Costs

Introduction (1/2)

7

Chapter Outline

7.1 Costs That Matter for Decision Making: Opportunity Costs
7.2 Costs That Do Not Matter for Decision Making: Sunk Costs
7.3 Costs and Cost Curves
7.4 Average and Marginal Costs
7.5 Short-Run and Long-Run Cost Curves
7.6 Economies in the Production Process
7.7 Conclusion

Introduction (2/2)

Costs and the manner in which costs are structured are key to a firm's production decisions.

- How much to produce?
- Whether to expand or shrink in response to changing market conditions
- Whether to switch to producing a different product

We began thinking about costs with the expansion path introduced in the last chapter; now, we examine cost structures more intimately.

- Introducing different types of costs
- Differentiating between short-run and long-run

Costs That Matter for Decision Making: Opportunity Costs (1/4)

7.1

Costs are thought about differently in economics than in accounting.

- **Accounting costs** include the direct costs of operating a business, including costs for raw materials, wages paid to workers, rent paid for office or retail space, etc.
- **Economic cost** is the sum of a producer's accounting and opportunity costs.
  - **Opportunity cost** is the value of what a producer gives up by using an input.

Inclusion of opportunity cost means an economist's interpretation of what constitutes profit will generally be different from an accountant's.

- **Accounting profit** is a firm's total revenue minus accounting cost.
- **Economic profit** is a firm's total revenue minus economic cost.

Costs That Matter for Decision Making: Opportunity Costs (2/4)

7.1

Opportunity costs occur everywhere in a production process.

- By choosing to start a business, you may give up your salary at your current position.
- When you invest in building a factory, you give up any other investment opportunities.
- By choosing to use an office building you own, you cannot rent it to someone else.

<u>Why does this distinction matter?</u>

- When firms make decisions on the use of inputs, they consider these opportunity costs.
- Economists try to describe behavior.
  - It is necessary to understand opportunity costs to know how firms make decisions.

Costs That Matter for Decision Making: Opportunity Costs (3/4): Question 1

7.1

Samuel quit his manufacturing job—a job that earned him $50,000 in annual salary—to start his own company making toy planes. It cost Samuel $40,000 for the supplies necessary to make the toy planes, and he spent $10,000 in shipping costs. Samuel's total revenue from his toy plane sales the past year was $100,000. Samuel's *accounting* profit is:

A. $0
B. $10,000
C. $40,000
D. $50,000

Costs That Matter for Decision Making: Opportunity Costs (3/4): Question 1 – Correct Answer

7.1

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A. $0
B. $10,000
C. $40,000
D. $50,000 (correct answer)

Costs That Matter for Decision Making: Opportunity Costs (4/4): Question 2

7.1

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A. $0
B. $10,000
C. $40,000
D. $50,000

Costs That Matter for Decision Making: Opportunity Costs (4/4): Question 2 – Correct Answer

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A. $0 (correct answer)
B. $10,000
C. $40,000
D. $50,000

Costs That Do Not Matter for Decision Making: Sunk Costs (1/4)

7.2

While opportunity costs should be considered when making decisions, **sunk costs** should be ignored.

Sunk costs are a form of **fixed costs**, or the cost of the firm's fixed inputs, independent of the quantity of the firm's output.

- Buildings, operating permits, durable equipment
  - These costs are partially *avoidable*; some money can be recovered.

Sunk costs cannot be recovered once spent.

- Licensing fees, long-term lease contracts, etc.
- Specific capital such as uniforms, menus, signs, etc.

Sunk costs cannot be recouped and therefore should not be considered if a firm is deciding whether or not to close.

Costs That Do Not Matter for Decision Making: Sunk Costs (2/4)

7.2

Sunk Costs and Decisions

Once incurred, sunk costs should not affect decision making.

Consider a business deciding whether to close down.

- Some of the costs associated with the business are unavoidable (e.g., permits, loss of value in kitchen equipment, uniforms).
- Other costs disappear when operations cease (e.g., wages for employees, raw materials, phone bills).

✓ **If staying open will generate some revenue, what should the firm do?**

- Stay open as long as **operating revenues** exceed **operating costs.**
  - **Operating revenue** is the money a firm earns from selling its output.
  - **Operating cost** is the cost a firm incurs in producing its output.

Costs That Do Not Matter for Decision Making: Sunk Costs (3/4)

7.2

Sunk Costs and Decisions

The **sunk cost fallacy** refers to the mistake of letting sunk costs affect a firm's operating decisions.

Often, people and firms allow sunk costs to influence decisions.

- Usually, this means continuing down one path because of a prior investment.

Example: Going to a baseball game because you bought season tickets even if the weather is horrible and there is something else you would rather do.

Costs That Do Not Matter for Decision Making: Sunk Costs (4/4): Question 1

7.2

Erin wanted to become a marathon runner. She bought running shoes for $100 and entered a marathon race that had a $40 entry fee. It is now mile 10 of 26 and Erin is exhausted and is considering dropping out of the race and going home. The taxi ride home will cost $125. When deciding whether or not to drop out and go home, Erin should consider which of these costs?

