

# Short-Run vs. Long-Run Costs

## Problem Set

- The long-run average cost curve will be upward sloping when the firm is experiencing:
  - economies of scale.
  - diseconomies of scale.**
  - constant returns to scale.
  - diminishing returns.
  - efficiencies in production.
- The long-run average total cost curve is tangent to an infinite number of:
  - short-run total cost curves.
  - short-run marginal cost curves.
  - short-run average variable cost curves.
  - short-run average total cost curves.**
  - short-run marginal product curves.

Use the table below to answer question 2.

Bushels of Soybeans	Long-Run Total Cost
1	\$50
2	\$80
3	\$90
4	\$120
5	\$200
6	\$300

- Over what range of output does this soybean grower experience constant returns to scale?
  - the first and second bushels
  - the third and fourth bushels**
  - the fourth and fifth bushels
  - the fifth and sixth bushels
  - the second and third bushels
- Buffalo Aircraft doubles the amount of all the inputs it uses—the factory doubles in size and twice as many workers are hired. After this expansion, the number of aircraft produced triples. This means that Buffalo Aircraft is experiencing:
  - increasing marginal cost.
  - constant returns to scale.
  - increasing average total cost.
  - decreasing average variable cost.
  - economies of scale.**
- The slope of a long-run average total cost curve exhibiting decreasing returns to scale is:
  - zero.
  - infinite.
  - positive.**
  - negative.
  - downward sloping.

- The accompanying table shows three possible combinations of fixed cost and average variable cost. Average variable cost is constant in this example (it does not vary with the quantity of output produced).
  - For each of the three choices, calculate the average total cost of producing 12,000, 22,000, and 30,000 units. For each of these quantities, which choice results in the lowest average total cost?

Choice	Fixed Cost	Average Variable Cost
1	\$8,000	\$1.00
2	\$12,000	\$0.75
3	\$24,000	\$0.25

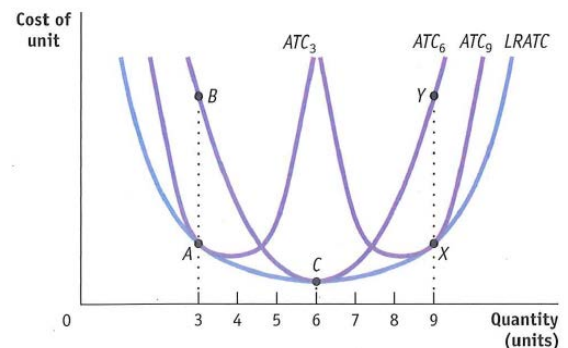
The accompanying table shows the average total cost of producing 12,000, 22,000, and 30,000 units for each of the three choices of fixed cost. For example, if the firm makes choice 1, the total cost of producing 12,000 units of output is  $\$8,000 + 12,000 \times \$1.00 = \$20,000$ . The average total cost of producing 12,000 units of output is therefore  $\$20,000/12,000 = \$1.67$ . The other average total costs are calculated similarly.

	12,000 units	22,000 units	30,000 units
ATC from choice 1	<b>\$1.67</b>	<b>\$1.36</b>	<b>\$1.27</b>
ATC from choice 2	<b>\$1.75</b>	<b>\$1.30</b>	<b>\$1.15</b>
ATC from choice 3	<b>\$2.25</b>	<b>\$1.34</b>	<b>\$1.05</b>

So if the firm wanted to produce 12,000 units, it would make choice 1 because this gives it the lowest average total cost. If it wanted to produce 22,000 units, it would make choice 2. If it wanted to produce 30,000 units, it would make choice 3.

- b. Suppose that the firm, which has historically produced 12,000 units, experiences as sharp, permanent increase in demand that leads it to produce 22,000 units. Explain how its average total cost will change in the short run and in the long run.

Having historically produced 12,000 units, the firm would have adopted choice 1. When producing 12,000 units, the firm would have had an average total cost of \$1.67. When output jumps to 22,000 units, the firm cannot alter its choice of fixed cost in the short run, so its average total cost in the short run will be \$1.36. In the long run, however, it will adopt choice 2, making its average total cost fall to \$1.30.



- c. Explain what the firm should do instead if it believes the change in demand is temporary.

If the firm believes that the increase in demand is temporary, it should not alter its fixed cost from choice 1 because choice 2 generates higher average total cost as soon as output falls back to its original quantity of 12,000 units: \$1.75 versus \$1.67

7. In each of the following cases, explain what kind of scale effects you think the firm will experience and why.
- a. A telemarketing firm in which employees make sales calls using computers and telephones.

This firm is likely to experience constant returns to scale. To increase output, the firm must hire more workers, purchase more computers, and pay additional telephone charges. Because these inputs are easily available, their long-run average total cost is unlikely to change as output increases.

