

ECON 202

Microeconomics

Chapter 20

**THE COSTS OF
PRODUCTION**

Ch 20 Learning Objectives

- Why economic costs include both explicit costs and implicit costs.
- How the law of diminishing returns relates to a firm's short-run production costs.
- Distinctions between fixed and variable costs and among total, average, and marginal costs.
- The link between a firm's size and its average costs in the long run.

Economic Costs

- **Economic costs** - payments a firm must make, or incomes it must provide, to resource suppliers to attract those resources away from their best alternative production opportunities. Payments may be explicit or implicit.

Explicit Costs

- Cash Payments a firm makes to those who supply labor services, materials, fuel, transportation services, etc.
- Money payments are for the use of resources owned by others.

Implicit Costs

- **Implicit costs** - opportunity costs of using its self-owned, self-employed resources.
- Money payments that self-employed resources could have earned in their best alternative use
- Forgone interest, forgone rent, forgone wages, and forgone entrepreneurial income.

- T-shirts example: Accounting profits - \$57,000
- Ignores implicit costs
- Overstates economic success

Normal Profits

- Normal profits are considered an implicit cost because they are the minimum payments required to keep the owner's entrepreneurial abilities self-employed. This is \$5,000 in the example.
- Cost of doing business

Economic Profits

- **Economic or pure profits** are total revenue less all costs (explicit and implicit including a normal profit).

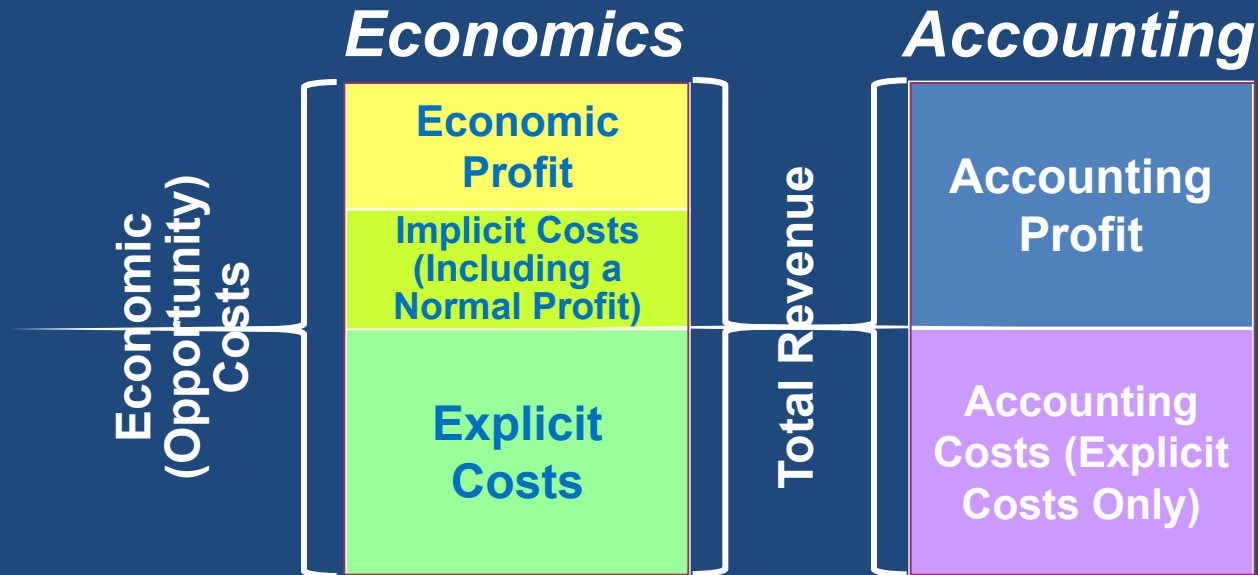
Short Run

- Time period that is too brief for a firm to alter its plant capacity. The plant size is fixed in the short run.
- Short-run costs, then, are the wages, raw materials, etc., used for production in a fixed plant.

Long-run

- The long run is a period of time long enough for a firm to change the quantities of all resources employed, including the plant size.
- Long-run costs are all costs, including the cost of varying the size of the production plant.

