CHAPTER 7

PRODUCTION COSTS

Microeconomics in Context (Goodwin, et al.), 1st Edition (Study Guide 2008)

Chapter Overview

Chapter 7 begins a two-chapter sequence describing the activity of production. The chapter begins by exploring the nature of different kinds of production costs. A numerical and graphical example is presented concerning how production levels, and production costs, change as the use of a variable input is increased. The concept of "marginal cost" will be introduced. You will learn about total product curves, total cost curves, marginal cost curves and the long-run average cost curve. If your instructor chooses to use the Appendix to this chapter, you will also learn how to graph and interpret average variable and average total cost curves.

Objectives

After reading and reviewing this chapter, you should be able to:

1. Understand the economist's notion of production.
2. Define the difference between economic and accounting costs.
3. Distinguish between internal and external costs.
4. Understand an economic production function.
5. Describe the relationship between patterns of returns and patterns of (total and marginal) production costs.
7. Discuss economies of scale.

Key Terms

inputs
outputs
waste products
intermediate goods
final goods
accounting costs
economic costs
internal costs
external costs
technical efficiency
social costs of production
false economies
production function
fixed input
variable input
short run
capacity constraint
limiting factor
long run
positive (direct) relationship
ceteris paribus
negative (inverse) relationship
marginal return
diminishing (marginal) returns
total product curve
constant (marginal) returns
increasing (marginal) returns
fixed cost
variable cost
total cost
marginal cost
increasing (marginal) costs
total cost curve
constant (marginal) costs

decreasing (marginal) costs
long run average cost
constant returns to scale
minimum efficient scale
input substitution
average (total) cost
economies of scale
diseconomies of scale
maximum efficient scale

Active Review

Fill in the Blank

1. Project costs that are borne by persons or entities not directly involved in the project activity are known as _____ costs.

2. Annika opens a riding stable. She factors in the cost of buying horses, buying riding tackle, renting space, and the opportunity cost of her time. She does not consider the effect of the noises and smells from her stable on a nearby, upscale outdoor restaurant. Annika is considering only the _____ costs of her project.

3. Ten processes exist to produce widgets. Of these, Process RXQ can make 100 widgets with less electricity and the same amount of other inputs as the other nine processes. Process RXQ is said to be _____.

4. An equation or graph that shows the relationship between types or quantities of inputs and quantity of the output is known as a(n) _____.

5. To isolate the effect of one variable on another, we endeavor to study the relationship _____, or "with all else constant."

6. When we consider a time scale long enough to allow fixed inputs to become variable, it becomes relevant to consider the long run _____ cost of production.

7. Applying fertilizer to a crop of beans is associated with diminishing marginal returns. From this fact, we can deduce that applying fertilizer to beans has _____ marginal costs.

8. When a company's long-run average cost increases with increasing output, that company is experiencing _____ of scale.

9. A lawn service decides to get rid of its leaf blowing machines and increase its number of workers, who will gather and move leaves using regular, nonautomated rakes. This decision is an example of input _____.

True or False

10. The harmful effects of the pesticide DDT on human health can be considered an external cost.

11. Cake baking process A uses one hour of the cook's time and half an hour of the assistant's time. Process B takes one hour of the assistant's time and half an hour of the cook's time. Thus, process A is technically efficient compared to process B.

12. The social costs of production include opportunity costs as well as external costs.

13. A process exhibits economies of scale when long-run average cost increases with increasing output capacity.

14. A paper mill pollutes a local river by discharging waste containing chlorine and other toxic chemicals. The cost of treating diseases that result from this pollution would be considered an internal cost of production.

15. A company signs a contract for five years, under which it will pay the same amount every month for property insurance. This cost, which is independent of the level of production in any given month, is referred to as a variable cost.

