induce firms to leave the industry. Their owners will seek a normal profit elsewhere rather than accept the below-normal profits (losses) now confronting them. As this exodus of firms proceeds, however, industry supply decreases, pushing the price up from $40 toward $50. Losses continue and more firms leave the industry until the supply curve shifts to S_3. Once this happens, price is again $50, just equal to the minimum average total cost. Losses have been eliminated so that the firms that remain are earning only a normal profit (zero economic profit). Since this is no better or worse than entrepreneurs could expect to earn in other business ventures, there is no longer any incentive to exit the industry. Long-run equilibrium is restored.

In Figure 9.2a and 9.2b, total quantity supplied is now 90,000 units and each firm is producing 100 units. Only 900 firms, not the original 1000, populate the industry. Losses have forced 100 firms out.

You may have noted that we have sidestepped the question of which firms will leave the industry when losses occur by assuming that all firms have identical cost curves. In the real world, of course, managerial talents differ. Even if resource prices and technology are the same for all firms, less skillfully managed firms tend to incur higher costs and therefore are the first to leave an industry when demand declines. Similarly, firms with less productive labor forces or higher transportation costs will be higher-cost producers and likely candidates to quit an industry when demand decreases.

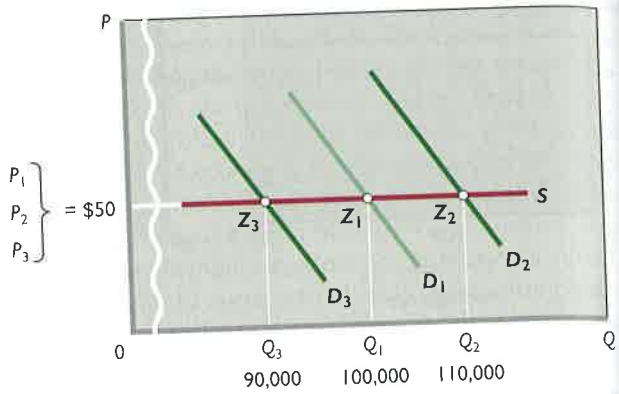
We have now reached an intermediate goal: Our analysis verifies that competition, reflected in the entry and exit of firms, eliminates economic profits or losses by adjusting price to equal minimum long-run average total cost. In addition, this competition forces firms to select output levels at which average total cost is minimized.

Long-Run Supply for a Constant-Cost Industry

Although our analysis has dealt with the long run, we have noted that the market supply curves in Figures 9.1b and 9.2b are short-run curves. What then is the character of the **long-run supply curve** of a competitive industry? Our analysis points us toward an answer. The crucial factor here is the effect, if any, that changes in the number of firms in the industry will have on costs of the individual firms in the industry.

In our analysis of long-run competitive equilibrium we assumed that the industry under discussion was a **constant-cost industry.** This means that industry expansion or contraction will not affect resource prices and therefore production costs. Graphically, it means

FIGURE 9.3 The long-run supply curve for a constant-cost industry is horizontal. In a constant-cost industry, the entry and exit of firms does not affect resource prices, or, therefore, unit costs. So an increase in demand (D_1 to D_2) raises industry output (Q_1 to Q_2) but not price ($50). Similarly, a decrease in demand (D_1 to D_3) reduces output (Q_1 to Q_3) but not price. Thus the long-run industry supply curve (S) is horizontal through points Z_1, Z_2 and Z_3.



that the entry or exit of firms does not shift the long-run ATC curves of individual firms. This is the case when the industry's demand for resources is small in relation to the total demand for those resources. Then the industry can expand or contract without significantly affecting resource prices and costs.

What does the long-run supply curve of a constant-cost industry look like? The answer is contained in our previous analysis. There we saw that the entry and exit of firms changes industry output but always brings the product price back to its original level, where it is just equal to the constant minimum ATC. Specifically, we discovered that the industry would supply 90,000, 100,000, or 110,000 units of output, all at a price of $50 per unit. In other words, the long-run supply curve of a constant-cost industry is perfectly elastic.

This is demonstrated graphically in Figure 9.3, which uses data from Figures 9.1 and 9.2. Suppose industry demand is originally D_1, industry output is Q_1 (100,000 units), and product price is P_1 ($50). This situation, from Figure 9.1, is one of long-run equilibrium. We saw that when demand increases to D_2, upsetting this equilibrium, the resulting economic profits attract new firms. Because this is a constant-cost industry, entry continues and industry output expands until the price is driven back down to the level of the unchanged minimum ATC. This is at price P_2 ($50) and output Q_2 (110,000).

