

## Chapter 9 Study Guide

Previous chapters discussed consumer behavior and product demand. This chapter switches to producer behavior and business firms. It explains how a firm's **costs of production** change as the firm's output changes, in the short run and in the long run.

This chapter begins with definitions of cost and profit. You should be somewhat familiar with these terms because they were first introduced in Chapters 1 and 2. The explanation is now more detailed. Several definitions of cost and profit are given in the chapter, so you must know the distinctions if you are to understand the true meaning of **economic cost** and **economic profit**.

The second and third sections of the chapter focus on **short-run** variable relationships and production costs for the firm. You are first introduced to the important **law of diminishing returns**, which defines the relationship between the quantity of resources used by the firm and the output the firm produces in the short run. The chapter discussion then shifts to costs because resource prices are associated with the fixed and variable resources the typical firm uses to produce its output. The three basic types of short-run costs—total, average, and marginal—vary for the firm as the quantity of resources and output changes. The chapter describes the relationship among the various cost curves and how they are shaped by the law of diminishing returns.

The fourth section of the chapter looks at production costs in the **long run**. All resources, and also production costs, are variable in the long run. You will learn that the long-run cost curve for the typical firm is based on the short-run cost curves for firms of different sizes. In the long run, firms can experience **economies of scale** and **diseconomies of scale** that will shape the long-run cost curve for the firm. The chapter concludes with several practical applications of the concept of scale economies. It is important that you master this material on the costs of production because it sets the foundation for understanding the price and output decisions of a firm operating under different market structures that you will be reading about in the next three chapters.

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### ■ CHECKLIST

When you have studied this chapter you should be able to

- Define economic cost in terms of opportunity cost.
- Distinguish between an explicit cost and an implicit cost.
- Define accounting profit in terms of revenue and costs.
- Describe how normal profit is measured.
- Define economic profit in terms of revenue and costs.
- Distinguish between the short run and the long run in production.

- Define total product, marginal product, and average product.
- State the law of diminishing returns and explain its rationale.
- Compute marginal product and average product to illustrate the law of diminishing returns when you are given the necessary data.
- Describe the relationship between marginal product and average product.
- Define fixed costs, variable costs, and total cost.
- Define average fixed cost, average variable cost, and average total cost.
- Explain how average product is related to average variable cost.
- Define marginal cost.
- Explain how marginal product is related to marginal cost.
- Explain why sunk costs are irrelevant in decision making.
- Compute and graph average fixed cost, average variable cost, average total cost, and marginal cost when given total-cost data.
- Describe the relation of marginal cost to average variable cost and average total cost.
- Explain why short-run cost curves shift.
- Illustrate the difference between short-run average-total-cost curves for a firm at different outputs and its long-run average-total-cost curve.
- Describe various possible long-run average-total-cost curves.
- Define and list reasons for the economies and diseconomies of scale.
- Explain the concept of minimum efficient scale and its relation to industry structure.
- Give examples of short-run costs, economies of scale, and minimum efficient scale in the real world.
- Explain how 3-D printing is likely to affect the costs of mass production and mass sales for businesses (*Last Word*).

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## ■ CHAPTER OUTLINE

1. Resources are scarce and are used to produce many different products. The *economic cost* of using resources to produce a product is an opportunity cost: the value or worth of the resources in their best alternative use.
  - a. Economic costs can be explicit or implicit. *Explicit costs* are the monetary payments that a firm makes to obtain resources from nonowners of the firm. *Implicit costs* are the monetary payments that would have been paid for self-owned or self-employed resources if they had been used in their next best alternative outside the firm. Both types of costs are opportunity costs because the use of the resources for this use means that they are not available for use in the next best alternative use.
  - b. *Accounting profit* is the difference between a firm's total sales revenue and its total explicit costs. *Normal profit* is an implicit cost and is the typical or normal amount of accounting profit that an entrepreneur would have received for working at other firms of this type and supplying entrepreneurial resources.
  - c. *Economic profit* is the revenue a firm receives in excess of all its explicit and implicit economic costs. These economic costs are opportunity costs that

measure the value of the forgone use of the resources. Included in the implicit costs is a normal profit that represents the entrepreneur's forgone income. The firm's accounting profit will be greater than its economic costs because accounting profit is the total of its sales revenue minus its explicit costs.

