

least one input is fixed. We can use Figure 10A-6 to show that as the firm expands in the short run, its costs will be higher than in the long run. For example, suppose that the firm is currently at point *B*, using 15 machines and 60 workers to produce 75 bookcases per day. The firm wants to expand its output to 100 bookcases per day, but in the short run, it is unable to increase the quantity of machines it uses. Therefore, to expand output, it must hire more workers. The figure shows that in the short run, to produce 100 bookcases per day using 15 machines, the lowest costs it can attain are at point *D*, where it employs 110 workers. With a rental price of machines of \$100 per day and a wage rate of \$25 per day, in the short run, the firm will have total costs of \$4,250 to produce 100 bookcases per day. In the long run, though, the firm can increase the number of machines it uses from 15 to 20 and reduce the number of workers from 110 to 80. This change allows it to move from point *D* to point *C* on its expansion path and to lower its total costs of producing 100 bookcases per day from \$4,250 to \$4,000. The firm's minimum total costs of production are lower in the long run than in the short run.

## Key Terms

Expansion path, 363


Isocost line, 356

Isoquant, 355

Marginal rate of technical substitution (*MRTS*), 356

### 10A Using isoquants and isocosts to understand production and cost, pages 355–364

LEARNING OBJECTIVE: Use isoquants and isocost lines to understand production and cost.

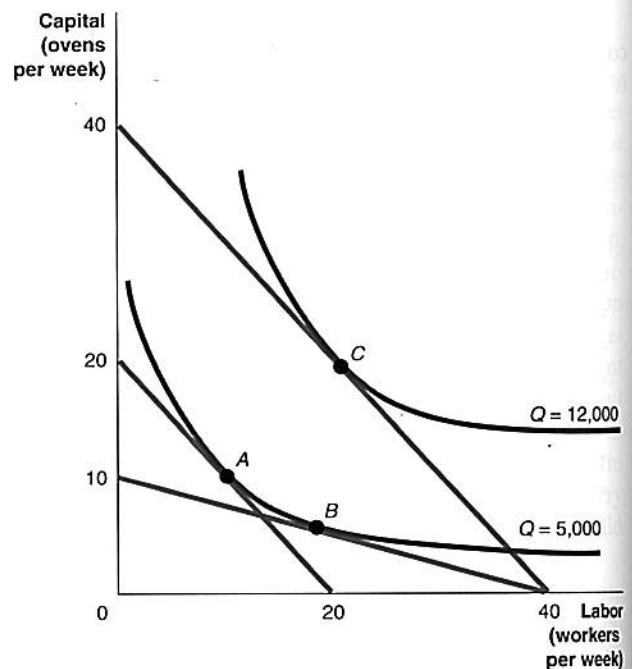
 Visit [www.myeconlab.com](http://www.myeconlab.com) to complete these exercises online and get instant feedback.

## Review Questions

- 10A.1 What is an isoquant? What is the slope of an isoquant?
- 10A.2 What is an isocost line? What is the slope of an isocost line?
- 10A.3 How do firms choose the optimal combination of inputs?

## Problems and Applications

- 10A.4 Draw an isoquant–isocost line graph to illustrate the following situation: Jill Johnson can rent pizza ovens for \$400 per week and hire workers for \$200 per week. She is currently using 5 ovens and 10 workers to produce 20,000 pizzas per week and has total costs of \$4,000. Make sure to label your graph showing the cost-minimizing input combination and the maximum quantity of labor and capital she can use with total costs of \$4,000.
- 10A.5 Use the following graph to answer the questions.
  - a. If the wage rate and the rental price of machines are both \$100 and total cost is \$2,000, is the cost-minimizing point *A*, *B*, or *C*? Briefly explain.
  - b. If the wage rate is \$25, the rental price of machines is \$100, and total cost is \$1,000, is the cost-minimizing point *A*, *B*, or *C*? Briefly explain.
  - c. If the wage rate and the rental price of machines are both \$100 and total cost is \$4,000, is the cost-minimizing point *A*, *B*, or *C*? Briefly explain.



- 10A.6 (Related to *Solved Problem 10A-1* on page 361) Consider the information in the following table for Jill Johnson's restaurant.

