chapter 9

Perfect Competition and the >> Supply Curve

Section 3: The Industry Supply Curve

The **industry supply curve** shows the relationship between the price of a good and the total output of the industry as a whole.

Why will an increase in the demand for organic tomatoes lead to a large price increase at first but a much smaller increase in the long run? The answer lies in the behavior of the **industry supply curve**—the relationship between the price and the total output of an industry as a whole. The industry supply curve is what we referred to in earlier chapters as *the* supply curve or the market supply curve. But here we take some extra care to distinguish between the *individual supply curve* of a single firm and the supply curve of the industry as a whole.

As you might guess from the previous section, the industry supply curve must be analyzed in somewhat different ways for the short run and the long run. Let's start with the short run.

The Short-Run Industry Supply Curve

Recall that in the short run the number of producers in an industry is fixed—there is no entry or exit. We can best understand how the industry supply curve emerges from individual producer supply curves by imagining that all the producers are alike. So let's

assume that there are 100 organic tomato farms, each with the same costs as Jennifer and Jason's farm.

Each of these 100 farms will have an individual short-run supply curve like the one in Figure 9-4 in "Section 2: Production and Profits." At a price below $10, no farms will produce. At a price of more than $10, each farm will produce the quantity of output at which its marginal cost is equal to the market price. As you can see from Figure 9-4, this will lead them to produce 4 bushels if the price is $14 per bushel, 5 bushels if the price is $18, and so on. So if there are 100 organic tomato farmers and the price of organic tomatoes is $18 per bushel, the industry as a whole will produce 500 bushels, corresponding to 100 farmers × 5 bushels per farmer, and so on. The result is the **short-run industry supply curve**, shown as *S* in Figure 9-5. This curve shows the quantity that producers will supply at each price, *taking the number of producers as given*.

The **short-run industry supply curve** shows how the quantity supplied by an industry depends on the market price given a fixed number of producers.

There is a **short-run market equilibrium** when the quantity supplied equals the quantity demanded, taking the number of producers as given.

The demand curve *D* in Figure 9-5 crosses the short-run industry supply curve at E_{MKT}, corresponding to a price of $18 and a quantity of 500 bushels. Point E_{MKT} is a **short-run market equilibrium:** the quantity supplied equals the quantity demanded, taking the number of producers as given. But the long run may look quite different, because in the long run farms may enter or exit the industry.

The Long-Run Industry Supply Curve

Suppose that in addition to the 100 farmers currently in the organic tomato business, there are many other potential producers. Suppose also that each of these potential producers would have the same cost curves as existing producers like Jennifer and Jason if it entered the industry

When will additional producers enter the industry? Whenever existing producers are making a profit—that is, whenever the market price is above the break-even price of $14 per bushel, the minimum average total cost of production. For example, at a price of $18 per bushel, new firms will enter the industry.

What will happen as additional producers enter the industry? Clearly, the quantity supplied at any given price will increase. The short-run industry supply curve will shift to the right. This will, in turn, alter the market equilibrium and result in a lower market price. Existing firms will respond to the lower market price by reducing their output, but the total industry output will increase because of the larger number of firms in the industry.

Figure 9-6 illustrates the effects of this chain of events on an existing firm and on the market; panel (a) shows how an individual existing firm responds to entry, and panel (b) shows how the market responds to entry. (Note that these two graphs have

Figure 9-5

The Short-Run Market Equilibrium

The short-run industry supply curve, *S*, is the industry supply curve taking the number of producers—here, 100—as given. It is generated by adding together the individual supply curves of the 100 producers. Below the shut-down price of $10, no producer wants to produce in the short run. Above $10, the short-run industry supply curve slopes upward, as each producer increases output as price increases. It intersects the demand curve, *D*, at point E_{MKT}, the point of short-run market equilibrium, corresponding to a market price of $18 and a quantity of 500 bushels. >web...