A. $100 for the shoes
B. $40 entry fee
C. $100 for the shoes and $40 entry fee
D. $125 taxi cost

Costs That Do Not Matter for Decision Making: Sunk Costs (4/4): Question 1 – Correct Answer

7.2

Erin wanted to become a marathon runner. She bought running shoes for $100 and entered a marathon race that had a $40 entry fee. It is now mile 10 of 26 and Erin is exhausted and is considering dropping out of the race and going home. The taxi ride home will cost $125. When deciding whether or not to drop out and go home, Erin should consider which of these costs?

A. $100 for the shoes
B. $40 entry fee
C. $100 for the shoes and $40 entry fee
D. $125 taxi cost (correct answer)

Costs and Cost Curves (1/6)

7.3

Economic analysis of costs divides operating costs into two categories:

1. **Fixed cost** (FC) is the cost of the firm's fixed inputs, independent of the quantity of the firm's output (e.g., office lease).

2. **Variable cost** (VC) is the cost of inputs that vary with the quantity of the firm's output (e.g., raw materials).

The sum of fixed and variable costs is a firm's **total cost.**

TC = FC + VC

Costs and Cost Curves (2/6)

7.3

Flexibility and Fixed Versus Variable Costs

- **Time horizon** is the chief factor determining flexibility of different input levels.
  - Over short time horizons, many inputs are fixed costs (e.g., in a single day for a restaurant most costs are fixed, including labor and capital).
  - As the time horizon expands, wait staff can be hired or fired, new capital can be purchased, and space can be expanded.

Other Factors Affecting Flexibility

- The presence (or lack) of active capital rental and resale markets allow some capital expenditures to become variable (e.g., renting an extra crane).
- Labor contracts may lead to stickiness in labor inputs; it may be difficult to fire workers, and firms may become reluctant to hire unless absolutely necessary.

Costs and Cost Curves (3/6)

7.3

Deriving Cost Curves

- A **cost curve** is the mathematical relationship between a firm's production costs and output.
  - Curves associated with fixed, variable, and total costs will have different shapes.
  - Costs can be represented by a table or a graph.

Consider *Fleet Foot,* a shoe company that produces running shoes.

Costs and Cost Curves (4/6)

7.3

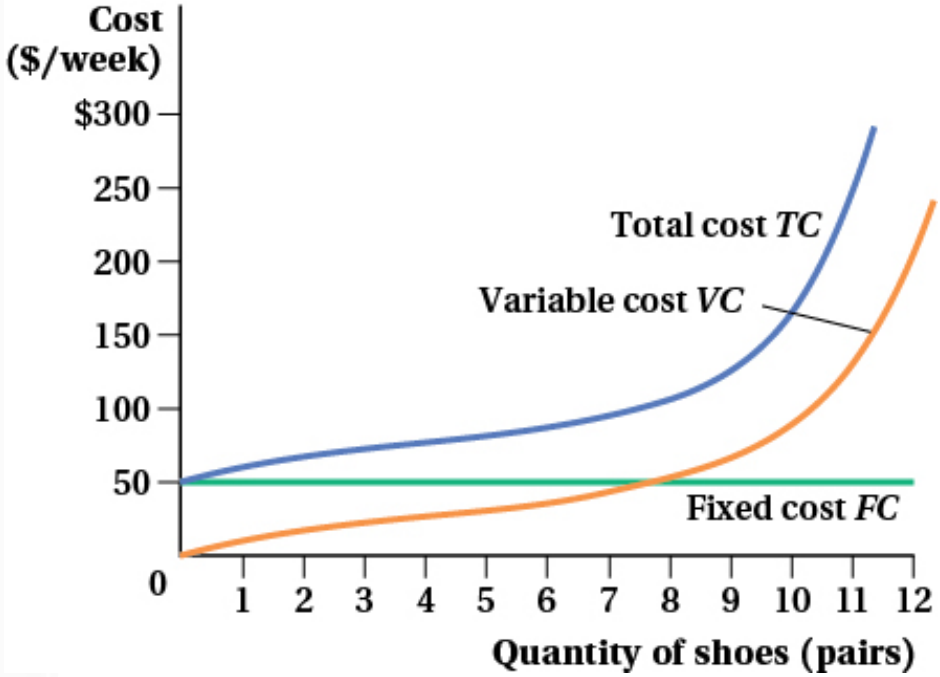
Table 7.1 Fixed, Variable, and Total Cost for Fleet Foot

Output Quantity *Q* (Pairs of Shoes/ Week)	Fixed Cost *FC* ($/Week)	Variable Cost *VC* ($/Week)	Total Cost *TC* ($/Week)
0	50	0	50
1	50	10	60
2	50	17.5	67.5
3	50	22.5	72.5
4	50	25	75
5	50	30	80
6	50	37.5	87.5
7	50	47.5	97.5
8	50	60	110
9	50	75	125
10	50	100	150
11	50	150	200
12	50	225	275

Costs and Cost Curves (5/6)

7.3

Figure 7.1 Fixed, Variable, and Total Costs



Costs and Cost Curves (6/6)

7.3

The **fixed cost curve** is horizontal.

