

Intermediate Microeconomics. Lecture 15

Costs and Cost Curves

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A firm can have two types of costs: fixed costs (FC) and variable costs (VC)

$$TC = FC + VC$$

- VC: labor, electricity, water or internet
- FC: capital (machines) and land

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- 1 Average and Marginal Costs
- 2 Short-Run and Long-Run Cost Curves
- 3 Economies of Scale

Average Cost Measures

Average cost is just cost divided by quantity

- Average fixed cost (AFC) is measured as the fixed cost per unit of output

$$AFC = FC/Q$$

- Average variable cost (AVC) measures the per-unit variable cost of production

$$AVC = VC/Q$$

- Average total cost (ATC) is the total cost per unit of output

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

$$ATC = AFC + AVC$$

Marginal Cost

The marginal cost (MC) is the firm's cost of producing one more unit of output

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

Notice that fixed cost does not affect marginal cost; only variable cost changes when the firm produces one more unit

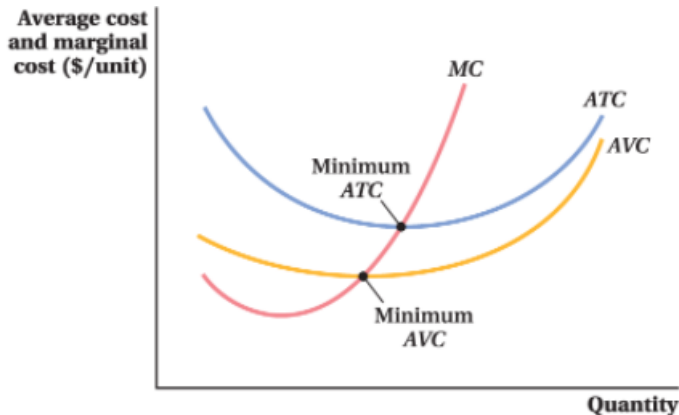
$$MC = \Delta VC / \Delta Q$$

Marginal Cost

But you can go further to analyze changes in total cost to infinitesimal changes in quantity using derivatives

$$MC = \frac{dTC(Q)}{dQ}$$

Relationships between Average and Marginal Costs



Goolsbee et al., *Microeconomics*, 3e, © 2020 Worth Publishers

Figure: Relationship between Average and Marginal Costs

Example

Suppose a firm's total cost curve is

$$TC = 15Q^2 + 8Q + 45$$

- Find marginal cost

$$MC = \frac{dTC(Q)}{dQ} = 30Q + 8$$

- Find, FC, VC, AVC, ATC

$$FC = 45$$

$$VC = 15Q^2 + 8Q$$

Example

$$AVC = 15Q + 8$$

$$ATC = 15Q + 8 + \frac{45}{Q}$$

- Find the output level that minimizes average total cost

$$ATC = MC \Rightarrow 15Q + 8 + \frac{45}{Q} = 30Q + 8$$

$$15Q = \frac{45}{Q} \Rightarrow Q^2 = \frac{45}{15} \Rightarrow \boxed{Q = \sqrt{3}}$$

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LR and SR Cost Curves

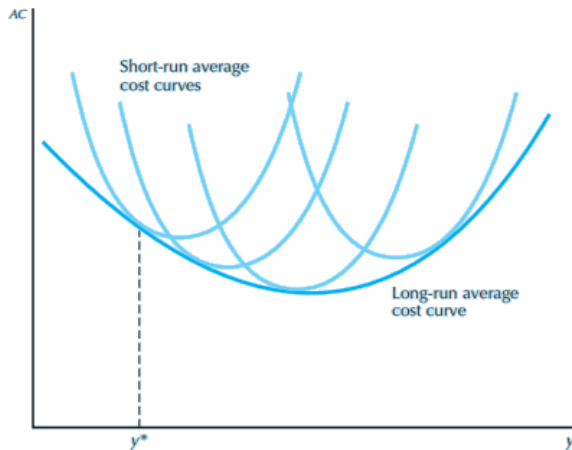


Figure: Long-Run Average Total Cost Curve Envelops the Short-Run Average Total Cost Curves

Example

A company has a production function represented by

$$Q = 4KL$$

The current wage rate (ω) is \$8 per hour, and the rental rate on capital (r) is \$10 per hour

- In the short run, the plant's capital stock is fixed at $\bar{K} = 10$. What is the cost the firm faces if it wants to produce $Q = 200$ units: $L = 50$ and $TC = 140$
- What will the firm wish to do in the long run to minimize the cost of producing $Q = 200$ units?

Example

To find the factors demands we start with the optimal condition

$$MRTS_{LK} = \frac{\omega}{r}$$

and substitute in the production function

$$Q = 4KL$$

$$L^* = 7.91$$

$$K^* = 6.33$$

$$TC = 126.58$$

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Economies of Scale

- If doubling output causes cost to less than double, a firm has economies of scale: total cost rises at a slower rate than output rises
- If doubling output causes cost to more than double, a firm has diseconomies of scale: total cost rises at a faster rate than output rises
- If doubling output causes cost to double, a firm has constant economies of scale: total cost rises at the same rate as output rises

Economies of Scale

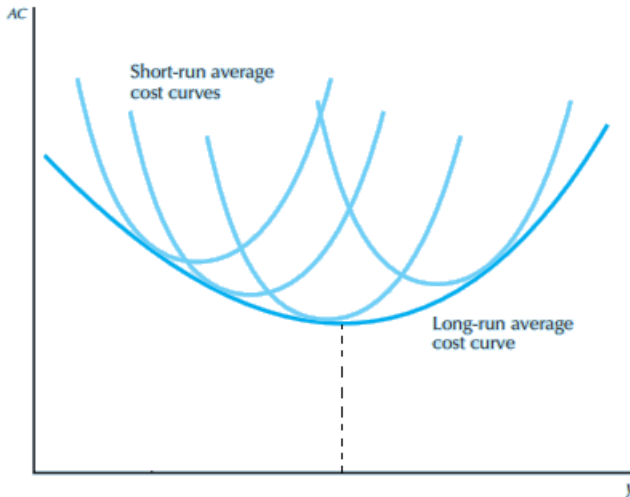


Figure: Economies of Scale

Example

Suppose that the long-run total cost function for a firm is

$$LTC = 32,000Q - 250Q^2 + Q^3$$

- At what levels of output will the firm face economies of scale? Diseconomies of scale?

Example

We know that minimum average cost occurs when
 $LMC = LATC \Rightarrow Q = 125$

- Thus, at $Q < 125$, the firm faces economies of scale
- At $Q > 125$, the firm faces diseconomies of scale