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Long-Run Costs and Output Decisions

9

CHAPTER OUTLINE

Short-Run Conditions and Long-Run Directions

Maximizing Profits
 Minimizing Losses
 The Short-Run Industry Supply Curve
 Long-Run Directions: A Review

Long-Run Costs: Economies and Diseconomies of Scale

Increasing Returns to Scale
 Constant Returns to Scale
 Decreasing Returns to Scale
 U-Shaped Long-Run Average Costs

Long-Run Adjustments to Short-Run Conditions

Short-Run Profits: Moves In and Out of Equilibrium
 The Long-Run Adjustment Mechanism: Investment Flows
 Toward Profit Opportunities

Output Markets: A Final Word

Appendix: External Economies and Diseconomies and the Long-Run Industry Supply Curve

We begin our discussion of the long run by looking at firms in three short-run circumstances:

- (1) Firms that earn economic profits.
- (2) Firms that suffer economic losses but continue to operate to reduce or minimize those losses.
- (3) Firms that decide to shut down and bear losses just equal to fixed costs.

Short-Run Conditions and Long-Run Directions

breaking even The situation in which a firm is earning exactly a normal rate of return.

Maximizing Profits

Example: The Blue Velvet Car Wash

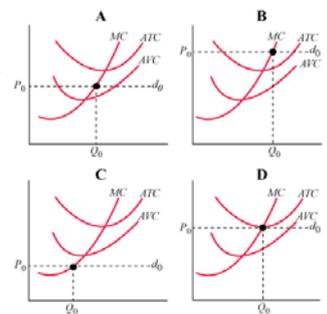
TABLE 9.1 Blue Velvet Car Wash Weekly Costs

TFC	TVC	TC	TR
Total Fixed Cost	Total Variable Cost (800 Washes)	Total Cost (800 Washes)	Total Revenue (P = \$5)
		$TC = TFC + TVC$	
1. Normal return to investors	1. Labor 2. Soap	\$1,000 600	$TR = \$5 \times 800$ = \$4,000
2. Other fixed costs (maintenance contract)		\$1,600	Profit = TR - TC = \$400
	1,000		
	\$2,000		



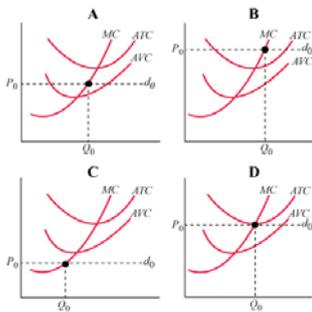
Refer to the figure. Given the market price and cost conditions described in the graphs, which of the four firms earns a normal rate of return?

- a. A
- b. B
- c. C
- d. D
- e. All of the firms above earn a normal rate of return because they produce the level of output for which $MR = MC$.

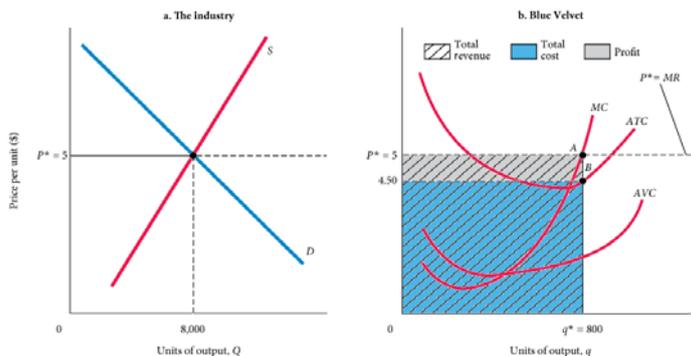


Refer to the figure. Given the market price and cost conditions described in the graphs, which of the four firms earns a normal rate of return?

- A
- B
- C
- D**
- All of the firms above earn a normal rate of return because they produce the level of output for which $MR = MC$.