- Costs do not vary with output; they are $50 per week, regardless of production.

Variable costs change with the amount of output, and the **variable cost curve** is, therefore, not constant.

- The slope of the variable cost curve is always positive.
- In this example, the curve becomes flatter as output rises from 0 to 4 pairs, then becomes steeper as the number of pairs produced per week increases.

The **total cost curve** is the sum of variable cost and fixed cost.

- The total cost curve will have the same shape as the variable cost curve, but it will be shifted up at each level of output by the amount of fixed costs.

Average and Marginal Costs (1/9)

7.4

Understanding the cost structure of firms is important but to understand how costs affect production decisions, we must introduce two related measures: **average cost** and **marginal cost.**

Average cost is simply cost divided by output:

- **Average Fixed Cost** (AFC) $AFC = FC / Q$
- **Average Variable Cost** (AVC) $AVC = VC / Q$
- **Average Total Cost** (ATC) $ATC = TC / Q = (FC + VC) / Q$

Returning to the shoe example:

$$ATC = TC / Q = (FC + VC) / Q$$
$$= FC / Q + VC / Q = AFC + AVC$$

Average and Marginal Costs (2/9)

7.4

Table 7.2 Costs for Fleet Foot

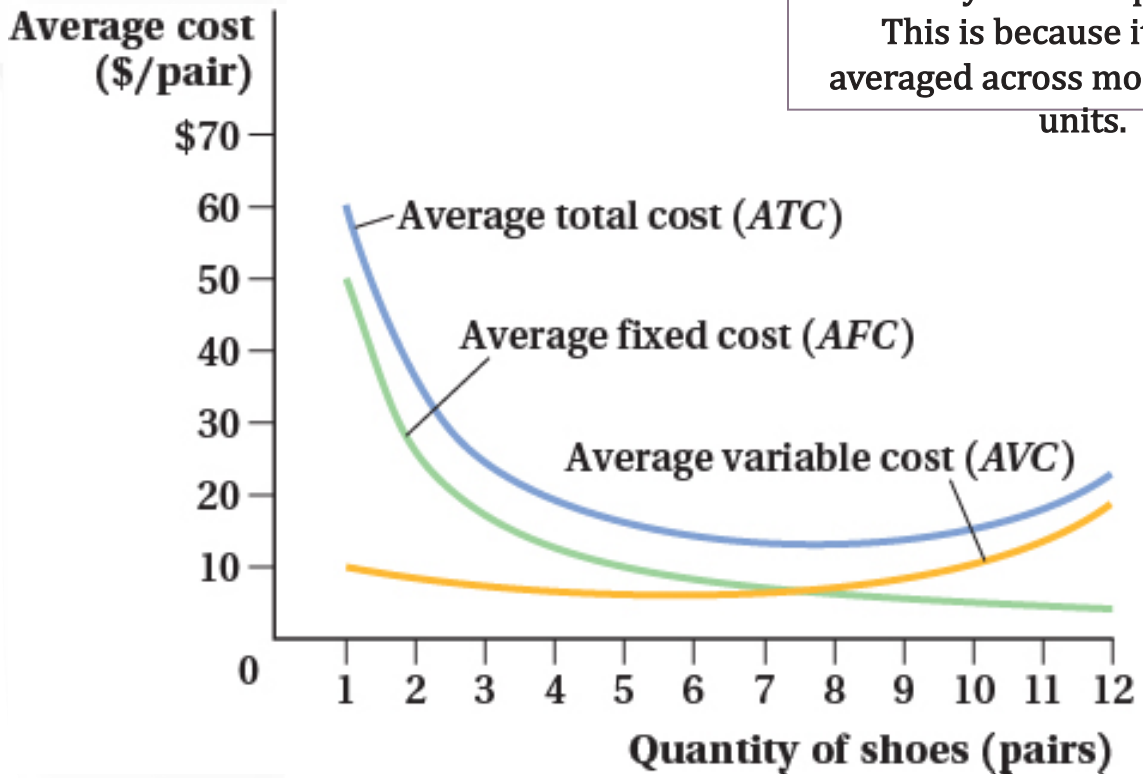
(1) Output Quantity *Q*	(2) Fixed Cost *FC*	(3) Variable Cost *VC*	(4) Total Cost *TC*	(5) Marginal Cost *MC* (= $\Delta TC/\Delta Q$) (= $\Delta VC/Q$)	(6) Average Fixed Cost *AFC* (= *FC*/*Q*)	(7) Average Variable Cost *AVC* (= *VC*/*Q*)	(8) Average Total Cost *ATC* (= *TC*/*Q*)
0	50	0	50	—	—	—	—
1	50	10	60	10	50	10	60
2	50	17.5	67.5	7.5	25	8.75	33.75
3	50	22.5	72.5	5	16.67	7.5	24.17
4	50	25	75	2.5	12.5	6.25	18.75
5	50	30	80	5	10	6	16
6	50	37.5	87.5	7.5	8.33	6.25	14.58
7	50	47.5	97.5	10	7.14	6.79	13.93
8	50	60	110	12.5	6.25	7.5	13.75
9	50	75	125	15	5.56	8.33	13.89
10	50	100	150	25	5	10	15
11	50	150	200	50	4.55	13.64	18.18
12	50	225	275	75	4.17	18.75	22.92

Average and Marginal Costs (3/9)

7.4

Figure 7.2 Average Cost Curves

AFC always falls as quantity rises. This is because it is being averaged across more and more units.



