

proficiency of the more specialized worker. Baseball players improve by playing baseball, and pianists by playing the piano. Similarly, the employees of a firm improve their skills as they experience “learning by doing” in their jobs. Even better, concentration on a narrower range of tasks can help workers discover or develop cost-reducing techniques. The result of greater size and specialization is often more output per unit of labor.

Large firms are also able to achieve lower costs by spreading fixed costs (like the costs of advertising, developing specialized equipment, and searching out and negotiating better input prices, for example) over many more units. For example, both McDonald’s and General Motors are able to spread these costs over a large number of stores and volume of sales. The cost advantages of scale come in many forms.

Economic theory explains why, at least initially, larger firms have lower unit costs than comparable smaller firms. Declining unit costs mean that **economies of scale** are present over the initial range of outputs. The long-run *ATC* curve is falling.

What about *diseconomies of scale*? As output continues to expand, is there reason to believe that larger firms will eventually have higher average total costs than smaller ones? The underlying causes of diseconomies of scale are less obvious, but they do occur. As a firm gets bigger and bigger, beyond some point bureaucratic inefficiencies *may* result. Inflexible procedures tend to replace managerial genius. Innovation requires clearance from more levels of management and becomes more difficult and costly. Motivating the workforce, carrying out managerial directives, and monitoring results of plans are also more complex when the firm is larger, and principal–agent problems grow as the number of employees increases and more levels of communication and monitoring are needed.

Circumstances vary, so diseconomies of scale set in at smaller firm sizes for some kinds of firms than for others. For example, firms in the fast-food industry can be very large and remain efficient; economies of scale apparently outweigh the diseconomies, even for giants like McDonald’s. But in the fine-dining segment of the restaurant industry, the best restaurants seem to be small. Customers demand individual attention, and a constantly changing, innovative menu that takes advantage of the continually changing array of locally available fresh ingredients—with consistently high quality as the only constant—is important. There are few truly gourmet restaurant chains because diseconomies seem to set in at a much smaller size at these firms. The bottom line for diseconomies of scale is this: For some firms, bureaucratic inefficiencies, principal–agent problems, difficulties with innovation, and similar problems that increase with firm size cause long-run average total costs to rise beyond some output level. However, there is considerable variation among industries and even among firms in the same industry concerning the precise output level at which diseconomies of scale begin to occur.

It is important to note that scale economies and diseconomies stem from sources different from those of increasing and diminishing returns. Economies and diseconomies of scale are long-run concepts. They relate to conditions of production when all factors are variable. In contrast, increasing and diminishing returns are short-run concepts, applicable only when the firm has at least one fixed factor of production.

## 8-7b ALTERNATIVE SHAPES OF THE LRATC

Exhibit 9 outlines three different long-run average total cost (*LRATC*) curves, each describing real-world conditions in differing industries. For a firm described by the cost curve in part (a), both economies and diseconomies of scale are present. Higher per-unit costs will result if the firm chooses a plant size other than the one that minimizes the cost of producing output  $q$ . If each firm in an industry faces the same cost conditions, we can generalize and say that all plants larger or smaller than this ideal size will experience higher unit costs. A very narrow range

### Economies of scale

Reductions in the firm’s per-unit costs associated with the use of large plants to produce a large volume of output.

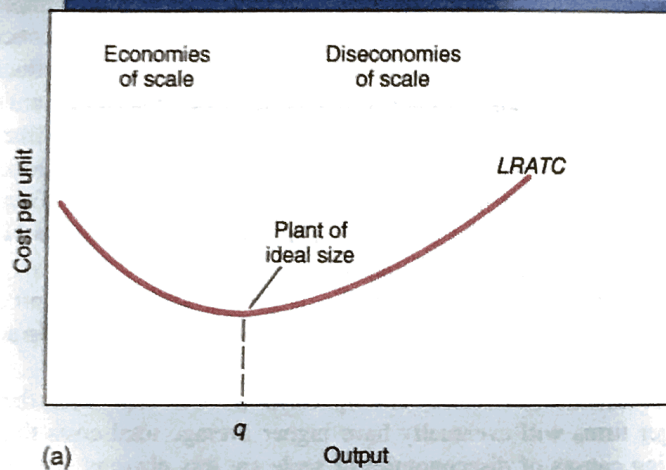
The consistently high quality of gourmet restaurants like 18 Seaboard in Raleigh, North Carolina, can seldom be duplicated by chain restaurants, in part because a gourmet chef must make decisions daily about which locally available fresh ingredients will be used and how they will be used to produce a constantly innovative menu, delivered by an attentive and dedicated staff. Thus, diseconomies of scale limit the size of firms like 18 Seaboard.