Graphic Presentation

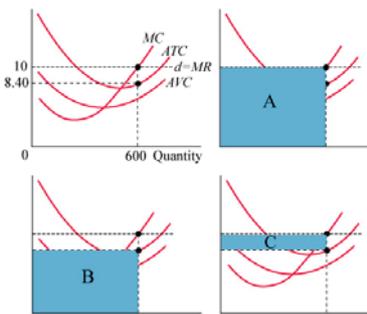


▼ FIGURE 9.1 Firm Earning a Positive Profit in the Short Run
 A profit-maximizing perfectly competitive firm will produce up to the point where $P^* = MC$. Profit is the difference between total revenue and total cost. At $q^* = 800$, total revenue is $\$5 \times 800 = \$4,000$, total cost is $\$4.50 \times 800 = \$3,600$, and profit = $\$4,000 - \$3,600 = \$400$. Because average total cost is derived by dividing total cost by q , we can get back to total cost by multiplying average total cost by q . $ATC = \frac{TC}{q}$ and so $TC = ATC \times q$.



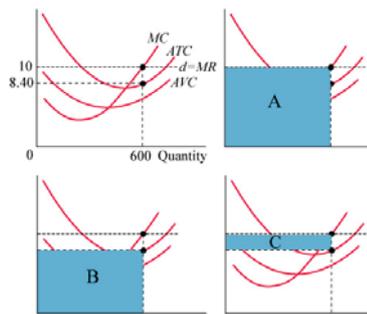
Use the graph in the upper-left corner as a reference. When the firm produces 600 units of output, which area, A, B, or C, corresponds to the firm's profit?

- A
- B
- C
- None of above. Profit is not an area but a distance.



Use the graph in the upper-left corner as a reference. When the firm produces 600 units of output, which area, A, B, or C, corresponds to the firm's profit?

- A
- B
- C**
- None of above. Profit is not an area but a distance.



Minimizing Losses

- If total revenue exceeds total variable cost, the excess revenue can be used to offset fixed costs and reduce losses, and it will pay the firm to keep operating.
- If total revenue is smaller than total variable cost, the firm that operates will suffer losses in excess of fixed costs. In this case, the firm can minimize its losses by shutting down.



Whether or not a firm decides to produce or shut down in the short run depends solely on whether revenues from operating are sufficient to cover:

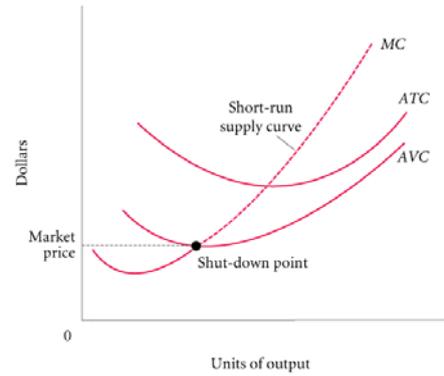
- Fixed costs.
- Variable costs.
- Total costs.
- Normal profit.

Producing at a Loss to Offset Fixed Costs

shutdown point The lowest point on the average variable cost curve. When price falls below the minimum point on AVC , total revenue is insufficient to cover variable costs and the firm will shut down and bear losses equal to fixed costs.

Whether or not a firm decides to produce or shut down in the short run depends solely on whether revenues from operating are sufficient to cover:

- a. Fixed costs.
- b. Variable costs.
- c. Total costs.
- d. Normal profit.



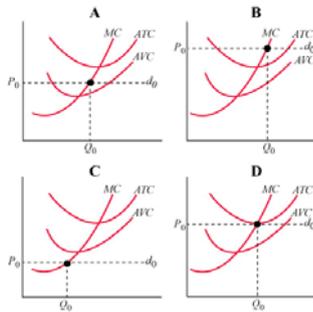
▲ FIGURE 9.2 Short-Run Supply Curve of a Perfectly Competitive Firm

At prices below average variable cost, it pays a firm to shut down rather than continue operating. Thus, the short-run supply curve of a competitive firm is the part of its marginal cost curve that lies above its average variable cost curve.



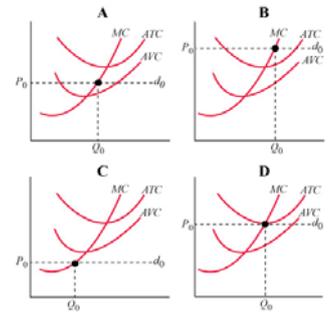
Refer to the figure below. Which of the firms below chooses to produce output at a loss?