Average and Marginal Costs (4/9)

Marginal cost is another deciding factor in firms' production decisions.

- The additional cost of producing an additional unit of output

$$MC = \Delta TC / \Delta Q$$

Returning to the previous table:

Average and Marginal Costs (5/9)

7.4

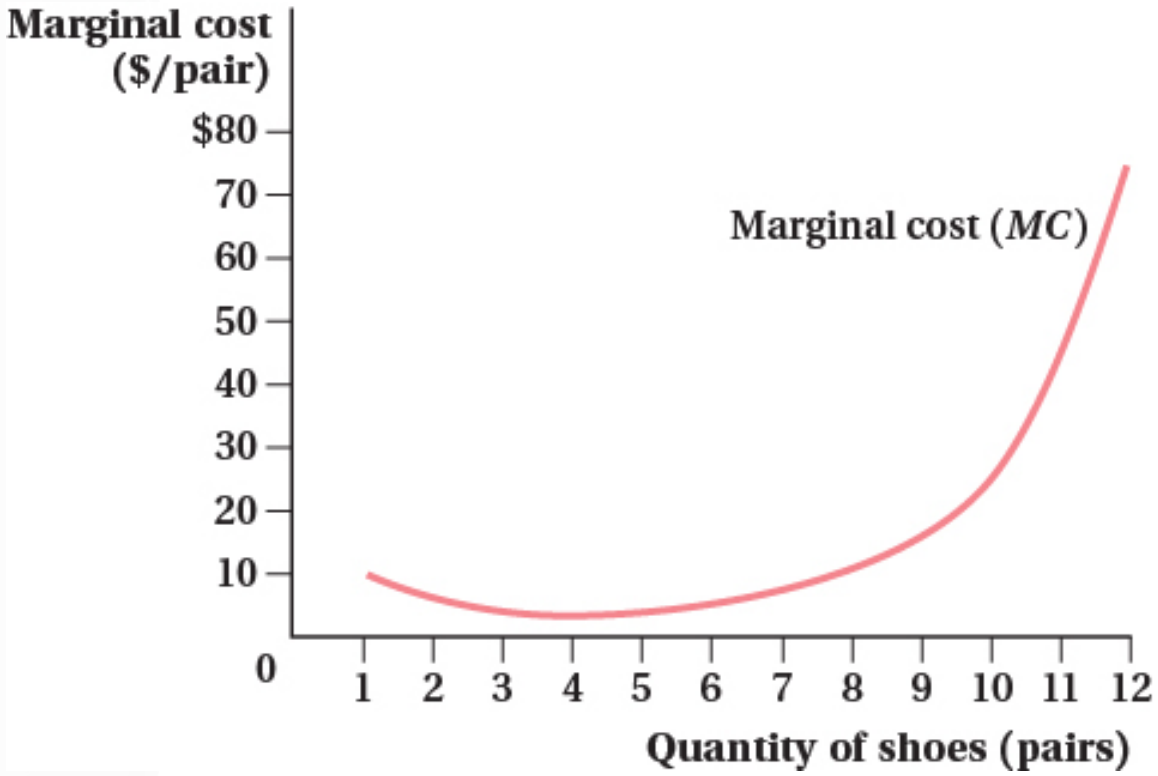
Table 7.2 Costs for Fleet Foot

(1) Output Quantity *Q*	(2) Fixed Cost *FC*	(3) Variable Cost *VC*	(4) Total Cost *TC*	(5) Marginal Cost *MC* (= $\Delta TC/\Delta Q$) (= $\Delta VC/Q$)	(6) Average Fixed Cost *AFC* (= *FC*/*Q*)	(7) Average Variable Cost *AVC* (= *VC*/*Q*)	(8) Average Total Cost *ATC* (= *TC*/*Q*)
0	50	0	50	—	—	—	—
1	50	10	60	**10**	50	10	60
2	50	17.5	67.5	**7.5**	25	8.75	33.75
3	50	22.5	72.5	**5**	16.67	7.5	24.17
4	50	25	75	**2.5**	12.5	6.25	18.75
5	50	30	80	**5**	10	6	16
6	50	37.5	87.5	**7.5**	8.33	6.25	14.58
7	50	47.5	97.5	**10**	7.14	6.79	13.93
8	50	60	110	**12.5**	6.25	7.5	13.75
9	50	75	125	**15**	5.56	8.33	13.89
10	50	100	150	**25**	5	10	15
11	50	150	200	**50**	4.55	13.64	18.18
12	50	225	275	**75**	4.17	18.75	22.92

Average and Marginal Costs (6/9)

7.4

Figure 7.3 Marginal Cost



Average and Marginal Costs (7/9)

7.4

Relationships Between Average and Marginal Costs

- Since fixed costs do not change when a firm expands output, marginal cost *only* depends on variable cost.

$$MC = \Delta VC / \Delta Q \ (= \Delta VC \ / \Delta Q)$$

What happens when marginal cost is less than average total cost?