16. In the long run, all inputs are variable.

Short Answer

17. Suggest a situation in which the economic costs of a project would be lower than the accounting costs.

    _____
    _____
    _____
    _____

18. Which is a better guide in making decisions about what projects to undertake: accounting cost or economic cost?

    _____
    _____
    _____

19. The relationship between hours spent studying (input) and knowledge of economics (output) is positive. However, once you have done 20 hours of studying, an additional hour does not add as much to your knowledge as the first hour did. When you graph the relationship between studying and knowledge, is the resulting line straight or curved? Why?

20. Explain the difference between fixed and variable costs.

Problems

1. As Augusta's Hair Salon increases its staff from 1 to 15 hairdressers, it experiences increasing marginal returns, because the hairdressers work faster and better when they are in a larger group. Illustrate this situation on a total product curve graph.

2. A shoe factory has 500 employees and produces a thousand pairs of shoes per hour.

   a. What is the shoe factory's productivity per worker per hour? _____

   b. The factory hires one new worker. Now, the factory produces 1,002 shoes per hour. Then the factory hires one more worker. Production rises to 1,004 per hour. Does the factory have diminishing, constant, or increasing marginal returns at this level of production?

   c. Graph the production function (total product curve) of the shoe factory at these levels of production, carefully labeling all lines and points.

3. Production at Julia's call center shows the following relationship between the number of workers and the number of phone calls handled (per day).

Quantity of Variable Input: Labor	Quantity of Output: Calls	Marginal Return to Additional Labor	Fixed Cost ($)	Variable Cost ($)	Total Cost ($)
0	0	--			
1	100				
2	180				
3	240				

a. Calculate the marginal return gained from the addition of each worker, filling in the column in the table.

b. Suppose Julie has entered a long term lease for an office space and telephones, and this is her only fixed cost. The lease costs her $50 (per day). Fill in the Fixed Cost column in the table.

c. Julia pays each worker she hires $80 per day, and this is her only variable cost. Fill in the Variable Cost column in the table.

d. Fill in the column for the Total Cost corresponding to each level of production.

4. Producing umbrellas requires inputs of fabric, metal, and labor. Umbra's Umbrella Factory experiences increasing returns to inputs of labor up to a certain point, and constant returns for all levels of production thereafter. There is no range of diminishing returns at Umbra's Umbrella Factory.

   a. What is the shape of the production function for Umbra's Umbrella Factory? Sketch (and fully label) it below.

b. Sketch the total cost curve for Umbra's Umbrella Factory.

c. Sketch the marginal cost curve for Umbra's Umbrella Factory.

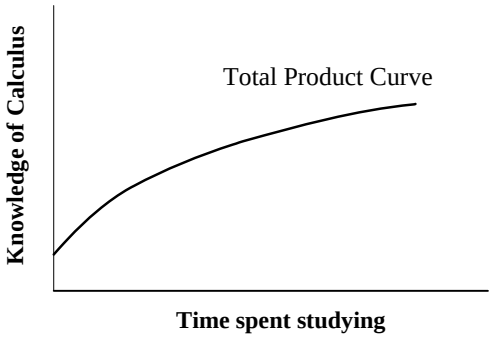
5. Coretta can build three chairs in her first week of work. In the second week, she starts to get tired and has to take time out to clean the workshop, so she can only make two additional chairs. In the third week, she settles into a pattern of one additional chair per week, which she can maintain for a fourth, fifth, and sixth week. In the seventh week, she's exhausted and can only finish half an additional chair.

a. Make a table showing the number of weeks worked and the marginal and total number of chairs produced.

b. Sketch Coretta's total product curve for chairs, where the variable input is the time she spends, and the output is the total number of chairs produced.

Self Test

For question # 1, refer to the graph shown below:



1. You are taking a calculus course. The graph above shows the relationship between time spent studying calculus (input) and knowledge of calculus (output). Based on the graph, you can see that

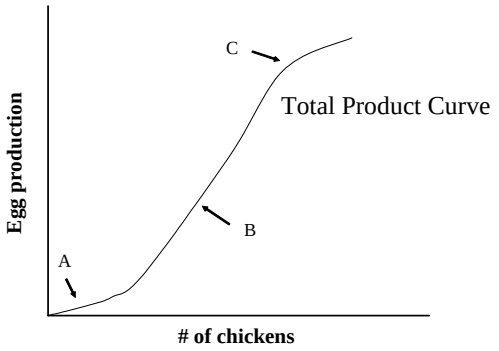
    a. Studying calculus is characterized by increasing marginal returns.
    b. Studying calculus is characterized by diminishing marginal returns.
    c. Studying calculus is characterized by constant marginal returns.
    d. Studying calculus has a synergistic effect on calculus knowledge.
    e. The slope of the studying production curve is constant.