- d. A distinction is made between the *short run* and the *long run*. The firm's economic costs vary as the firm's output changes. These costs depend on whether the firm is able to make short-run or long-run changes in its resource use. In the short run, the firm's plant is a fixed resource, but in the long run it is a variable resource. So, in the short run the firm cannot change the size of its plant and can vary its output only by changing the quantities of the variable resources it employs.
2. There are **short-run** relationships between inputs and outputs in the production process.
- a. Several product terms need to be defined to show these relationships. **Total product (TP)** is the total quantity of output produced. **Marginal product (MP)** is the change made in total product from a change in a variable resource input. **Average product (AP)**, or productivity, is the total product per unit of resource input.
  - b. The **law of diminishing returns** determines the manner in which the costs of the firm change as it changes its output in the short run. As more units of a variable resource are added to a fixed resource, beyond some point the marginal product from each additional unit of a variable resource will decline.
    1. There are three phases reflected in a graph of the total product and marginal product curves: increasing, decreasing, and negative marginal returns.
    2. When total product is increasing at an increasing rate, marginal product is rising; when total product is increasing at a decreasing rate, marginal product is falling; and when total product declines, marginal product is negative.
    3. When marginal product is greater than average product, average product rises, and when marginal product is less than average product, average product falls.
    4. *Consider This* (Diminishing Returns from Study). The idea of diminishing returns can be explained with a nonbusiness example. Consider total course learning to be a function of study time and other factors such as intelligence and teacher effectiveness. Assume that these other factors are fixed and only study time is allowed to vary. The first hour of additional study time will add to total course learning, and maybe even the second and the third hours, but at some point each additional hour of study time is likely to add less and less to total learning. So it is also with a business. If most factors of

production are fixed and only labor resources are allowed to vary, at some point there will be diminishing returns to adding another worker to the fixed set of other resources.

3. When input, output, and price information are available, it is possible to calculate **short-run production costs**.
  - a. The **total cost (TC)** is the sum of the firm's fixed costs and variable costs. As output increases,
    1. **fixed costs** do not change;
    2. at first, the **variable costs** increase at a decreasing rate, and then increase at an increasing rate; and
    3. at first total costs increase at a decreasing rate and then increase at an increasing rate.
  - b. **Average costs** consist of **average fixed costs (AFC)**, **average variable costs (AVC)**, and **average total costs (ATC)**. They are equal, respectively, to the firm's fixed, variable, and total costs divided by its output. As output increases,
    1. average fixed cost decreases ;
    2. at first, average variable cost decreases and then increases; and
    3. at first, average total cost also decreases and then increases.
  - c. **Marginal cost (MC)** is the extra cost incurred in producing one additional unit of output.
    1. Because the marginal product of the variable resource increases and then decreases (as more of the variable resource is employed to increase output), marginal cost decreases and then increases as output increases.
    2. At the output at which average variable cost is a minimum, average variable cost and marginal cost are equal, and at the output at which average total cost is a minimum, average total cost and marginal cost are equal.
    3. On a graph, marginal cost will always intersect average variable cost at its minimum point and marginal cost will always intersect average total cost at its minimum point. These intersections will always have marginal cost approaching average variable cost and average total cost from below.
  - d. Changes in either resource prices or technology will cause the cost curves to shift.
  - e. **Consider This (Ignore Sunk Costs)**. Sunk costs are irrelevant to economic decision making because they are already incurred and cannot be recovered. Sunk costs are the result of making a past decision and it is a fallacy to include them as part of a current decision. A current decision is made on the basis of evaluating the marginal cost and marginal benefit of a project, and

not what was spent on the project in the past. If the marginal cost is less than the marginal benefit, the current action should be taken.