Economic Profit Versus Accounting Profits



Short Run and Long Run

- *Short Run: Fixed Plant*
- *Long Run: Variable Plant*

Short-Run Production Relationships

- Total Product (TP)
- Marginal Product (MP)
- Average Product (AP)

$$\text{Marginal Product} = \frac{\text{Change in Total Product}}{\text{Change in Labor Input}}$$

$$\text{Average Product} = \frac{\text{Total Product}}{\text{Units of Labor}}$$



Law of Diminishing returns

- Assumes technology is fixed & techniques for production do not change.
- As successive units of a variable resource are added to a fixed resource, beyond some point the extra or marginal product that can be attributed to each additional unit of the variable resource will decline.

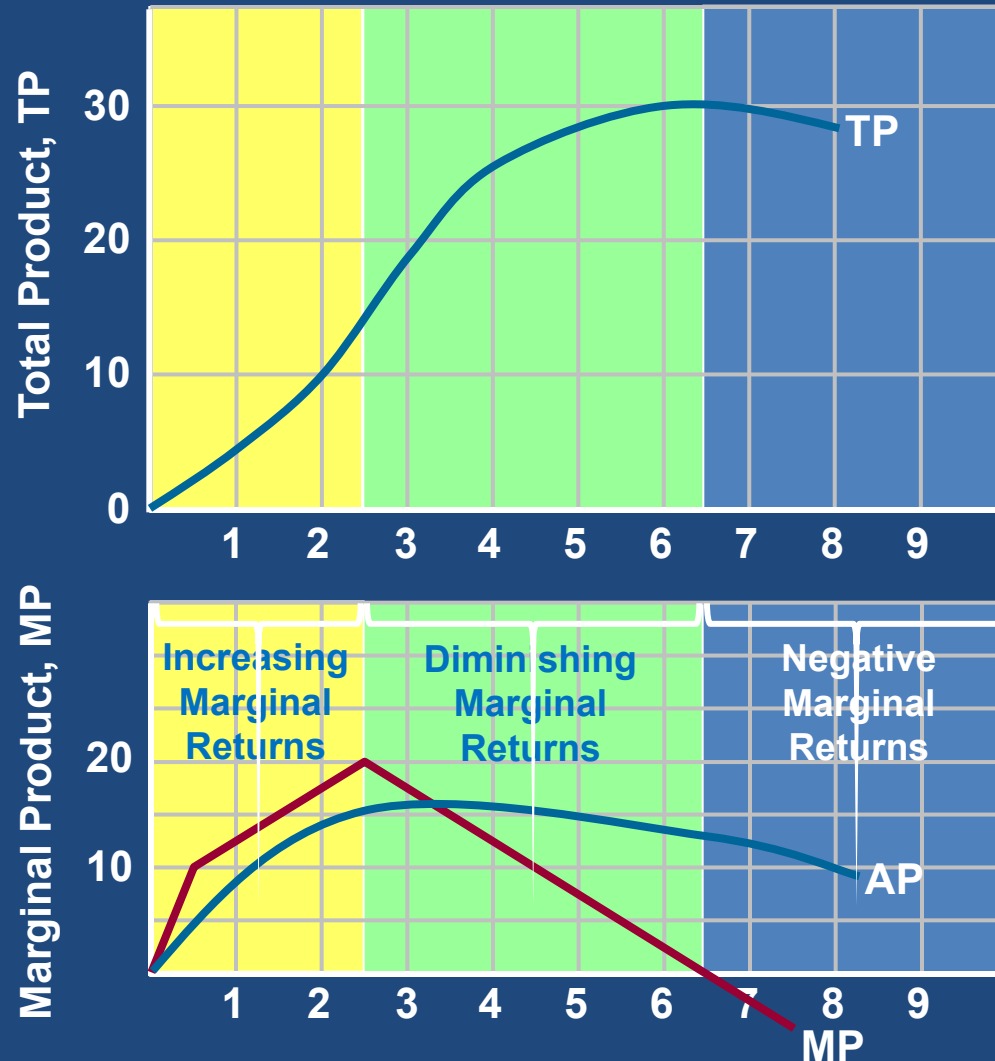
Law of Diminishing Returns

(1) Units of the Variable Resource (Labor)	(2) Total Product (TP)	(3) Marginal Product (MP), Change in (2)/ Change in (1)	(3) Average Product (AP), (2)/(1)
0	0	10	-
1	10	15	10.00
2	25	20	12.50
3	45	15	15.00
4	60	10	15.00
5	70	5	14.00
6	75	0	12.50
7	75	-5	10.71
8	70		8.75