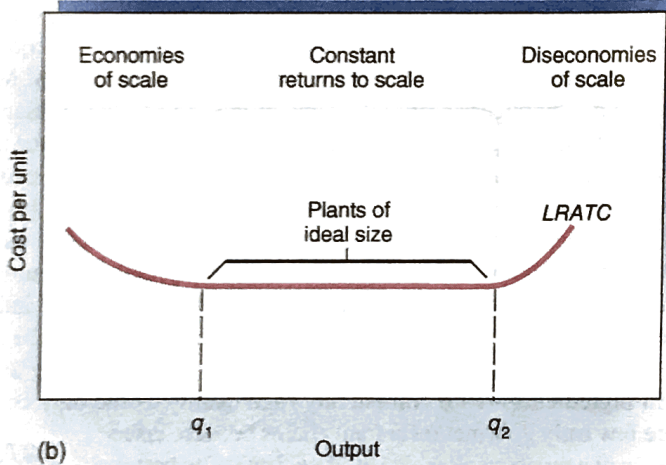
**EXHIBIT 9**

**Three Different Types of Long-Run Average Total Cost Curves**

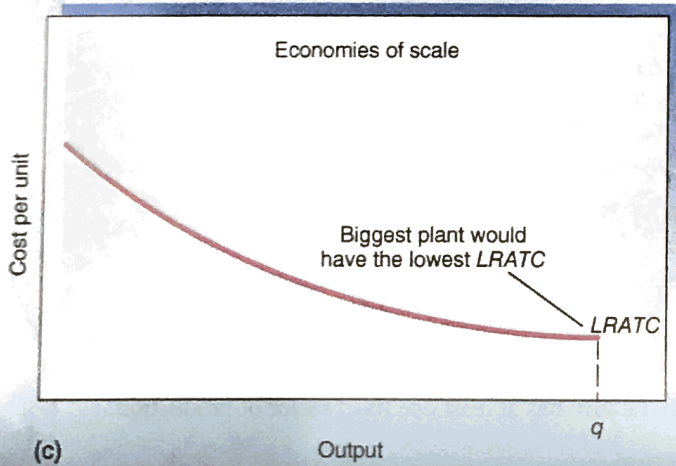
For one type of *LRATC* curve, economies of scale are present for output levels less than  $q$ , but immediately beyond  $q$ , diseconomies of scale occur (a). In another instance, economies of scale are important until some minimum output level ( $q_1$ ) is attained. Once the minimum level has been attained, there is a wide range of output levels ( $q_1$  to  $q_2$ ) consistent with the minimum *LRATC* for the industry (b). In the third situation, economies of scale exist for all relevant output levels (c). As we will see later, this type of *LRATC* curve has important implications for how industries are structured.



(a)



(b)



(c)

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of plant sizes would be expected in industries with the *LRATC* depicted by part (a). Some agricultural products and retail lines approximate these conditions.

Part (b) demonstrates the general shape of the *LRATC* that economists believe is present in most industries. Initially, economies of scale exist, but once a minimum efficient scale is reached, wide variation in firm size is possible. Firms smaller than the minimum efficient size would have higher per-unit costs, but firms larger than that would not gain a cost advantage. **Constant returns to scale** are present for a broad range of output rates

**Constant returns to scale**

Unit costs that are constant as the scale of the firm is altered. Neither economies nor diseconomies of scale are present.

(between  $q_1$  and  $q_2$ ), in other words. This situation is consistent with real-world conditions in many industries. For example, small firms can be as efficient as larger ones in the apparel, lumber, and publishing industries, as well as in several retail industries.