4. In the long run, all the resources employed by the firm are variable resources. **Long-run production costs** are all variable costs.
  - a. As the firm expands its output by increasing the size of its plant, average total cost tends to fall at first because of the *economies of scale*, but as this expansion continues, sooner or later, average total cost begins to rise because of the *diseconomies of scale*.
  - b. The long-run average-total-cost curve shows the least average total cost at which any output can be produced after the firm has had time to make all changes in its plant size. Graphically, it is made up of all the points of tangency of the unlimited number of short-run average-total-cost curves.
  - c. The economies and diseconomies of scale encountered in the production of different goods are important factors influencing the structure and competitiveness of various industries.
    1. *Economies of scale* (a decline in long-run average total costs) arise because of labor specialization, managerial specialization, efficient capital, and other factors such as spreading the start-up, advertising, or development costs over an increasing level of output.
    2. *Diseconomies of scale* arise primarily from the problems of efficiently managing and coordinating the firm's operations as it becomes a large-scale producer.
    3. *Constant returns to scale* are the range of output where long-run average total cost does not change.
  - d. Economies and diseconomies of scale can determine the structure in an industry. *Minimum efficient scale (MES)* is the smallest level of output at which a firm can minimize long-run average costs. This concept explains why relatively large and small firms could coexist in an industry and be viable when there is an extended range of constant returns to scale.
    1. In some industries the long-run average-cost curve will decline over a range of output. Given consumer demand, efficient production will be achieved only with a small number of large firms.
    2. If economies of scale extend beyond the market size, the conditions for a *natural monopoly* are produced, which is a rare situation where unit costs are minimized by having a single firm produce a product.
    3. If there are few economies of scale, then there is minimum efficient size at a low level of output and there are many firms in an industry.
5. There are several applications and illustrations of shortrun costs, economies of scale, and minimum efficient cost.

- a. A rise in the price of gasoline raises short-run cost curves (AVC, MC, ATC) for businesses that use gasoline as an input for trucks and vehicles used to produce a product.
  - b. Economies of scale can be seen in successful start-up firms such as Intel, Microsoft, or Starbucks.
  - c. Economies of scale are also exhibited in the Verson stamping machine that makes millions of auto parts per year.
  - d. As the number of newspaper readers has fallen due to the shift of readership to the Internet, the average fixed cost of producing a newspaper has risen. In response, some newspapers have raised their prices, thus further reducing the number of readers. This situation creates a back (few readers) and forth (rising newspaper prices) problem that has the potential to bankrupt many newspapers.
  - e. Economies of scale are extensive in aircraft production, but modest in concrete mixing, which achieves minimum efficient scale at a low level of output. As a consequence, there are few aircraft factories and many concrete mixing companies.
6. *Last Word* (3-D Printers). 3-D printing is likely to change production by replacing mass production and mass sales with mass customization. Since the Industrial Revolution, mass production has required high fixed costs to build factories to produce the product. Mass sales also have high costs in the form of large distribution networks, big advertising budgets, and the expense of transporting products. 3-D printing may revolutionize production again by giving businesses the possibility of manufacturing whatever product they want and in whatever quantity they need, thus eliminating the high fixed costs associated with mass production and the other costs associated with mass sales and transportation.
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## ■ HINTS AND TIPS

1. Many **cost** terms and **profit** terms are described in this chapter. Make yourself a glossary so that you can distinguish among them. You need to know what each one means if you are to master the material in the chapter. If you try to learn them in the order in which you encounter them, you will have little difficulty because the later terms build on the earlier ones.
2. Make sure you know the difference between **marginal** and **average** relationships in this chapter. Marginal product (MP) shows the *change* in total output associated with each additional input. Average product (AP) is simply the output per unit of resource input. Marginal cost (MC) shows the change in total cost associated with

producing another unit of output. Average cost shows the per-unit cost of producing a level of output.

3. Practice drawing the different sets of **cost curves** used in this chapter: (1) short-run total-cost curves, (2) short-run average- and marginal-cost curves, and (3) long-run cost curves. Also, explain to yourself the relationship between the curves in each set that you draw.
  
4. In addition to learning *how* the costs of the firm vary as its output varies, be sure to understand *why* the costs vary the way they do. In this connection note that the behavior of short-run costs is the result of the law of diminishing returns and that the behavior of long-run costs is the consequence of economies and diseconomies of scale.

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## ■ IMPORTANT TERMS

**economic cost**

**explicit costs**

**implicit costs**

**accounting profit**

**normal profit**

**economic profit**

**short run**

**long run**

**total product (TP)**

**marginal product (MP)**

**average product (AP)**

**law of diminishing returns**

**total cost (TC)**

**fixed costs**

**variable costs**

**average fixed cost (AFC)**

**average variable cost (AVC)**

**average total cost (ATC)**

**marginal cost (MC)**

**economies of scale**

**diseconomies of scale**

**constant returns to scale**

**minimum efficient scale (MES)**

**natural monopoly**