity). The wiser choice economically is to shut down until warm weather brings enough customers who are willing to pay a higher price.

Changing Fixed Cost

Although fixed cost cannot be altered in the short run, in the long run firms can acquire or get rid of machines, buildings, and so on. As we learned in Chapter 8, in the long run the level of fixed cost is a matter of choice. We saw that a firm will choose the level of fixed cost that minimizes the average total cost for its desired output quantity. Now we will focus on an even bigger question facing a firm when choosing its fixed cost: whether to incur *any* fixed cost at all by remaining in its current business.

In the long run, a producer can always eliminate fixed cost by selling off its plant and equipment. If it does so, of course, it can't ever produce—it has exited the industry. In contrast, a potential producer can take on some fixed cost by acquiring machines and other resources, which puts it in a position to produce—it can enter the industry. In most perfectly competitive industries the set of producers, although fixed in the short run, changes in the long run as firms enter or leave the industry.

Consider Jennifer and Jason's farm once again. In order to simplify our analysis, we will sidestep the problem of choosing among several possible levels of fixed cost. Instead, we will assume from now on that Jennifer and Jason have only one possible choice of fixed cost if they operate, the amount of $14 that was the basis for the calculations in Tables 9-1, 9-2, and 9-3. Alternatively, they can choose a fixed cost of zero if they exit the industry. (With this assumption, Jennifer and Jason's short-run average total cost curve and long-run average total cost curve are one and the same.)

Suppose that the market price of organic tomatoes is consistently less than $14 over an extended period of time. In that case, Jennifer and Jason never fully cover their fixed cost: their business runs at a loss. In the long run, then, they can do better by closing their business and leaving the industry. In other words, *in the long run* firms will exit an industry if the market price is consistently less than their break-even price—their minimum average total cost.

On the other hand, suppose, that the price of organic tomatoes is consistently above the break-even price, $14, for an extended period of time. Because their farm is profitable, Jennifer and Jason will remain in the industry and continue producing. But things won't stop there. The organic tomato industry meets the criterion of *free entry*: there are many potential organic tomato producers because the necessary inputs are easy to obtain. And the cost curves of those potential producers are likely to be similar to those of Jennifer and Jason, since the technology used by other producers is likely to be very similar to that used by Jennifer and Jason. If the price is high enough to generate profits for existing producers, it will also attract some of these potential producers into the industry. So *in the long run* a price in excess of $14 should lead to entry: new producers will come into the organic tomato industry.

As we will see in the next section, exit and entry lead to an important distinction between the *short-run industry supply curve* and the *long-run industry supply curve*.

Summing Up: The Competitive Firm's Profitability and Production Conditions

In this chapter, we've studied where the supply curve for a perfectly competitive firm comes from. Every perfectly competitive firm makes its production decisions by maximizing profit, and these decisions determine the supply curve. Table 9-4 summarizes the competitive firm's profitability and production conditions. It also relates them to entry and exit from the industry.

TABLE 9-4

Summary of the Competitive Firm's Profitability and Production Conditions

Profitability Condition (minimum *ATC* = break-even price)	Result
$P >$ minimum *ATC*	Firm profitable. Entry into industry in the long run.
$P =$ minimum *ATC*	Firm breaks even. No entry into or exit from industry in the long run.
$P <$ minimum *ATC*	Firm unprofitable. Exit from industry in the long run.
Production Condition (minimum *AVC* = shut-down price)	**Result**
$P >$ minimum *AVC*	Firm produces in the short run. If $P <$ minimum *ATC*, firm covers variable cost and some but not all of fixed cost. If $P >$ minimum *ATC*, firm covers all variable cost and fixed cost.
$P =$ minimum *AVC*	Firm indifferent between producing in the short run or not. Just covers variable cost.
$P <$ minimum *AVC*	Firm shuts down in the short run. Does not cover variable cost.