In part (c) of Exhibit 9, economies of scale exist for all relevant output levels. The larger the firm size, the lower the per-unit cost. The *LRATC* for local telephone service can approximate the curve shown here.

## 8-8 WHAT FACTORS CAUSE COST CURVES TO SHIFT?

When we drew the general shapes of a firm's cost curves in both the long run and short run, we assumed that certain other factors—resource prices, taxes, regulations, and technology—remained constant as the firm altered its rate of output. Let's now consider how changes in these factors affect the firm's costs.

### 8-8a PRICES OF RESOURCES

If the price of resources used should rise, the firm's cost curves will shift upward, as Exhibit 10 shows. Higher resource prices will increase the cost of producing each alternative output level. For example, what happens to the cost of producing automobiles when the price of steel rises? The cost of producing automobiles also rises. Conversely, lower resource prices will reduce costs and shift the cost curves downward at each level of output.

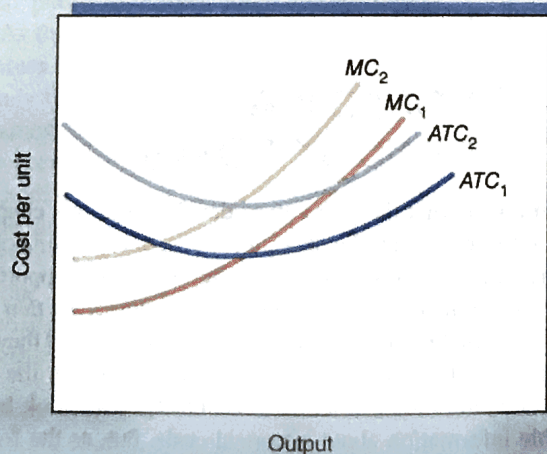
### 8-8b TAXES

Taxes are a component of a firm's cost. Suppose that an excise tax of 20 cents were levied on the seller for each gallon of gasoline sold. What would happen to the seller's costs? They would increase, just as they did in Exhibit 10. The firm's average total and marginal cost curves would shift upward by the amount of the tax. If the tax were an annual business license fee instead, it would raise the average cost, but not the variable cost. Can you explain why?

### 8-8c REGULATIONS

The government often imposes health, safety, environmental, and production regulations on business firms. Federal regulations under the Americans with Disabilities Act compel

## EXHIBIT 10



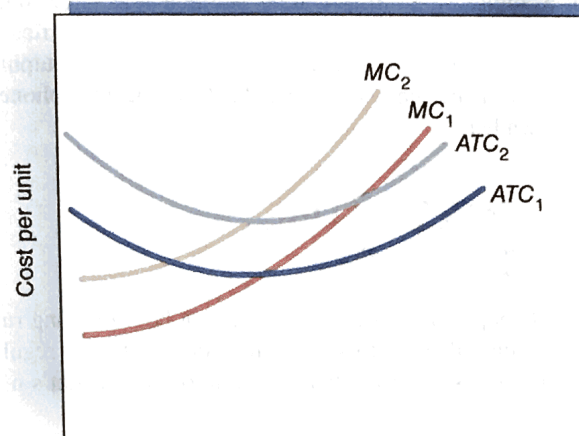
### Higher Resource Prices and Cost

An increase in resource prices will cause the firm's cost curves to shift upward.

## EXHIBIT 11

### Egg Production Costs and Technological Change

Suppose an egg producer discovers (or develops) a “super” mineral water that makes it possible to get more eggs from the same number of chickens. Because of this technological improvement, various output levels of eggs can now be produced with less feed, space, water, and labor. Costs will be reduced. The egg producer’s  $ATC$  and  $MC$  curves will shift downward.



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many firms to make their facilities accessible to people in wheelchairs, and the Patient Protection and Affordable Care Act (PPACA) requires certain firms to provide health benefits to full-time workers. Other regulations force firms to build certain features into their products. Strong bumpers and air bags in automobiles are examples. Although regulations provide benefits, they are also costly. Just processing the paperwork that must be submitted to regulators is costly, and so are the compulsory changes themselves. Like tax increases, increases in regulatory compliance costs will shift cost curves upward. In some cases, only fixed costs will be affected; in other instances, variable costs will be altered as well. In both cases, the firm's  $ATC$  will be higher.