2. A hat maker cuts hats out of felt, then sells the left-over felt scraps to a pillow maker, who shreds the scraps and uses them to stuff pillows. The felt scraps are

    a. final goods

b. intermediate goods
c. principal
d. internal costs
e. external costs

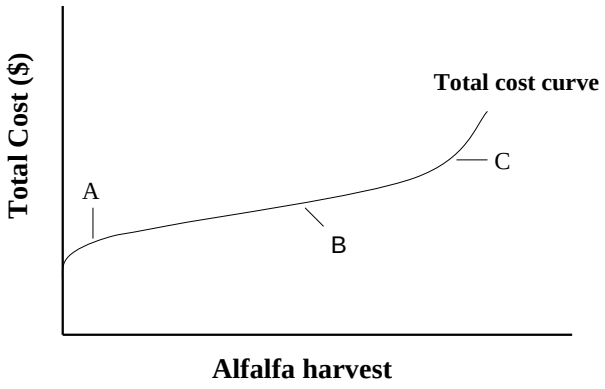
For question #3, refer to the graph shown below:



3. Babette's Barn produces eggs. The production function for Babette's Barn is shown above. Based on the graph (not on your knowledge of chicken biology), which of the following statements is likely to be *false*?

    a. In region A, there's lots of space in the barn and the chickens are lonely. In this region, adding one additional chicken makes all the chickens happier and more likely to lay eggs.
    b. In region B, the barn is overcrowded and each additional chicken increases stress, decreasing the number of eggs laid per chicken.
    c. In region C, the barn is overcrowded and each additional chicken increases stress, decreasing the number of eggs laid per chicken.
    d. Throughout the range of production shown here, the number of chickens has a positive relationship to egg production.
    e. Throughout the range of production shown here, the number of chickens has a direct relationship to egg production.

For question # 4, refer to the graph shown below:



4. The graph above shows the total cost curve for the alfalfa harvest on Alf's Alfalfa Farm. Based on this graph, which of the following statements about Alf's Alfalfa Farm must be *false*?

   a. In region A, marginal costs are increasing.
   b. In region B, marginal costs are constant.
   c. Total costs increase as production rises.
   d. The marginal cost curve is flat in region B.
   e. In region A, the production function is characterized by increasing marginal returns.

5. Jim decides to start a business manufacturing toothpaste. Which of the following would be included in the *accounting* costs of the undertaking?

   a. $100,000 of Jim's own money that he invests to start up the business.
   b. Interest Jim could have made if he put the $100,000 into a savings account instead.
   c. Money Jim could make if he got a job at a local shampoo factory instead.
   d. Costs of toothpaste ingredients Jim needs to purchase each week.
   e. Both a and d are true.

6. Albert is interested in opening a bicycle repair shop, but to do so will require getting information about other bike shops in the city, getting a permit to open a new business, and interviewing applicants for the positions of shop manager and accounts manager. All of these factors, which will slow down the process considerably, are

   a. extra costs
   b. external costs
   c. equity costs
   d. accounting costs
   e. transaction costs

7. Which of the following is an example of external costs?

   a. Mark purchases 10 books and pays 10% tax on the entire purchase.
   b. Aurelio sells an acre of land but has to pay to have the land surveyed before the sale is completed.
   c. Marty opens a chocolate factory and offers free samples to neighborhood children every Friday.
   d. Gustave buys a new piece of equipment for his factory.
   e. Georgette operates a noisy machine every morning, and scares away the birds from the local wildlife refuge.