- a. A
- b. C
- c. Both A and C.
- d. A, C, and D.



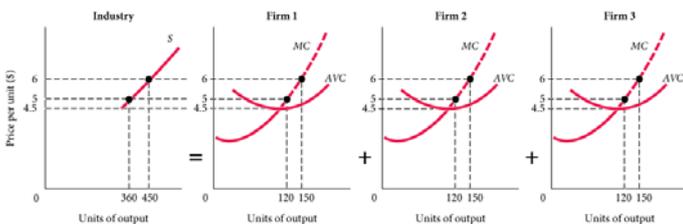
Refer to the figure below. Which of the firms below chooses to produce output at a loss?

- a. A
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- c. Both A and C.
- d. A, C, and D.



The Short-Run Industry Supply Curve

short-run industry supply curve The sum of the marginal cost curves (above AVC) of all the firms in an industry.



▲ FIGURE 9.3 The Industry Supply Curve in the Short Run Is the Horizontal Sum of the Marginal Cost Curves (above AVC) of All the Firms in an Industry

If there are only three firms in the industry, the industry supply curve is simply the sum of all the products supplied by the three firms at each price. For example, at \$6 each firm supplies 150 units, for a total industry supply of 450.

Long-Run Directions: A Review

TABLE 9.2 Profits, Losses, and Perfectly Competitive Firm Decisions in the Long and Short Run

	Short-Run Condition	Short-Run Decision	Long-Run Decision
Profits	$TR > TC$	$P = MC$: operate	Expand: new firms enter
Losses	1. $TR \geq TVC$	$P = MC$: operate (loss < total fixed cost)	Contract: firms exit
	2. $TR < TVC$	Shut down: loss = total fixed cost	Contract: firms exit

Long-Run Costs: Economies and Diseconomies of Scale

increasing returns to scale, or economies of scale An increase in a firm's scale of production leads to lower costs per unit produced.

constant returns to scale An increase in a firm's scale of production has no effect on costs per unit produced.

decreasing returns to scale, or diseconomies of scale An increase in a firm's scale of production leads to higher costs per unit produced.

Increasing Returns to Scale

The Sources of Economies of Scale

Some economies of scale result not from technology but from firm-level efficiencies and bargaining power that can come with size.

Economies of scale have come from advantages of larger firm size rather than gains from plant size.

Example: Economies of Scale in Egg Production

TABLE 9.3 Weekly Costs Showing Economies of Scale in Egg Production

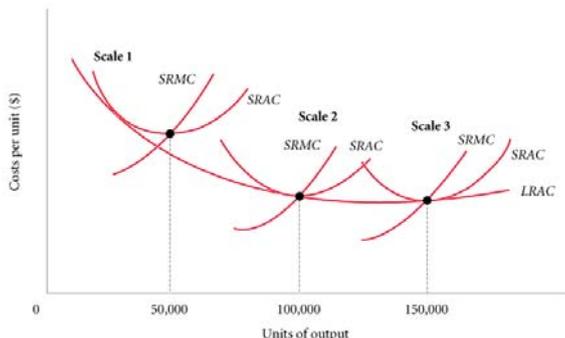
Jones Farm	Total Weekly Costs
15 hours of labor (implicit value \$8 per hour)	\$120
Feed, other variable costs	25
Transport costs	15
Land and capital costs attributable to egg production	17
	<u>\$177</u>
Total output	2,400 eggs
Average cost	\$0.074 per egg

Chicken Little Egg Farms Inc.	Total Weekly Costs
Labor	\$ 5,128
Feed, other variable costs	4,115
Transport costs	2,431
Land and capital costs	19,230
	<u>\$30,904</u>
Total output	1,600,000 eggs
Average cost	\$0.019 per egg

Graphic Presentation

long-run average cost curve (LRAC) The "envelope" of a series of short-run cost curves.

minimum efficient scale (MES) The smallest size at which the long-run average cost curve is at its minimum.