### 8-8d TECHNOLOGY

Improvements in technology often make it possible to produce a specific amount of output with fewer resources. Computers and robotics have lowered costs in many industries. The Internet has made it easy to find and outsource many business-to-business services, ranging from building maintenance and bookkeeping to software development to the purchase of manufacturing components. As Exhibit 11 shows, a technological improvement will shift the firm's cost curves downward, reflecting the lower amount of resources needed to produce different levels of output.

## 8-9 THE ECONOMIC WAY OF THINKING ABOUT COSTS

Think for a moment about what the cost curves developed in this chapter really mean. The firm's short-run  $MC$  curve represents the opportunity cost of expanding output, *given the firm's current plant size*. The firm's long-run  $ATC$  curve represents the opportunity cost per unit of output associated with varying plant sizes and rates of output, *given that the alternative plants are still on the drawing board*. Costs are associated with choices, and they are forward-looking. At the time decisions must be made, neither the short-run  $MC$  nor the long-run  $ATC$  can be determined from accounting records, because accounting costs look backward. Accounting figures yield valuable information about historical costs, but, as the following section illustrates, they must be interpreted carefully when they are used to forecast future costs.

## 8-9a WHAT ARE SUNK COSTS?

**Sunk costs** are the historical costs of past decisions that cannot be reversed. Sunk costs give managers hindsight when it comes to making current decisions, but the specific costs themselves are no longer relevant. When past choices cannot be reversed—no refund is available, for example—money that has been spent is gone for good. Today's choices must be based on the costs and benefits expected under *current and future* market conditions, if mistakes are to be avoided (see the accompanying Myths of Economics feature).

To minimize costs, business decision-makers need to realize that sunk costs are, indeed, *sunk*. A simple example will emphasize this point. Suppose that the firm in Exhibit 5 pays \$100,000 to purchase and install a roller blade-producing machine. The machine is expected to last ten years. The company's books record the cost of the machine as \$10,000 each year under the heading of depreciation. The machine can be used only to make roller blades, though. Because dismantling and reinstallation costs are high, it cannot be leased or sold to another firm. Also, it has no scrap value. In other words, there are no alternative uses for the machine. The machine's annual production of roller blades will generate \$50,000 of revenues for the firm when it is employed with raw materials and other factors of production that cost \$46,000. Thus, the net revenue generated by the machine is \$4,000.

Should the firm continue to use the machine? Its depreciation figures suggest that the machine is costing the firm \$10,000 annually, compared to the \$4,000 net revenue it generates. Put another way, accounting costs indicate that the machine is reducing the firm's profit by \$6,000 annually. The machine's depreciation cost, however, is a sunk cost. It was incurred when the machine was purchased and installed, which is over and done with now. The *current* opportunity cost of the machine is therefore precisely zero. Because using the machine generates \$4,000 of additional net revenue, the firm can gain by continuing with its operation. Of course, if market conditions are not expected to improve, the firm will not

### Sunk costs

Costs that have already been incurred as a result of past decisions. They are sometimes referred to as historical costs.

## MYTHS OF ECONOMICS

### "A Good Business Decision-Maker Will Never Sell a Product for Less Than Its Production Costs."

This statement contains a grain of truth. A profit-seeking entrepreneur will not undertake a project knowing the costs can't be covered. However, the statement fails to emphasize (1) the time dimension of the production process and (2) the uncertainty associated with business decisions. The production process takes time. Raw materials must be purchased, employees hired, and plants equipped. Retailers must contract with suppliers. As these decisions are made, costs result. Many of the firm's costs of production are incurred long before its product is ready for marketing.

Even a good business decision-maker is not always able to predict the future because market conditions can change quickly and unexpectedly. At the time the product is ready for sale, buyers might be unwilling to pay a price that will cover the seller's past costs of production. These past costs, however, are now sunk costs and no longer relevant. Decisions must now be made on the basis of the firm's current costs of delivering value to buyers, and the revenues to be gained by doing so.