The table illustrates the Law of Diminishing Returns. The first column shows the units of the variable resource (labor) from 0 to 8. The second column shows the total product (TP) at each level. The third column shows the marginal product (MP), which is the change in total product divided by the change in labor. The fourth column shows the average product (AP), which is the total product divided by the number of units of labor. The marginal product starts at 10 for the first unit, increases to 15 for the second unit, and then decreases to 20 for the third unit. This is labeled as "Increasing Marginal Returns". From the fourth unit onwards, the marginal product decreases to 15, 10, 5, 0, and -5, which is labeled as "Diminishing Marginal Returns". The marginal product becomes negative at the seventh unit, labeled as "Negative Marginal Returns".

Law of Diminishing Returns

- Graphical Portrayal



Law of Diminishing Returns Example

- For example, a farmer will find that a certain number of farm laborers will yield the maximum output per worker. If that number is exceeded, the output per worker will fall.
- Table 20.1 - Example of output per labor unit.

- The law of diminishing returns assumes all units of variable inputs—workers in this case—are of equal quality. Marginal product diminishes not because successive workers are inferior but because more workers are being used relative to the amount of plant and equipment available.

Short-Run Production Costs

- Fixed Costs
- Variable Costs
- Total Cost
 $TC = TFC + TVC$

Short-Run Production Relationships

- Short-run production reflects the law of diminishing returns that states that as successive units of a variable resource are added to a fixed resource, beyond some point the product attributable to each additional resource unit will decline.

Short Run Production Costs

- **Fixed, variable and total costs**
 - 1. Total fixed costs are those costs whose total does not vary with changes in short-run output.
 - 2. Total variable costs are those costs that change with the level of output. They include payment for materials, fuel, power, transportation services, most labor, and similar costs.
 - 3. Total cost is the sum of total fixed and total variable costs at each level of output (see Figure 20.3).

Short Run Production Costs

- **Per unit or average**

- 1. Average fixed cost is the total fixed cost divided by the level of output (TFC/Q). It will decline as output rises.
- 2. Average variable cost is the total variable cost divided by the level of output ($AVC = TVC/Q$).
- 3. Average total cost is the total cost divided by the level of output ($ATC = TC/Q$), sometimes called unit cost or per unit cost. Note that ATC also equals $AFC + AVC$ (see Figure 20.4).

Short Run Production Costs

- **Marginal cost** - additional cost of producing one more unit of output ($MC = \text{change in TC} / \text{change in } Q$).
 - 1. Marginal cost can also be calculated as $MC = \text{change in TVC} / \text{change in } Q$.
 - 2. Marginal decisions are very important in determining profit levels. Marginal revenue and marginal cost are compared.
 - 3. Marginal cost is a reflection of marginal product and diminishing returns. When diminishing returns begin, the marginal cost will begin its rise.
 - 4. The marginal cost is related to AVC and ATC. These average costs will fall as long as the marginal cost is less than either average cost. As soon as the marginal cost rises above the average, the average will begin to rise. Students can think of their grade-point averages with the total GPA reflecting their performance over their years in school, and their marginal grade points as their performance this semester. If their overall GPA is a 3.0, and this semester they earn a 4.0, their overall average will rise, but not as high as the marginal rate from this semester.

Short Run Production Costs

- Cost curves will shift if the resource prices change or if technology or efficiency change.