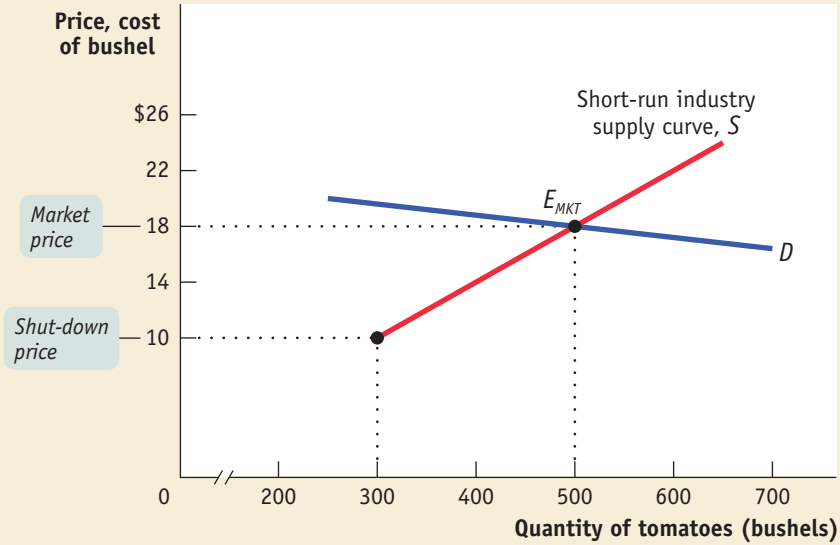
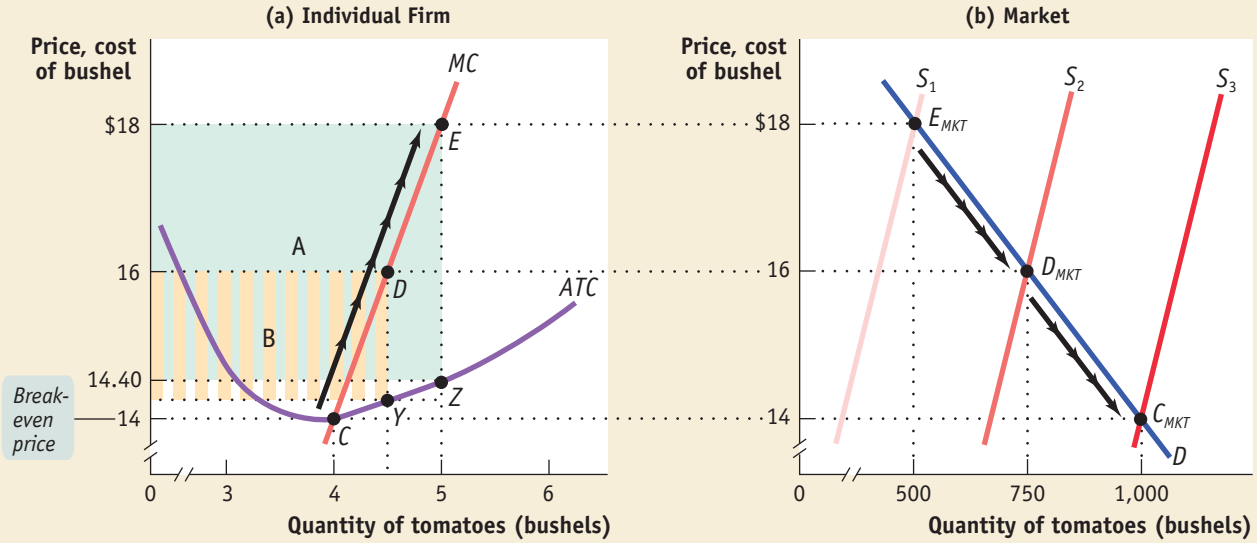


Figure 9-6 **The Long-Run Market Equilibrium**



Point E_{MKT} of panel (b) shows the initial short-run market equilibrium, at the intersection of the demand curve, D, and the initial short-run industry supply curve, S_1. Because the market price ($18) is above the break-even price ($14), each of the 100 existing producers makes an economic profit; this is illustrated in panel (a), where the rectangle labeled A shows the profit of an existing firm. These profits induce entry by additional producers, shifting the short-run industry supply curve outward from S_1 to S_2 in panel (b). This results in a new short-run equilibrium at point D_{MKT} with a lower market price of $16 and higher industry output. The output and profits of existing firms are reduced; but some profit remains, as shown by the rectangle labeled B in panel (a). Entry continues shifting out the short-run industry supply curve, as price falls and industry output increases yet again. Entry finally ceases once an equilibrium, at point C_{MKT} on supply curve S_3, is reached. Here market price is equal to the break-even price; existing producers make zero economic profits and there is no incentive for entry or exit. Therefore C_{MKT} is also a long-run market equilibrium.

been rescaled in comparison to Figure 9-4 in "Section 2: Production and Profits" to better illustrate how profit changes in response to price.) In panel (b), S_1 is the initial short-run industry supply curve, based on the existence of 100 producers. The initial short-run market equilibrium is at E_{MKT}, with an equilibrium market price of $18 and a quantity of 500 bushels. At this price existing producers are profitable, which is reflected in panel (a): an existing firm makes a total profit represented by the shaded rectangle labeled *A* when market price is $18.