▲ FIGURE 9.4 A Firm Exhibiting Economies of Scale

The long-run average cost curve of a firm shows the different scales on which the firm can choose to operate in the long run. Each scale of operation defines a different short run. Here we see a firm exhibiting economies of scale; moving from scale 1 to scale 3 reduces average cost.

ECONOMICS IN PRACTICE

Economies of Scale in the World Marketplace

In a world economy in which trade occurs across geographical boundaries, if economies of scale exist, it is possible to exploit those economies across a very large output base.

A single plant in Dongguan, China, produces more than 30 percent of the world's magnetic recording heads used in hard disk drives. Another plant in the same city produces 60 percent of the electronic learning devices sold in the United States, while a third plant produces 30 million mobile phones, again all in one plant.

Clearly, the scale economies in these three sectors must be very large indeed. Notice in the case of all three examples that products are also light and cost very little to ship.

THINKING PRACTICALLY

1. Why is steel production much less concentrated than computer chips even though there are large economies of scale in both industries?

ECONOMICS IN PRACTICE

Economies of Scale in Solar

The process of producing solar panels is subject to scale economies, so that as the use of solar panels increases, the long-run average cost of producing them is likely to fall.

It is an open question about just how low costs of solar energy might ever be. In new technologies it is not easy to figure out just how large scale economies might be, given that firms have little experience with expanding firm size, and doing so carries some risks.



THINKING PRACTICALLY

1. How does the price of oil affect a firm's willingness to experiment with large scale solar energy production?

Constant Returns to Scale

Technically, the term *constant returns* means that the quantitative relationship between input and output stays constant, or the same, when output is increased.

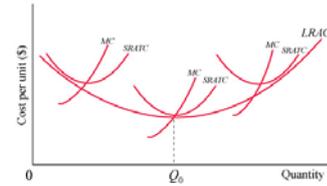
Constant returns to scale mean that the firm's long-run average cost curve remains flat.

Decreasing Returns to Scale

When average cost increases with scale of production, a firm faces *decreasing returns to scale*, or *diseconomies of scale*.

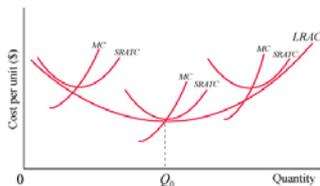


Refer to the figure below. The firm in question exhibits economies of scale:



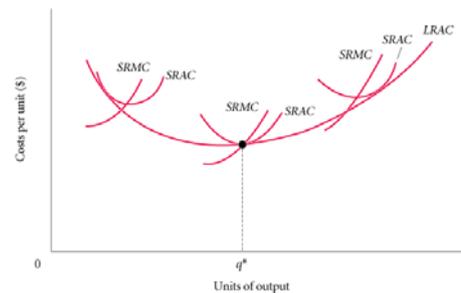
- Along the decreasing portion of the long-run average cost curve (*LRAC*), up until Q_0 .
- Along the increasing portion of the long-run average cost curve (*LRAC*), after Q_0 .
- At Q_0 , where *LRAC* is minimum.
- Anywhere along the *LRAC*, as long as increasing the scale of operations does not affect cost per unit.

Refer to the figure below. The firm in question exhibits economies of scale:



- Along the decreasing portion of the long-run average cost curve (*LRAC*), up until Q_0 .
- Along the increasing portion of the long-run average cost curve (*LRAC*), after Q_0 .
- At Q_0 , where *LRAC* is minimum.
- Anywhere along the *LRAC*, as long as increasing the scale of operations does not affect cost per unit.

U-Shaped Long-Run Average Costs



▲ FIGURE 9.5 A Firm Exhibiting Economies and Diseconomies of Scale

Economies of scale push this firm's average costs down to q^* . Beyond q^* , the firm experiences diseconomies of scale; q^* is the level of production at lowest average cost, using optimal scale.

optimal scale of plant The scale of plant that minimizes average cost.

ECONOMICS IN PRACTICE

The Long-Run Average Cost Curve: Flat or U-Shaped?

A long-run average cost curve was first drawn as the "envelope" of a series of short-run curves in 1931.