8. A manager decides to site a new factory next to an elementary school. According to his cost analysis, this location will minimize operation costs and maximize overall

production efficiency. However, he does not take into account the large external costs associated with polluting the air near an elementary school. If these costs were taken into account, it would be clear that building the factory is economically inefficient. The manager's decision is an example of

a. a false economy
b. economic efficiency
c. internalizing costs
d. transaction costs
e. productive efficiency

9. You have signed a two-year lease on a building in which you are planning to open a day care center. You have no choice about how much money you spend on rent for the next two years, because you are already committed to this agreement. This is an example of

a. a variable input
b. a short run input
c. a long run input
d. a fixed input
e. a false economy

10. Suppose that adding fertilizer always increases corn growth. The relationship between fertilizer application and corn growth would be

a. positive
b. direct
c. fixed
d. technically efficient
e. both a and b are true.

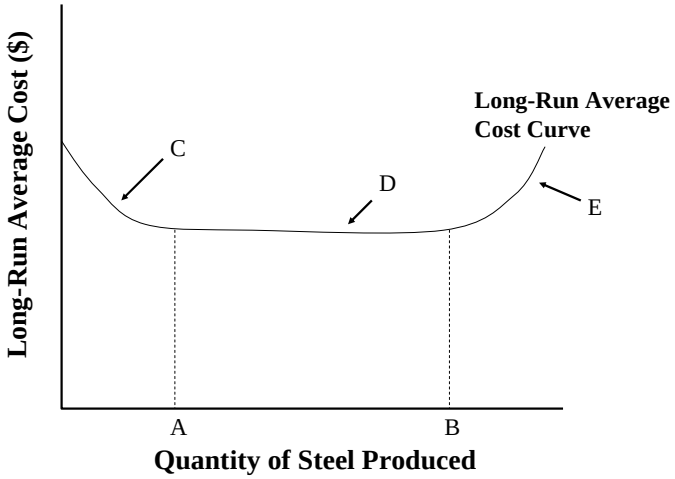
11. Charlie initially leased a one-room space and started a small day care center with only 4 children and one staff member. But he found that the costs per child were very high. When he leased a larger space, and expanded the center to have more children and staff, the cost per child fell. Which of the following factors came into play when Charlie expanded the center?

a. economies of scale
b. diseconomies of scale
c. increasing returns to the labor inputs
d. decreasing returns to the labor inputs
e. input substitution

12. Which of the following statements is true?

a. Long-run average cost is calculated by multiplying marginal cost by the unit of time in question.
b. In computing marginal cost, we can ignore fixed costs.
c. Constant returns to scale result from increasing marginal returns to production.
d. Diseconomies of scale occur when long-run average cost declines with rising output.
e. Increasing factory size always leads to decreasing marginal costs.

Questions 13 to 16 refer to the following graph.



13. The graph above shows the long-run average cost curve for a steel foundry. On this graph, point A is

a. The minimum efficient scale.
b. The maximum efficient scale.
c. The point where economies of scale begin.
d. The point where diseconomies of scale begin.
e. The optimal level of output.

14. The region marked D is characterized by

a. Economies of scale.
b. Increasing returns to scale.
c. Constant returns to scale.
d. Diseconomies of scale.
e. Maximum average long-run cost.

15. Which of the following statements is true regarding the graph?

a. Returns to scale are constant throughout.
b. As production increases, the the amount used of all inputs--including the quantity of labor and the size of the factory--increases.

c. In region E, there isn't enough space for all the workers required to produce at this level and they are getting in one another's way.
d. The minimum efficient scale is at a production level of zero.
e. The maximum efficient scale is marked by point A.