These profits will induce new producers to enter the industry, shifting the short-run industry supply curve to the right. For example, the short-run industry supply curve when the number of producers has increased to 167 is S_2. Corresponding to this supply curve is a new short-run market equilibrium labeled D_{MKT}, with a market price of $16 and a quantity of 750 bushels. At $16, each firm produces 4.5 bushels, so that industry output is $167 \times 4.5 = 750$ bushels (rounded). From panel (a) you can see the effect of the entry of 67 new producers on an existing firm: the fall in price causes it to reduce its output, and its profit falls to the area represented by the shaded rectangle labeled *B*.

Although diminished, the profit of existing firms at D_{MKT} means that entry will continue and the number of firms will continue to rise. If the number of producers rises to 250, the short-run industry supply curve shifts out again to S_3, and the market equilibrium is at C_{MKT}, with a quantity supplied and demanded of 1,000 bushels and a market price of $14 per bushel.

Like E_{MKT} and D_{MKT}, C_{MKT} is a short-run equilibrium. But it is also something more. Because the price of $14 is each firm's break-even price, an existing producer makes zero economic profits—neither a profit nor a loss—when producing its profit-maximizing output of 4 bushels. At this price there is no incentive either for potential producers to enter or for existing producers to exit the industry. So C_{MKT} corresponds to a **long-run market equilibrium**—a situation in which quantity supplied equals the quantity demanded given that sufficient time has elapsed for producers to either enter or exit the industry. In a long-run market equilibrium, all existing and potential producers have fully adjusted to their optimal long-run choices; as a result, no producer has an incentive to either enter or exit the industry.

A market is in **long-run market equilibrium** when the quantity supplied equals the quantity demanded, given that sufficient time has elapsed for entry into and exit from the industry to occur.

To explore further the significance of the difference between short-run and long-run equilibrium, consider the effect of an increase in demand on an industry with free entry that is initially in long-run equilibrium. Panel (b) in Figure 9-7 shows the market adjustment; panels (a) and (c) show how an existing individual firm behaves during the process.

In panel (b)of Figure 9-7, D_1 is the initial demand curve and S_1 is the initial short-run industry supply curve. Their intersection at point X_{MKT} is both a short-run and a

Figure 9-7 **The Effect of an Increase in Demand in the Short Run and the Long Run**