For example, consider your overall GPA. What happens to your 3.0 average when you get a 2.5 for the semester?

  - It drops below 3.0. ☹

Average and Marginal Costs (8/9)

7.4

Relationships Between Average and Marginal Costs

- The same holds with costs; when marginal cost is less than the *average* total cost, producing another unit will *reduce* average total cost, and vice versa.

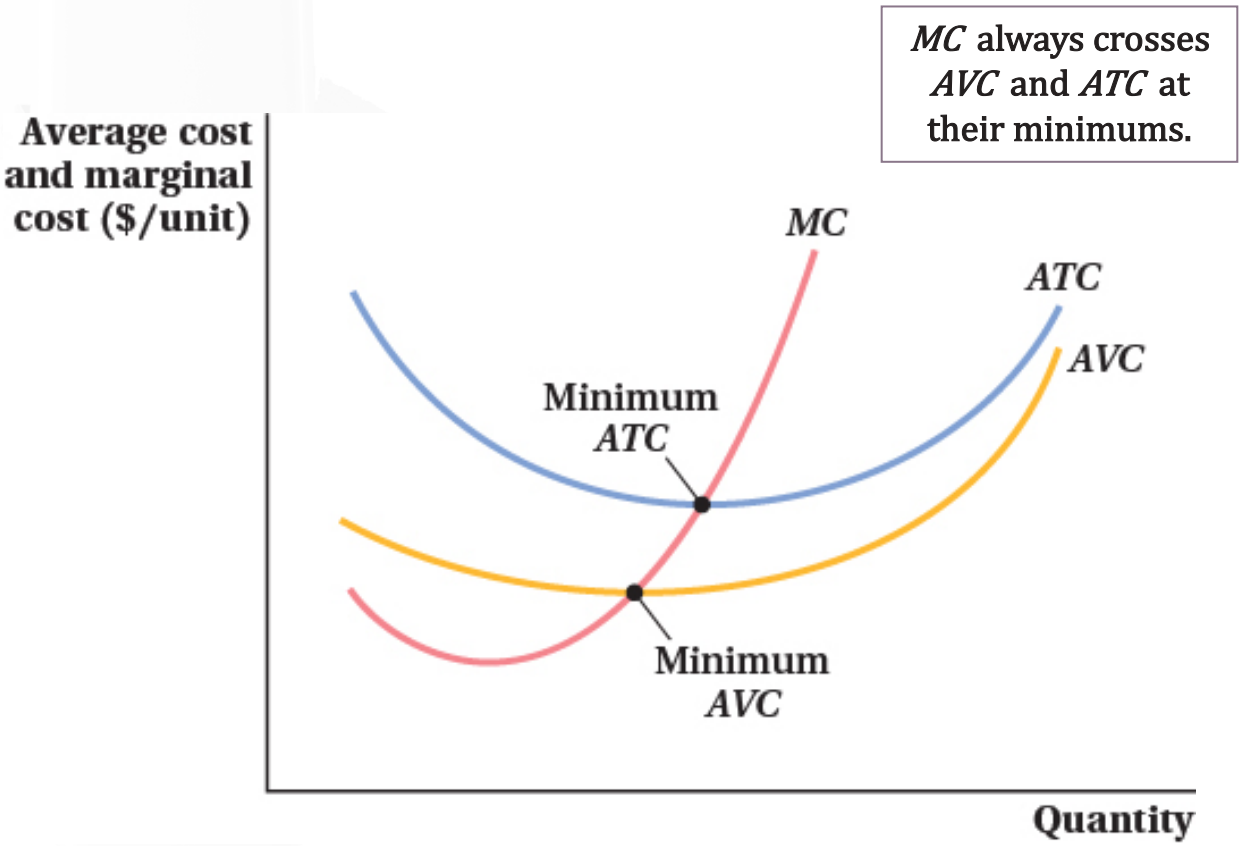
This observation helps to determine when average total costs are minimized.

- Average total costs are minimized when $ATC = MC$.
  - This explains why ATC and AVC have a "U" shape.

Average and Marginal Costs (9/9)

7.4

Figure 7.4 The Relationship Between Average and Marginal Costs



Short-Run and Long-Run Cost Curves (1/7)

7.5

We now analyze how the time horizon affects the cost structure facing a firm.

- Remember, in the short run, the amount of capital is assumed to be fixed.

Short-Run Production and Total Cost Curves

A firm's **short-run total cost curve** describes the total cost of producing various quantities of output when the amount of capital available for use is fixed.