Jacob Viner gave his draftsman the task of drawing the long-run curve through the minimum points of all the short-run average cost curves.

In 1986, Professor Herbert Simon of Carnegie-Mellon University explained that studies show the firm's cost curves are not U-shaped but instead slope down to the right and then level off.

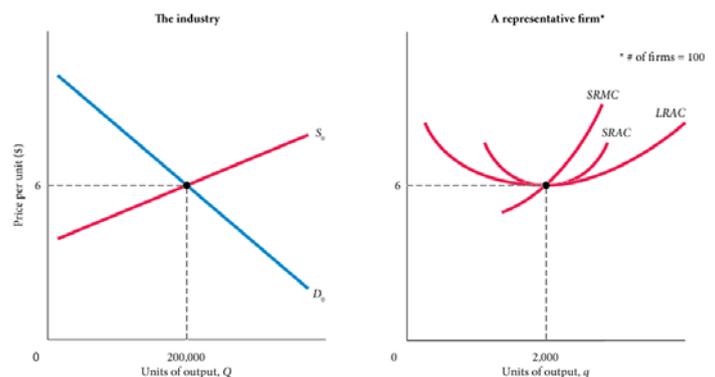


THINKING PRACTICALLY

- Some have argued that even if long-run AC curves do eventually slope up, we would not likely see many firms operating at this size. Why not?

Long-Run Adjustments to Short-Run Conditions

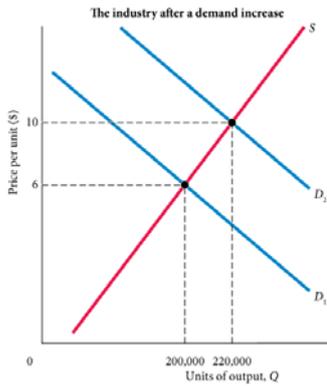
Short-Run Profits: Moves In and Out of Equilibrium



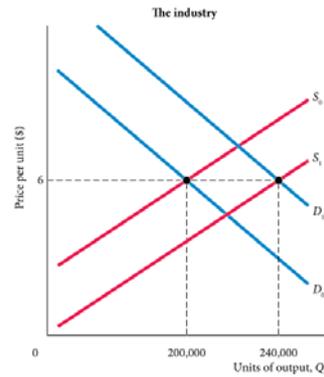
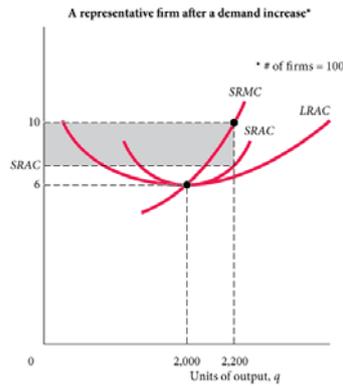
▲ FIGURE 9.6 Equilibrium for an Industry with U-shaped Cost Curves

The individual firm on the right is producing 2,000 units, and so we also know that the industry consists of 100 firms.

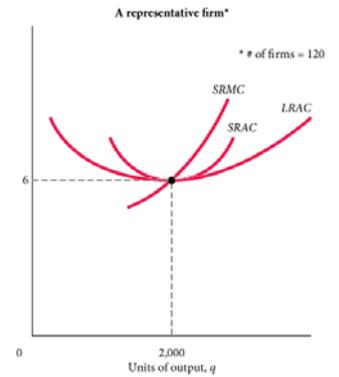
All firms are identical, and all are producing at the uniquely best output level of 2,000 units.



▲ FIGURE 9.7 Industry Response to an Increase in Demand



▲ FIGURE 9.8 New Equilibrium with Higher Demand



Refer to the figure below. Which level of output does the firm produce under long-run, perfectly competitive conditions?

- q_1 .
- Either q^* or q_1 .
- q^* .
- In the long run, the firm may produce any level of output, so both q^* and q_1 are possible.