Should a grocer refuse to sell oranges that are about to spoil because their wholesale cost cannot be covered? The grocer's current opportunity cost of selling the oranges at this point is nearly zero. The alternative would be to throw them in the garbage next week. Almost any price, even one far below past costs, will be better than letting the oranges spoil.

Consider another example. Suppose a couple that owns a house plans to relocate temporarily. Should they refuse to rent the house they're moving out of for \$500 (if this is the best offer available) because their monthly house payment is \$800? Of course not. The house payment will go on, regardless of whether they rent the house. If the homeowners can cover their opportunity costs (perhaps the expected wear and tear plus a \$60 monthly fee for a property management service), they will gain by renting rather than leaving the house vacant.

Past mistakes provide useful lessons for the future, but they cannot be reversed. Bygones are bygones, even if they resulted in business loss. There is no need to fret over spilt milk, burnt toast, or yesterday's business losses.

purchase a similar machine or replace the machine when it wears out, but this should not influence its decision whether to continue operating the one it already has.

## 8-9b HOW WILL COST INFLUENCE SUPPLY?

Costs underpin the firm's supply decisions. A strictly profit-maximizing firm will compare the expected revenues derived from a decision or a course of action with the expected costs. If the anticipated revenues exceed costs, then the course of action will be chosen because it is expected to expand profits (or reduce losses).

*For short-run supply decisions, the marginal cost of producing additional units is the relevant cost to consider.* To maximize profits, the decision-maker should compare the expected marginal costs with the expected additional revenue from larger sales. If the latter exceeds the former, output (the quantity supplied) should be expanded.

While marginal costs are central in the short run, average total costs are the relevant cost consideration in the long run. Before entering an industry (or purchasing capital assets for expansion or replacement), a profit-maximizing decision-maker will compare the expected market price with the expected long-run average total cost. Profit-seeking potential entrants will supply the product if, and only if, they expect the market price to exceed their long-run average total cost. Similarly, existing firms will continue to supply a product in the long run only if they expect that the market price will enable them at least to cover their long-run average total cost.

## LOOKING AHEAD

This chapter focused on the relationship between output and cost in both the short and long runs. The next three chapters will use these general principles to analyze the price and output decisions of firms under alternative market conditions.

### KEY POINTS

- The business firm is used to organize productive resources and transform them into goods and services. There are three major types of business structure—proprietorships, partnerships, and corporations.
- The principal-agent problem tends to reduce efficiency within the firm. Monitoring and the structure of incentives can be used to minimize inefficiencies arising from this source.
- The demand for a product indicates the intensity of consumers' desires for the item. The (opportunity) cost of producing the item indicates the intensity of consumers' desires for other goods that could have been produced instead, with the same resources.
- In economics, total cost includes not only explicit payments for resources employed by the firm, but also the implicit costs associated with the use of productive resources owned by the firm (like the opportunity cost of the firm's equity capital or owner-provided services) that could be used elsewhere.
- Because accounting methods omit the cost of equity capital (and sometimes other implicit costs), they tend to understate the opportunity cost of producing a good and overstate the firm's economic profit.
- Economic profit (or loss) results when a firm's sales revenues exceed (or are less than) its total costs, both explicit and implicit.
- Firms that are earning the market (or "normal") rate of return on their assets will therefore make zero economic profit.
- The firm's short-run average total cost (*ATC*) curve will tend to be U-shaped.
- The law of diminishing returns explains why a firm's short-run marginal and average total costs will eventually rise. When diminishing marginal returns are present, successively larger amounts of the variable input will be required to increase output by one more unit. As this happens, marginal cost will rise.
- The long-run *ATC* (*LRATC*) reflects the costs of production for plants of various sizes. When economies of scale are present, *LRATC* will decline. When constant returns to scale are experienced, *LRATC* will be constant. When diseconomies of scale are present, *LRATC* will rise.
- Changes in (1) resource prices, (2) taxes, (3) regulations, and (4) technology will cause the cost curves of firms to shift.
- Sunk costs are costs that have already been incurred and cannot be recovered. Sunk costs give managers hindsight when it comes to making current decisions, but the specific costs themselves are no longer directly relevant for current and future decisions.