16. Which of the points or regions on this graph is associated with diseconomies of scale?

a. A
b. B
c. C
d. D
e. E

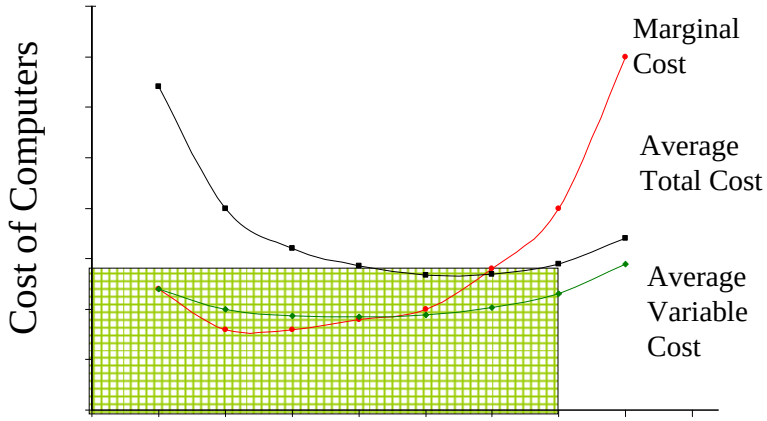
17. A self-employed accountant spends a lot of money identifying clients and advertising her services. These activities are an example of:

a. external costs
b. transaction costs
c. fixed inputs
d. marginal returns
e. opportunity costs

18. In economics, the "long run" is a time period in which

a. All inputs are variable.
b. All inputs are paid for.
c. All outputs are determined.
d. All loans are repaid.
e. All interest is paid.

Note: Questions #19 and #20 draw on material contained in the Appendix to Chapter 7.
For Questions #19 and #20, refer to graph below:



19. The shaded area in the graph shown above represents

a. The total cost of producing computers.
b. The marginal cost of producing computers.
c. The average cost of producing computers.
d. The total number of computers produced.
e. The variable costs of production.

20. The marginal cost curve represents

a. Variable costs plus fixed costs.
b. Fixed costs only.
c. The cost of producing the last unit at a given level of production.
d. Per-unit total costs.
e. Average costs at the margin.

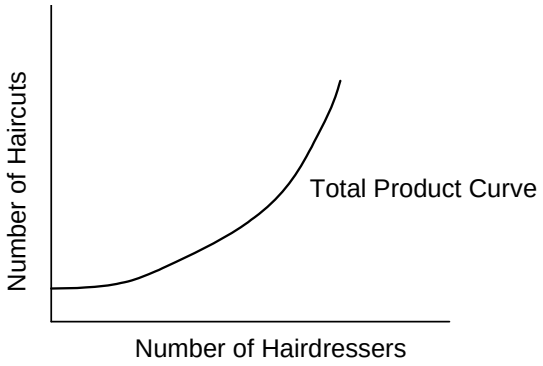
Answers to Active Review Questions

1. external
2. internal
3. technically efficient
4. production function or total product curve
5. ceteris paribus
6. average
7. increasing
8. diseconomies
9. substitution
10. True.
11. False. For technical efficiency, we need to be able to say that one process requires *less* than some inputs and *no more* of others.
12. True.
13. False. Economies of scale are present when long-run average cost *declines* with increasing output capacity.
14. False.
15. False. This is a fixed cost.
16. True.
17. A project that hires people who would otherwise be unemployed, and pays them the legal minimum wage or union negotiated wage, has economic costs below the accounting costs because it is bringing otherwise unused resources into valuable activity.
18. Economic cost is a better guide, because it takes into account the real value of whatever is given up in order to undertake the project.
19. The resulting line is curved, because marginal returns diminish with increasing time spent studying.

20. Fixed cost is the cost associated with using fixed inputs, which is the same no matter what quantity of output is produced. For example, if you have signed a lease on a factory building, you have to pay the same amount each month regardless of what you produce. A variable cost is the cost of using variable inputs (e.g. raw materials, energy, labor), which rise with quantity of output.