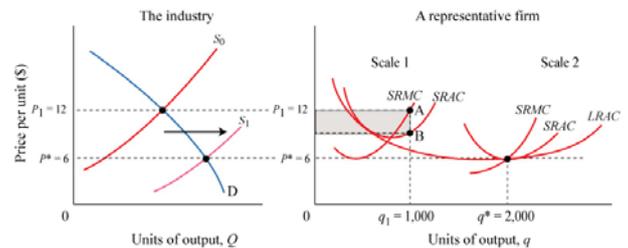
In equilibrium, each firm has

$$SRMC = SRAC = LRAC$$

Firms make no excess profits so that

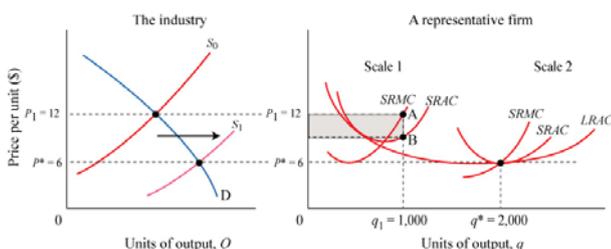
$$P = SRMC = SRAC = LRAC$$

and there are enough firms so that supply equals demand.



Refer to the figure below. Which level of output does the firm produce under long-run, perfectly competitive conditions?

- q_1 .
- Either q^* or q_1 .
- q^* .
- In the long run, the firm may produce any level of output, so both q^* and q_1 are possible.



ECONOMICS IN PRACTICE

The Fortunes of the Auto Industry

In 2010 the U.S. government was a “reluctant shareholder” in General Motors to help the firm move out of the bankruptcy that it entered in 2009.

By 2010, General Motors had returned to profitability. The demand for autos shifted right as the recession eased, and this allowed GM to raise prices and sell more vehicles.

Improved sales also helped on the cost side. The auto industry exhibits large economies of scale due in part to the large capital investment of the assembly lines. In the 2008–2009 recession, the auto industry found itself with excess capacity, and the per-unit costs of cars rocketed up. By using more of its capacity, average costs fell, making for better profitability.

THINKING PRACTICALLY

- How did this change the long-run AC curve?

The Long-Run Adjustment Mechanism: Investment Flows Toward Profit Opportunities

The entry and exit of firms in response to profit opportunities usually involve the financial capital market. In capital markets, people are constantly looking for profits. When firms in an industry do well, capital is likely to flow into that industry in a variety of forms.

long-run competitive equilibrium When $P = SRMC = SRAC = LRAC$ and profits are zero.

Investment—in the form of new firms and expanding old firms—will over time tend to favor those industries in which profits are being made; and over time, industries in which firms are suffering losses will gradually contract from disinvestment.

ECONOMICS IN PRACTICE

Why Are Hot Dogs So Expensive in Central Park?

In New York, you need a license to operate a hot dog cart, and a license to operate in the park costs more.

Since hot dogs are \$0.50 more in the park, the added cost of a license each year must be roughly \$0.50 per hot dog sold.

In fact, in New York City, licenses to sell hot dogs in the park are auctioned off for many thousands of dollars, while licenses to operate in more remote parts of the city cost only about \$1,000.



THINKING PRACTICALLY

1. Show on a graph how a higher-priced license increases hot dog prices.
2. Who is the woman in the coat?

Output Markets: A Final Word

In the last four chapters, we have been building a model of a simple market system under the assumption of perfect competition.

In our wine example, higher demand leads to higher prices, and wine producers find themselves earning positive profits. *This increase in price and consequent rise in profits is the basic signal that leads to a reallocation of society's resources.*

In the short run, wine producers are constrained by their current scales of operation. In the long run, however, we would expect to see resources flow in to compete for these profits. What starts as a shift in preferences thus ends up as a shift in resources.

You have now seen what lies behind the demand curves and supply curves in competitive output markets. The next two chapters take up competitive *input* markets and complete the picture.

REVIEW TERMS AND CONCEPTS

breaking even

constant returns to scale

decreasing returns to scale or diseconomies of scale

increasing returns to scale or economies of scale

long-run average cost curve (LRAC)

long-run competitive equilibrium

minimum efficient scale (MES)

optimal scale of plant

short-run industry supply curve

shutdown point

long-run competitive equilibrium, $P = SRMC = SRAC = LRAC$

CHAPTER 9 APPENDIX

External Economies and Diseconomies and the Long-Run Industry Supply Curve

When long-run average costs decrease as a result of industry growth, we say that there are **external economies**.