- b. An interior design firm in which design projects are based on the expertise of the firm's owner.

This firm is likely to experience decreasing returns to scale. As the firm takes on more projects, the costs of communication and coordination required to implement the expertise of the firm's owner are likely to increase.

- c. A diamond-mining company.

This firm is likely to experience increasing returns to scale. Because diamond mining requires a large initial set-up cost for excavation equipment, long-run average total cost will fall as output increases.

8. Refer to the graph below to answer the following questions:
- a. The same level of fixed cost that puts the firm at point B when the quantity is 3 minimizes short-run average total cost for what output level? 6
- b. At an output level of 3, is the firm experiencing economies or diseconomies of scale? Explain. Economies of scale because at an output of 3, the LRATC is decreasing.
- c. In the long-run, if the firm expects to produce an output of 9, the firm will produce on which short-run average total cost curve and at which point on the graph? In the long-run the firm will produce on ATC9 and at point X.
9. Consider the following table of long-run total costs for three different firms. Does each of these firms experience economies of scale, diseconomies of scale or both? Explain.

Quantity	1	2	3	4	5	6	7
Firm A	\$60	\$70	\$80	\$90	\$100	\$110	\$120
Firm B	\$11	\$24	\$39	\$56	\$75	\$96	\$119

Firm C	\$21	\$34	\$49	\$66	\$85	\$106	\$129
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Quantity	Firm A		Firm B		Firm C	
	TC	ATC	TC	ATC	TC	ATC
1	\$60	\$60	\$11	\$11	\$21	\$21
2	\$70	\$35	\$24	\$12	\$34	\$17
3	\$80	\$26.7	\$39	\$13	\$49	\$16.3
4	\$90	\$22.5	\$56	\$14	\$66	\$16.5
5	\$100	\$20	\$75	\$15	\$85	\$17
6	\$110	\$18.3	\$96	\$16	\$106	\$17.7
7	\$120	\$17.1	\$119	\$17	\$129	\$18.4

Firm A has economies of scale because average total cost declines as output increases. Firm B has diseconomies of scale because average total cost rises as output rises. Firm C has economies of scale from one to three units of output and diseconomies of scale for levels of output beyond three units.

10. Don owns a small concrete-mixing company. His fixed cost is the cost of the concrete-batching machinery and his mixer trucks. His variable cost is the cost of the sand, gravel, and other inputs for producing concrete; the gas and maintenance for the machinery and trucks; and his workers. He is trying to decide how many mixer trucks to purchase. He has estimated the costs shown in the accompanying table based on estimates of the number of orders his company will receive per week.

Quantity of Trucks	Fixed Costs	Variable Costs		
		20 orders	40 orders	60 orders
2	\$6,000	\$2,000	\$5,000	\$12,000
3	\$7,000	\$1,800	\$3,800	\$10,800
4	\$8,000	\$1,200	\$3,600	\$8,400

- a. For each level of fixed cost, calculate Don's total cost for producing 20, 40, and 60 orders per week.

Quantity of Trucks	Total Costs		
	20 orders	40 orders	60 orders
2	\$8,000	\$11,000	\$18,000
3	\$8,800	\$10,800	\$17,800
4	\$9,200	\$11,600	\$16,400

- b. If Don is producing 20 orders per week, how many trucks should he purchase and what will his average total cost be? Answer the same questions for 40 and 60 orders per week.

Quantity of Trucks	Average Total Costs		
	20 orders	40 orders	60 orders
2	\$400	\$275	\$300
3	\$440	\$270	\$297
4	\$460	\$290	\$273

Don will purchase 2 trucks if he expects to produce 20 orders per week because it minimizes his average total cost. Purchasing 3 or 4 trucks leads to a greater average total cost, which is not efficient. If Don expects to produce 40 orders per week he will purchase 3 trucks. He will purchase 4 trucks if he expects to produce 60 orders per week. In all cases he is minimizing his average total costs.

## Concepts and Measures of Cost

	Measurement	Definition	Mathematical Formula
Short Run	Fixed cost	Cost that does not depend on the quantity of output produced	FC
	Average fixed cost	Fixed cost per unit of output	$AFC = FC/Q$
Short Run and Long Run	Variable cost	Cost that depends on the quantity of output produced	VC
	Average variable cost	Variable cost per unit of output	$AVC = VC/Q$
	Total cost	The sum of fixed cost (short-run) and variable cost	$TC = FC + VC$
	Average total cost	Total cost per unit of output	$ATC = TC/Q$ or $ATC = AFC + AVC$
	Marginal cost	The change in total cost generated by producing one more unit of output	$MC = \Delta TC / \Delta Q$
Long Run	Long-run average total cost	Average total cost when fixed cost has been chosen to minimize average total cost for each level of output	LRATC