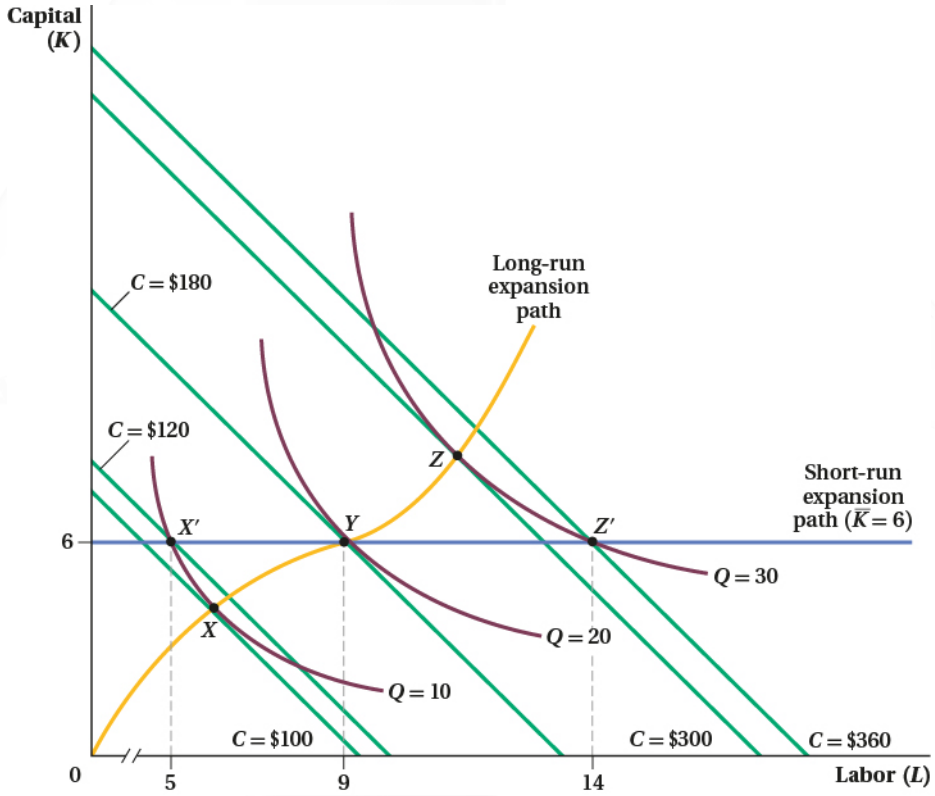
- An easy way to see this concept in action is with a graph.
- Consider the production of engines.

Short-Run and Long-Run Cost Curves (2/7)

7.5

Capital and labor are used to produce engines (quantities are per week).

Figure 7.5

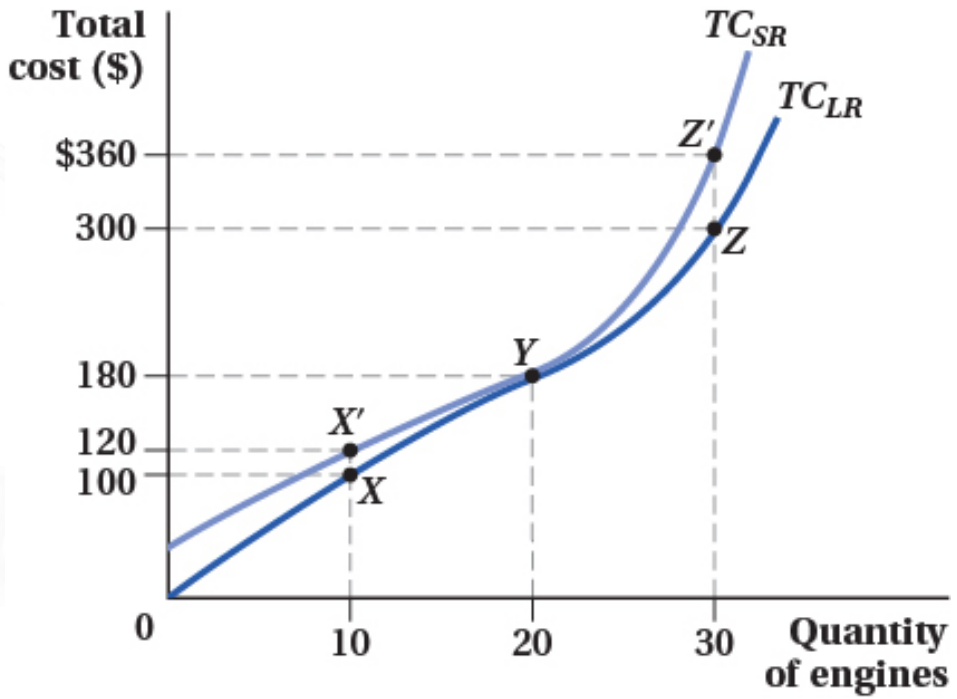


Short-Run and Long-Run Cost Curves (3/7)

7.5

Capital and labor are used to produce engines (quantities are per week).

Figure 7.6



Short-Run and Long-Run Cost Curves (4/7)

7.5

Short-Run Versus Long-Run Average Total Cost Curves

Figure 7.6 shows that the short-run total cost curve will *never* fall below the long-run total cost curve.