When average costs increase as a result of industry growth, we say that there are **external diseconomies**.

TABLE 9A.1 Construction of New Housing and Construction Materials Costs, 2000–2005

Year	House Prices % over the Previous Year	Housing Starts (Thousands)	Housing Starts % Change over the Previous Year	Construction Materials Prices % Change over the Previous Year	Consumer Prices % Change over the Previous Year
2000	—	1,573	—	—	—
2001	7.5	1,661	5.6%	0%	2.8%
2002	7.5	1,710	2.9%	1.5%	1.5%
2003	7.9	1,853	8.4%	1.6%	2.3%
2004	12.0	1,949	5.2%	8.3%	2.7%
2005	13.0	2,053	5.3%	5.4%	2.5%

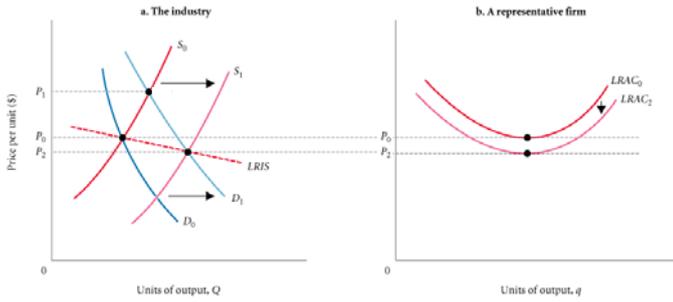
The Long-Run Industry Supply Curve

long-run industry supply curve (LRIS) A curve that traces out price and total output over time as an industry expands.

decreasing-cost industry An industry that realizes external economies—that is, average costs decrease as the industry grows. The long-run supply curve for such an industry has a negative slope.

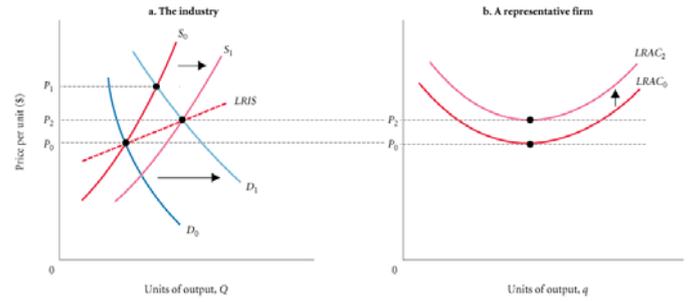
increasing-cost industry An industry that encounters external diseconomies—that is, average costs increase as the industry grows. The long-run supply curve for such an industry has a positive slope.

constant-cost industry An industry that shows no economies or diseconomies of scale as the industry grows. Such industries have flat, or horizontal, long-run supply curves.



▲ FIGURE 9A.1 A Decreasing-Cost Industry: External Economies

In a decreasing-cost industry, average cost declines as the industry expands. As demand expands from D_0 to D_1 , price rises from P_0 to P_1 . As new firms enter and existing firms expand, supply shifts from S_0 to S_1 , driving price down. If costs decline as a result of the expansion to $LRAC_2$, the final price will be below P_0 at P_2 . The long-run industry supply curve ($LRIS$) slopes downward in a decreasing-cost industry.



▲ FIGURE 9A.2 An Increasing-Cost Industry: External Diseconomies

In an increasing-cost industry, average cost increases as the industry expands. As demand shifts from D_0 to D_1 , price rises from P_0 to P_1 . As new firms enter and existing firms expand output, supply shifts from S_0 to S_1 , driving price down. If long-run average costs rise, as a result, to $LRAC_2$, the final price will be P_2 . The long-run industry supply curve ($LRIS$) slopes up in an increasing-cost industry.

APPENDIX REVIEW TERMS AND CONCEPTS

- constant-cost industry
- decreasing-cost industry
- external economies and diseconomies
- increasing-cost industry
- long-run industry supply curve ($LRIS$)