From Figure 9.2, we saw that a decline in market demand from D_1 to D_3 causes an exit of firms and ultimately restores equilibrium at price P_3 ($50) and output Q_3 (90,000 units). The points Z_1, Z_2, and Z_3 in Figure 9.3 represent these three price-quantity combinations. A line or

curve connecting all such points shows the various price-quantity combinations that firms would produce if they had enough time to make all desired adjustments to changes in demand. This line or curve is the industry's long-run supply curve. In a constant-cost industry this curve (straight line) is horizontal, as in Figure 9.3, thus representing perfectly elastic supply.

Long-Run Supply for an Increasing-Cost Industry

Constant-cost industries are a special case. Most industries are **increasing-cost industries,** in which firms' ATC curves shift upward as the industry expands and downward as the industry contracts. Usually, the entry of new firms will increase resource prices, particularly in industries using specialized resources whose long-run supplies do not readily increase in response to increases in resource demand. Higher resource prices result in higher long-run average total costs for all firms in the industry. These higher costs cause upward shifts in each firm's long-run ATC curve.

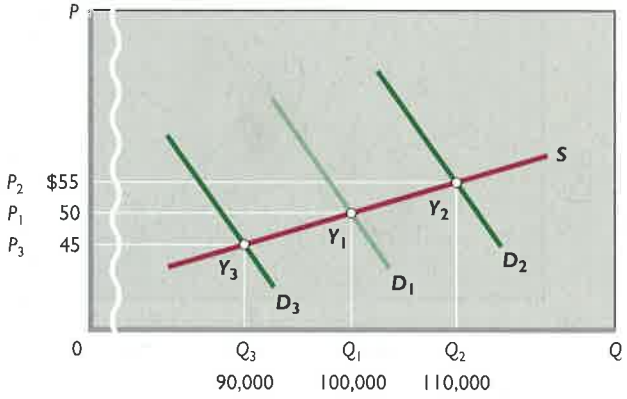
Thus, when an increase in product demand results in economic profits and attracts new firms to an increasing-cost industry, a two-way squeeze works to eliminate those profits. As before, the entry of new firms increases market supply and lowers the market price. But now each firm's entire ATC curve also shifts upward. The overall result is a higher-than-original equilibrium price. The industry produces a larger output at a higher product price because the industry expansion has increased resource prices and the minimum average total cost.

Since greater output will be supplied at a higher price, the long-run industry supply curve is upsloping. Instead of supplying 90,000, 100,000, or 110,000 units at the same price of $50, an increasing-cost industry might supply 90,000 units at $45, 100,000 units at $50, and 110,000 units at $55. A higher price is required to induce more production, because costs per unit of output increase as production rises.

Figure 9.4 nicely illustrates the situation. Original market demand is D_1 and industry price and output are P_1 ($50) and Q_1 (100,000 units), respectively, at equilibrium point Y_1. An increase in demand to D_2 upsets this equilibrium and leads to economic profits. New firms enter the industry, increasing both market supply and the production costs of individual firms. A new price is established at point Y_2, where P_2 is $55 and Q_2 is 110,000 units.

Conversely, a decline in demand from D_1 to D_3 makes production unprofitable and causes firms to leave the industry. The resulting decline in resource prices reduces

FIGURE 9.4 The long-run supply curve for an increasing-cost industry is upsloping. In an increasing-cost industry, the entry of new firms in response to an increase in demand (D_3 to D_1 to D_2) will bid up resource prices and thereby increase unit costs. As a result, an increased industry output (Q_3 to Q_1 to Q_2) will be forthcoming only at higher prices ($55 > $50 > $45). The long-run industry supply curve (S) therefore slopes upward through points Y_3, Y_1, and Y_2.



the minimum average total cost of production for firms that stay. A new equilibrium price is established at some level below the original price, say, at point Y_3, where P_3 is $45 and Q_3 is 90,000 units. Connecting these three equilibrium positions, we derive the upsloping long-run supply curve S in Figure 9.4.

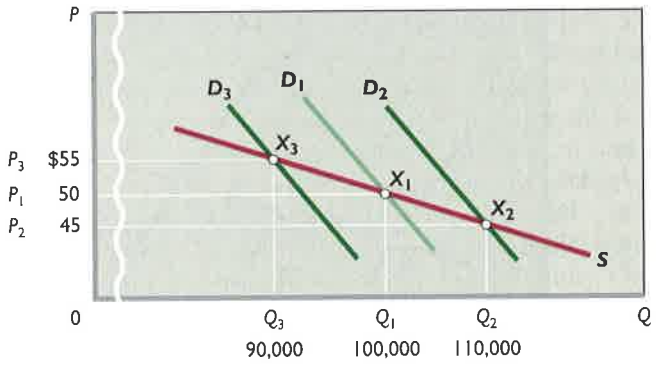
Long-Run Supply for a Decreasing-Cost Industry

In **decreasing-cost industries,** firms experience lower costs as their industry expands. The personal computer industry is an example. As demand for personal computers increased, new manufacturers of computers entered the industry and greatly increased the resource demand for the components used to build them (for example, memory chips, hard drives, monitors, and operating software). The expanded production of the components enabled the producers of those items to achieve substantial economies of scale. The decreased production costs of the components reduced their prices, which greatly lowered the computer manufacturers' average costs of production. The supply of personal computers increased by more than demand, and the price of personal computers declined.