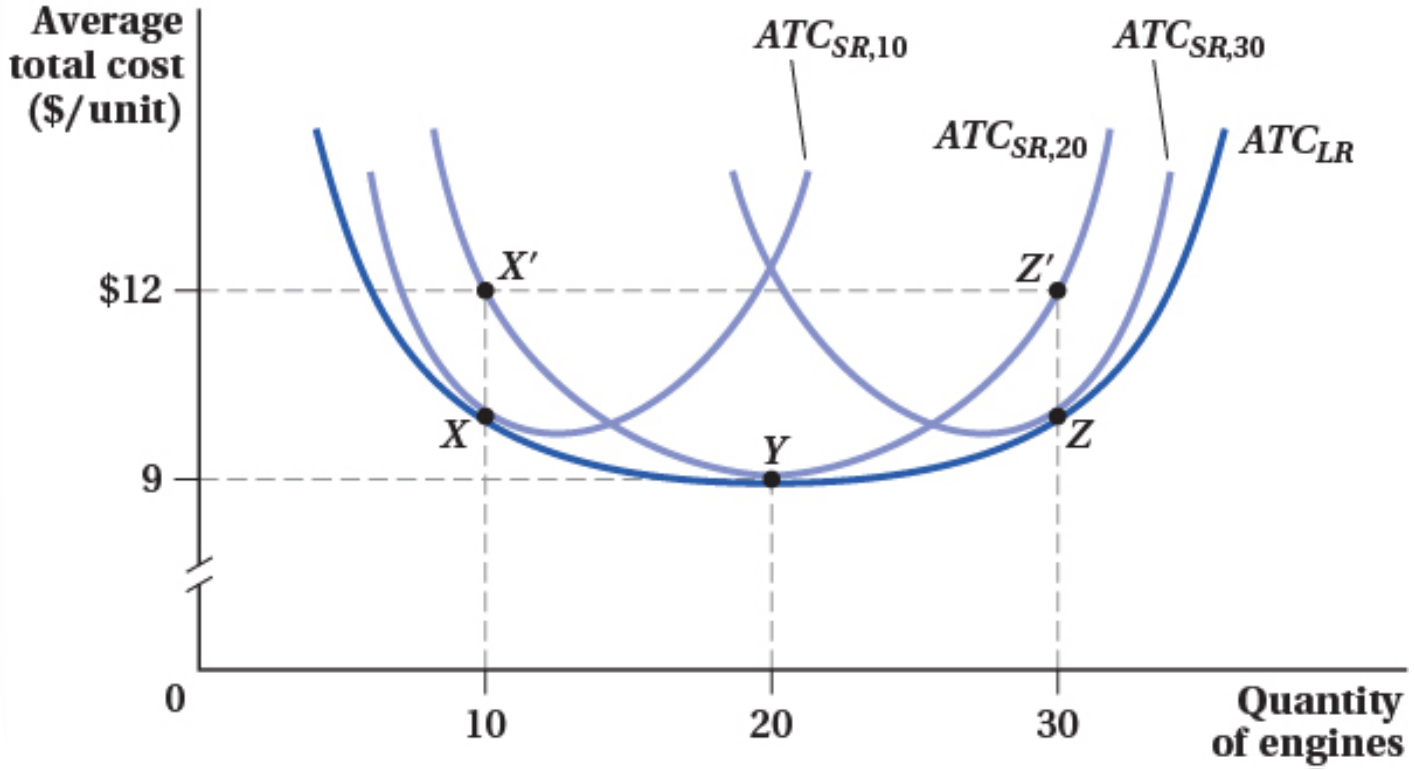
- This further implies that the short-run average total cost curve will *never* fall below the long-run average total cost curve.
- This fact holds true for *all* short-run average total cost curves.
  - Each of which corresponds to a different fixed capital level.

This property means that the long-run *ATC* curve will envelop all of the short-run *ATC* curves.

Short-Run and Long-Run Cost Curves (5/7)

7.5

Figure 7.8 The Long-Run Average Total Cost Curve Envelops the Short-Run Average Cost Curves



Short-Run and Long-Run Cost Curves (6/7)

7.5

Short-Run Versus Long-Run Marginal Cost Curves

Just as with average costs,

- short-run marginal cost is the cost of producing an additional unit of output when capital is *fixed.*
- long-run marginal cost is the cost of producing an additional unit of output when both capital and labor are *variable.*