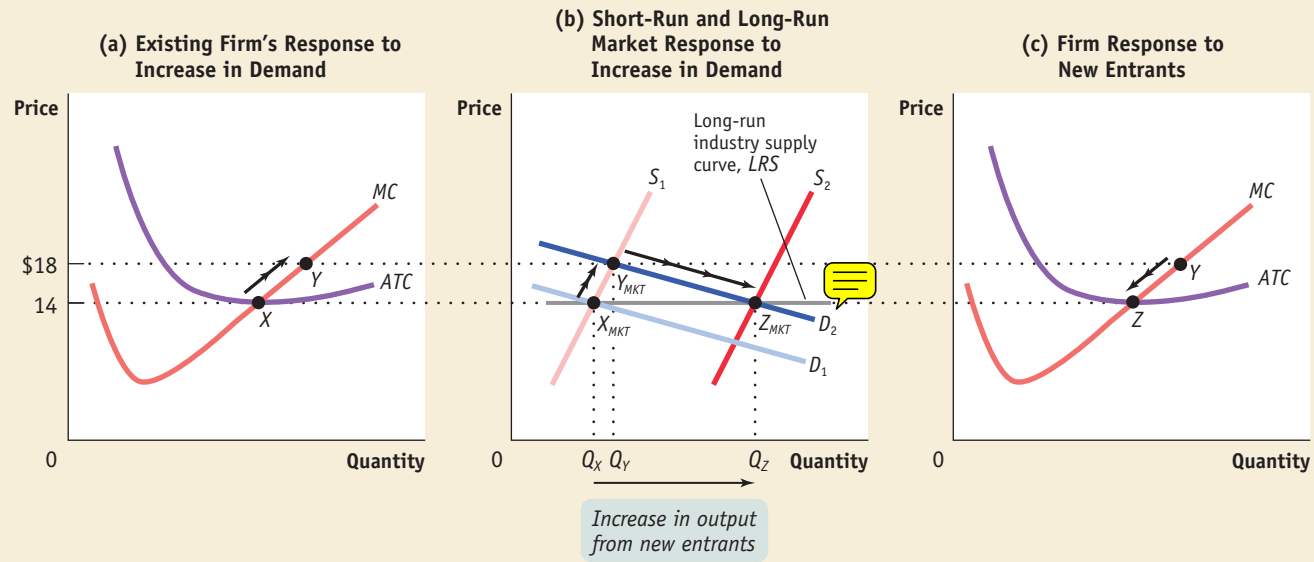


Figure 9-7 The Effect of an Increase in Demand in the Short Run and the Long Run (continued)

Panel (b) shows how an industry adjusts in the short and long run to an increase in demand; panels (a) and (c) show the corresponding adjustments by an existing firm. Initially the market is a point X_{MKT} in panel (b), a short-run and long-run equilibrium at a price of \$14 and industry output of Q_X. An existing firm makes zero profit, operating at point X in panel (a) at minimum average total cost. Demand increases as D_1 shifts rightward to D_2, and raises the market price to \$18. Existing firms increase their output and industry output moves along the short-run industry supply curve S_1 to a short-run equilibrium at Y_{MKT}. Correspondingly, the existing firm in panel (a) moves from point X to point Y. But at a price of \$18 existing firms are profitable. As shown in panel (b), in the long run new entrants arrive and the short-run industry suppply curve shifts rightward, from S_1 to S_2. There is a new equilibrium at point Z_{MKT}, at a lower price of \$14 and higher industry output of Q_Z. An existing firm responds by moving from Y to Z in panel (c), returning to its initial output level and zero profit. Production by new entrants accounts for the total increase in industy output, $Q_Z - Q_X$. Like X_{MKT}, Z_{MKT} is also a short-run and long-run equilibrium: with existing firms earning zero economic profits, there is no incentive for any firms to enter or exit the industry. The horizontal line passing through X_{MKT} and Z_{MKT}, *LRS*, is the *long-run industry supply curve*: at the break-even price of \$14, producers will produce any amount that consumers demand in the long run.

long-run market equilibrium, because the equilibrium price of \$14 leads to zero economic profits—and therefore neither entry nor exit. It corresponds to point X in panel (a), where an individual existing firm is operating at the minimum of its average total cost curve.

Now suppose that the demand curve shifts out for some reason to D_2. As shown in panel (b), in the short run, industry output moves along the short-run industry supply curve S_1 to the new short-run market equilibrium at Y_{MKT}, the intersection of S_1 and D_2. The market price rises to \$18 per bushel and industry output increases from Q_X to Q_Y. This corresponds to the movement from X to Y in panel (a), as an existing firm increases its output in response to the rise in the market price.

But we know that Y_{MKT} is not a long-run equilibrium, because \$18 is higher than minimum average total cost, so existing producers are making economic profits. This will lead additional firms to enter the industry. Over time entry will cause the short-run industry supply curve to shift to the right. In the long run, the short-run industry supply curve will have shifted out to S_2, and the equilibrium will be at Z_{MKT}—with the price falling back to \$14 per bushel and industry output increasing yet again, from Q_Y to Q_Z. Like X_{MKT} before the increase in demand, Z_{MKT} is both a short-run and a long-run market equilibrium.

The effect of entry on an existing firm is illustrated in panel (c), in the movement from *Y* to *Z* along the firm's individual supply curve. The firm reduces its output in response to the fall in price, ultimately arriving back at its original output quantity, corresponding to the minimum of its average total cost curve. In fact, every firm that is now in the industry—the initial set of firms and the new entrants—will operate at the minimum of its average total cost curves, at point *Z*. This means that the entire increase in industry output, from Q_X to Q_Z, comes from production by new entrants.

The **long-run industry supply curve** shows how the quantity supplied responds to the price once producers have had time to enter or exit the industry.

The line *LRS* that passes through X_{MKT} and Z_{MKT} in panel (b) is the **long-run industry supply curve.** It shows how the quantity supplied by an industry responds to the price given that producers have had time to enter or exit the industry.