Marginal product of capital	4,000
Marginal product of labor	100
Wage rate	\$10
Rental price of pizza ovens	\$500

Briefly explain whether Jill is minimizing costs. If she is not minimizing costs, explain whether she should rent more ovens and hire fewer workers or rent fewer ovens and hire more workers.

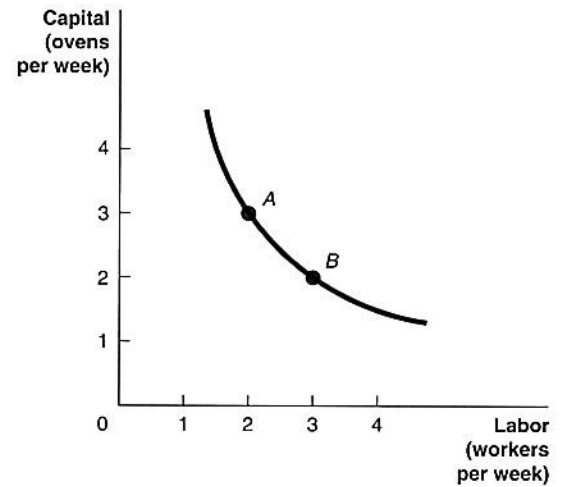
- 10A.7 (Related to *Solved Problem 10A-1* on page 361) Draw an isoquant–isocost line graph to illustrate the following situation: Jill Johnson can rent pizza ovens for \$200 per week and hire workers for \$100 per week. Currently, she is using 5 ovens and 10 workers to produce 20,000 pizzas per week and has total costs of \$2,000. Jill's marginal rate of technical substitution (*MRTS*) equals  $-1$ . Explain why this means that she's not minimizing costs and what she could do to minimize costs.

- 10A.8 (Related to the *Making the Connection* on page 359) During the eighteenth century, the American colonies had much more land per farmer than did Europe, with the result that the price of labor in the colonies was much higher relative to the price of land than was true in Europe. Assume that Europe and the colonies had access to the same technology for producing food. Use an isoquant–isocost line graph to illustrate why the combination of land and labor used in producing food in the colonies would have been different than the combination used to produce food in Europe.

- 10A.9 Draw an isoquant–isocost line graph to illustrate the following situation and the change that occurs: Jill Johnson can rent pizza ovens for \$2,000 per week and hire workers for \$1,000 per week. Currently, she is using 5 ovens and 10 workers to produce 20,000 pizzas per week and has total costs of \$20,000. Then Jill reorganizes the way things are done in her business and achieves positive technological change.

- 10A.10 Use the following graph to answer the following questions about Jill Johnson's isoquant curve.

- Which combination of inputs yields more output: combination A (3 ovens and 2 workers) or combination B (2 ovens and 3 workers)?
- What will determine whether Jill selects A, B, or some other point along this isoquant curve?
- Is the marginal rate of technical substitution (*MRTS*) greater at point A or point B?



- 10A.11 Draw an isoquant–isocost line graph to illustrate the following situation: Jill Johnson can rent pizza ovens for \$2,000 per week and hire workers for \$1,000 per week. She can minimize the cost of producing 20,000 pizzas per week by using 5 ovens and 10 workers, at a total cost of \$20,000. She can minimize the cost of producing 45,000 pizzas per week by using 10 ovens and 20 workers, at a total cost of \$40,000. And she can minimize the cost of producing 60,000 pizzas per week by using 15 ovens and 30 workers, at a total cost of \$60,000. Now draw Jill's long-run average cost curve and discuss its economies and diseconomies of scale.

- 10A.12 In Brazil, a grove of oranges is picked using 20 workers, ladders, and baskets. In Florida, a grove of oranges is picked using 1 worker and a machine that shakes the oranges off the trees and scoops up the fallen oranges. Using an isoquant–isocost line graph, illustrate why these two different methods are used to pick the same number of oranges per day in these two locations.

- 10A.13 Jill Johnson is minimizing the costs of producing pizzas. The rental price of one of her ovens is \$2,000 per week, and the wage rate is \$600 per week. The marginal product of capital in her business is 12,000 pizzas. What must be the marginal product of her workers?

- 10A.14 (Related to the *Making the Connection* on page 362) If Massey and Thaler are correct, should the team that has the first pick in the draft keep the pick or trade it to another team for a lower pick? Explain.