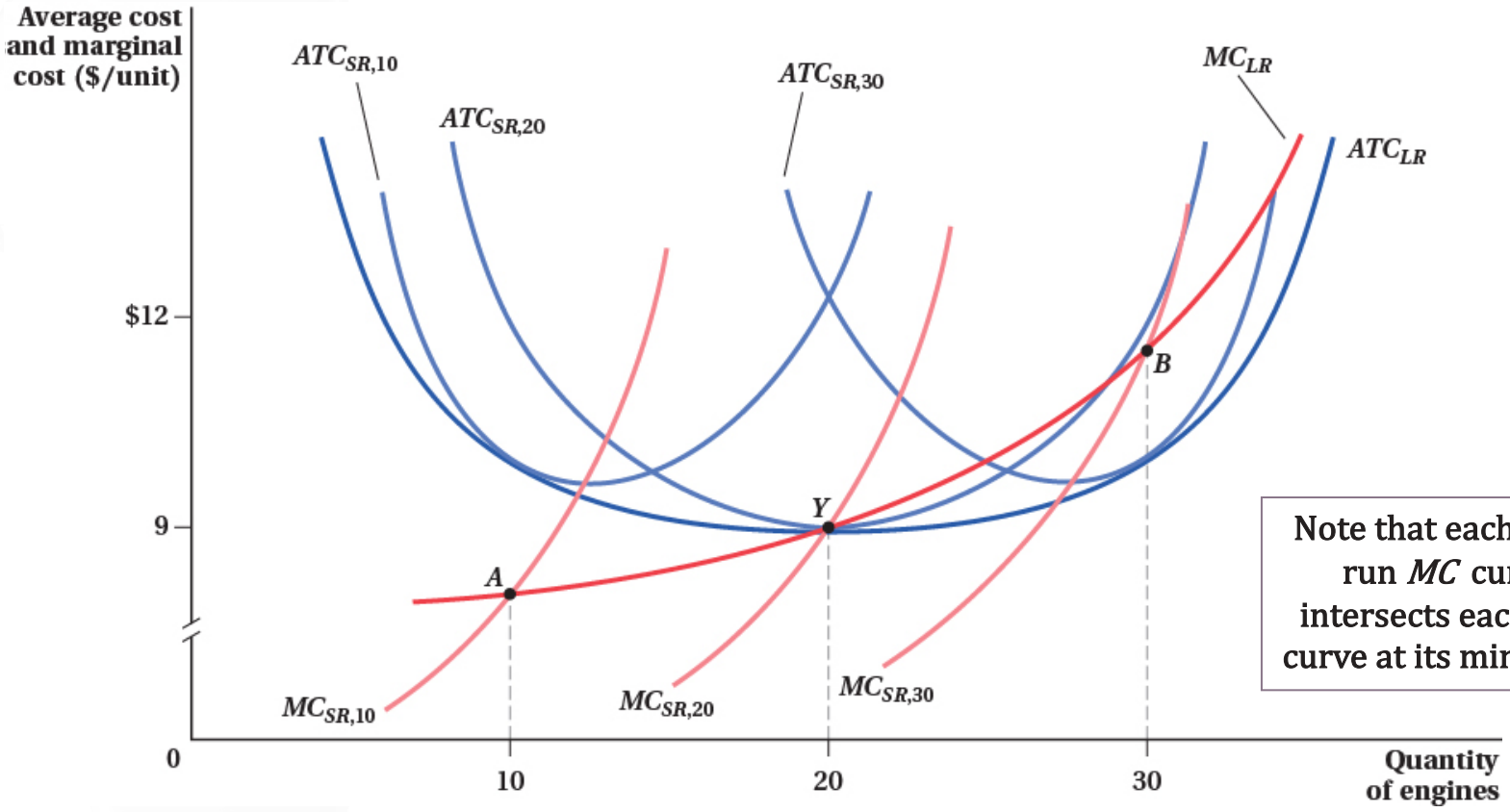
What does this imply for the shape of the marginal cost curves?

- In general, the long-run marginal cost curve will be *flatter* than the short-run marginal cost curve.

Short-Run and Long-Run Cost Curves (7/7)

7.5

Figure 7.9 Long-Run and Short-Run Marginal Costs



Economies in the Production Process (1/3)

7.6

What happens to the long-run *ATC* curve as a firm grows?

- The answer reveals information about *economies* in the production process.
- Similar to returns to scale but focused on the cost side

Economies of Scale: Costs rise *more slowly* than production.

Constant Economies of Scale: Costs rise at the *same* rate as output.

Diseconomies of Scale: Costs rise *more quickly* than production.

Economies in the Production Process (2/3)

7.6

Given these relationships, what does the common "U-shape" of the long-run ATC curve imply for production?

- At first, average cost per unit produced falls (economies of scale). Eventually, as output rises considerably, diseconomies of scale take hold.

What factors might cause diseconomies of scale to set in?

- Overcrowding, overutilization of capital, organizational complexity, etc.

Not the same as returns to scale!

- Returns to scale describes how production changes when all inputs are changed by a common factor.
- Economies of scale does not impose this "common factor" rule in input proportions.

Economies in the Production Process (3/3)

7.6

Economies of Scope

A related concept is the idea of economies of scope.

- The simultaneous production of multiple products comes at a lower cost than if a firm made each product separately then added up the costs.

Why might a firm observe economies of scope?

1. Flexible inputs or production processes
   - For instance, oil refineries can produce many different petroleum products at the same time through distillation at a much lower aggregate cost than if each were produced separately.
2. Expertise is translatable across several products/services
   - For instance, life and auto insurance

Conclusion (1/1)

7.7

We have now linked cost to production.

- Opportunity costs, fixed costs, variable costs, sunk costs
- Marginal and average costs
- Short- and long-run costs

In the next chapters, we introduce market conditions to a firm's production decision.

We begin with the case of a perfectly competitive market in **Chapter 8.**