In this particular case, the long-run industry supply curve is horizontal at \$14. In other words, in this industry supply is *perfectly elastic* in the long run—given time to enter or exit, producers will supply any quantity consumers demand at a price of \$14. Perfectly elastic long-run supply is actually a good assumption for many industries. However, in other industries even the long-run industry supply curve is upward sloping. The usual reason even the long-run industry supply curve is upward sloping is that producers must use some input that is in limited supply and as the industry expands, the price of that input is driven up. For example, beach-resort hotels must compete for a limited quantity of prime beachfront property.

Whether the long-run industry supply curve is horizontal or upward sloping, however, the long-run price elasticity of supply is *higher* than the short-run price elastic-

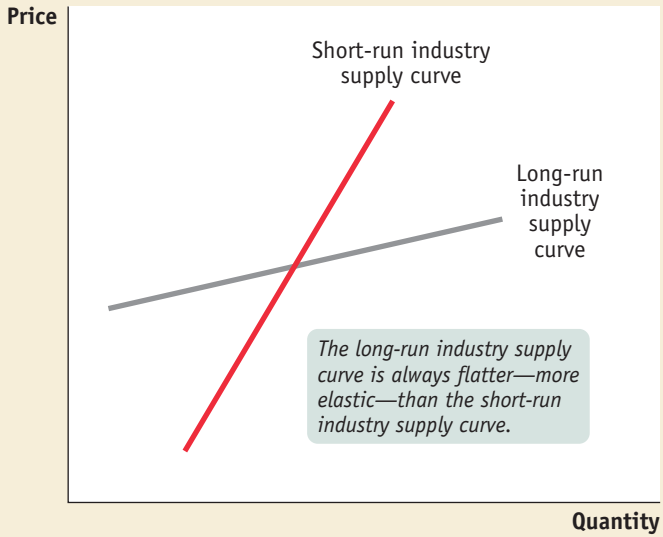
ity whenever there is free entry and exit. As shown in Figure 9-8, the long-run industry supply curve is always flatter than the short-run industry supply curve. The reason is entry and exit: a high price attracts entry by new producers, resulting in a rise in industry output and a fall in price; a low price induces existing firms to exit, leading to a fall in industry output and an increase in price.

The distinction between the short-run industry supply curve and the long-run industry supply curve is very important in practice. We often see a sequence of events

Figure 9-8

Comparing the Short-Run and Long-Run Industry Supply Curves

The long-run industry supply curve may slope upward, but it is always flatter—more elastic—than the short-run industry supply curve. This is because of entry and exit: a higher price attracts new entrants in the long run, resulting in a rise in industry output and lower price; a fall in price induces existing producer to exit in the long run, generating a fall in industry output and a rise in price.



like that shown in Figure 9-7: an increase in demand initially leads to a large price increase, but prices return to their initial level once new firms have entered the industry. Or we see the sequence in reverse: a fall in demand reduces prices in the short run, but they return to their initial level as producers exit the industry.

The Cost of Production and Efficiency in Long-run Equilibrium

Our analysis leads us to three conclusions about the cost of production and efficiency in the long-run equilibrium of a perfectly competitive industry. These results will be important in our discussion in Chapter 14 of how monopoly gives rise to inefficiency.

First, in a perfectly competitive industry in equilibrium, the value of marginal cost is the same for all firms. That's because all firms produce the quantity of output at which marginal cost equals the market price, and as price-takers they all face the same market price.

Second, in a perfectly competitive industry with free entry and exit, each firm will have zero economic profits in long-run equilibrium. Each firm produces the quantity of output that minimizes its average total cost—corresponding to point *Z* in panel (c) of Figure 9-7. So the total cost of production of the industry's output is minimized in a perfectly competitive industry.

The third and final conclusion is that the long-run market equilibrium of a perfectly competitive industry is efficient: no mutually beneficial transactions go unexploited. To understand this we need to recall a fundamental requirement for efficiency from Chapter 6: all consumers who have a willingness to pay greater than or equal to sellers' costs actually get the good. And we also learned that a market is efficient (except under certain, well-defined conditions)—the market price matches all consumers with a willingness to pay greater than or equal to the market price to all sellers who have a cost of producing the good less than or equal to the market price.

How do we know that the long-run equilibrium of a perfectly competitive industry is efficient? Because each firm produces the output level at which price is equal to marginal cost. And marginal cost is in fact the same as seller's cost—the lowest price the firm is willing to accept for the good. So the long-run equilibrium of a market with a perfectly competitive industry is indeed efficient. ■