INTERACTIVE GRAPHS
G 9.1
Long-run competitive supply

Unfortunately, however, the industries that show decreasing costs when output expands also show increasing costs if output contracts. A good example is the American shoe-manufacturing industry as it contracted due to

FIGURE 9.5 The long-run supply curve for a decreasing-cost industry is downsloping. In a decreasing-cost industry, the entry of new firms in response to an increase in demand (D_3 to D_1 to D_2) will lead to decreased input prices and, consequently, decreased unit costs. As a result, an increase in industry output (Q_3 to Q_1 to Q_2) will be accompanied by lower prices ($55 > $50 > $45). The long-run industry supply curve (S) therefore slopes downward through points X_3, X_1, and X_2.



foreign competition. Back when the industry was doing well and there were many shoemaking firms, the cost of specialized technicians who repair shoemaking machinery could be spread across many firms. This was because the repairmen worked as independent contractors going from one firm's factory to another firm's factory on a daily basis as various pieces of equipment at different factories needed repairs. But as the demand for American footwear fell over time, there were fewer and fewer factories, so the cost of a repair technician had to be spread over fewer and fewer firms. Thus, costs per firm and per unit of output increased.

Figure 9.5 illustrates the situation. The original market demand is D_1 and industry price and output are P_1($50) and Q_1(100,000 units), respectively, at equilibrium point X_1. An increase in demand to D_2 upsets this equilibrium and leads to economic profits. New firms enter the industry, increasing market supply but decreasing the production costs of individual firms. A new price is established at point X_2, where P_2 is $45 and Q_2 is 110,000 units.

Conversely, a decline in demand from D_1 to D_3 makes production unprofitable and causes firms to leave the industry. The resulting increase in input prices increases the minimum average total cost of production for the firms that remain. A new equilibrium price is established at some level above the original price, say at point X_3, where P_3 is $55 and Q_3 is 90,000 units. Connecting these three equilibrium positions in Figure 9.5, we derive the downsloping long-run supply curve S for this decreasing-cost industry.

QUICK REVIEW 9.1

- In pure competition, entrepreneurs remove resources from industries and firms that are generating economic losses in order to transfer them to industries and firms that are generating economic profits.
- In the long run, the entry of firms into an industry will compete away any economic profits, and the exit of firms will eliminate economic losses, so price and minimum average total cost are equal. Entry and exit cease when the firms in the industry return to making a normal profit (zero economic profit).
- The long-run supply curves of constant-, increasing-, and decreasing-cost industries are horizontal, upsloping, and downsloping, respectively.

Pure Competition and Efficiency

Figure 9.6 (Key Graph) demonstrates the efficiency characteristics of the individual firms (Figure 9.6a) and the market (Figure 9.6b) after long-run adjustments in pure competition. Assuming a constant- or increasing-cost industry, the final long-run equilibrium positions of all firms have the same basic efficiency characteristics. As shown in Figure 9.6a, price (and marginal revenue) will settle where it is equal to minimum average total cost: P (and MR) = minimum ATC. Moreover, since the marginal-cost curve intersects the average-total-cost curve at its minimum point, marginal cost and average total cost are equal: MC = minimum ATC. So in long-run equilibrium a triple equality occurs: P (and MR) = MC = minimum ATC. Thus, in long-run equilibrium, each firm produces at the output level Q_f that is associated with this triple equality.[1]

The triple equality tells us two very important things about long-run equilibrium. First, it tells us that although a competitive firm may realize economic profit or loss in the short run, it will earn only a normal profit by producing in accordance with the MR (= P) = MC rule in the long run. Second, the triple equality tells us that in long-run equilibrium, the profit-maximizing decision rule that leads each firm to produce the quantity at which P = MR also implies that each firm will produce at the output level Q_f that is associated with the minimum point on each identical firm's ATC curve.

This is very important because it suggests that pure competition leads to the most efficient possible use of society's resources. Indeed, subject only to Chapter 5's

[1]This triple equality does not always hold for decreasing-cost industries in which individual firms produce a large fraction of the total market output. In such cases, MC may remain below ATC if average costs are decreasing. We will discuss this situation of "natural monopoly" in Chapter 10.