Answers to Problems

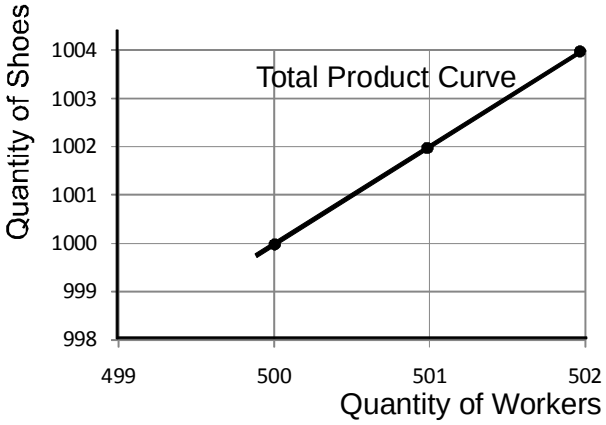
1.



2. a. 2

2. b. constant

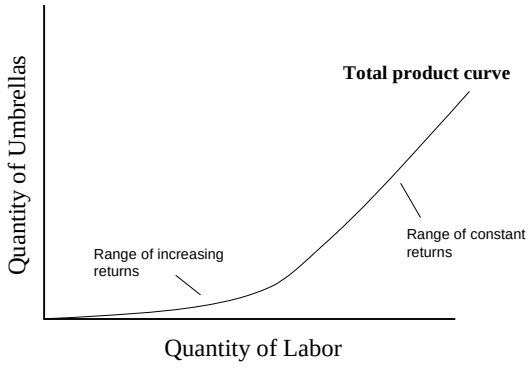
2. c.



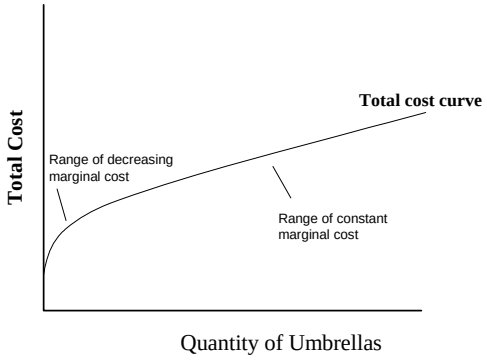
3. The completed table is:

Quantity of Variable Input: Labor	Quantity of Output: Calls	a. Marginal Return to Additional Labor	b. Fixed Cost ($)	c. Variable Cost ($)	d. Total Cost ($)
0	0	--	$50	0	$50
1	100	100	$50	$80	$130
2	180	80	$50	$160	$210
3	240	60	$50	$240	$290

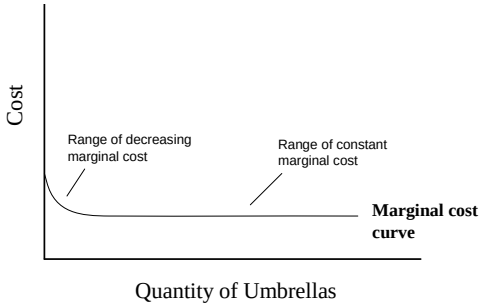
4. a.



4. b.



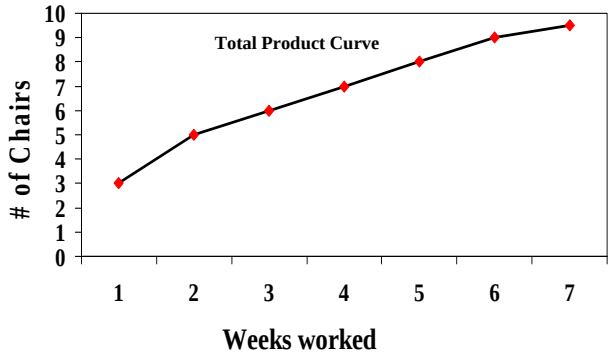
4. c.



5. a.

Number of Weeks worked	Marginal return to additional week of work (number of chairs)	Total Quantity of Chairs Produced
1	3	3
2	2	5
3	1	6
4	1	7
5	1	8
6	1	9
7	½	9 1/2

5.b.



Answers to Self Test Questions

1. b
2. b
3. b
4. a
5. e
6. e
7. e
8. a
9. d
10. e
11. a
12. b
13. a
14. c
15. b
16. e
17. b
18. a.
19. a.
20. c.