Short-Run Production Costs

- Per-Unit or Average Costs
 - Average Fixed Cost (AFC)
 - Average Variable Cost (AVC)
 - Average Total Cost (ATC)
 - Marginal Cost (MC)

$$\text{AFC} = \frac{\text{TFC}}{Q} \quad \text{AVC} = \frac{\text{TVC}}{Q}$$

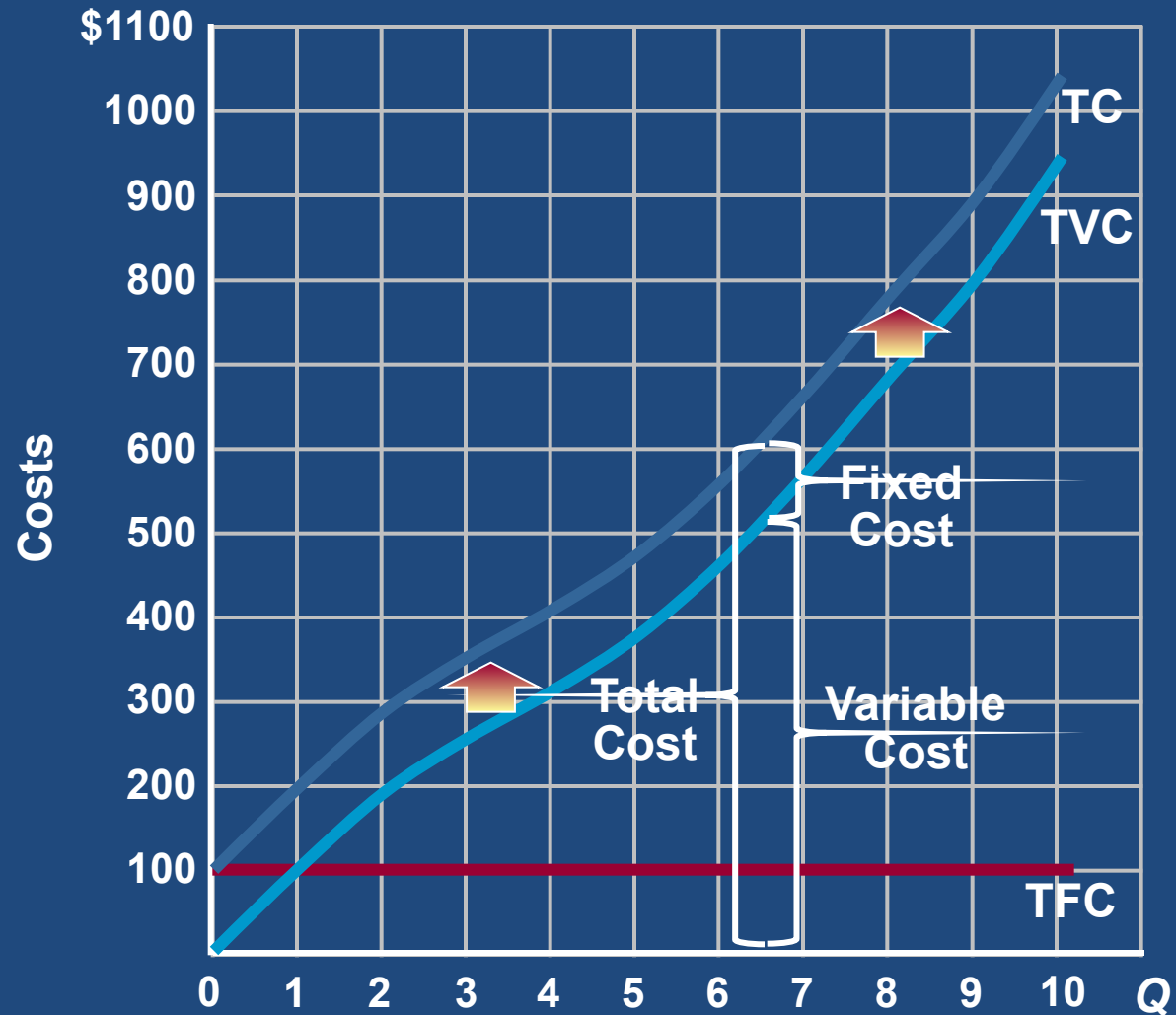
$$\text{ATC} = \frac{\text{TC}}{Q} = \text{AFC} + \text{AVC}$$

$$\text{MC} = \frac{\text{Change in TC}}{\text{Change in } Q}$$

Graphically...

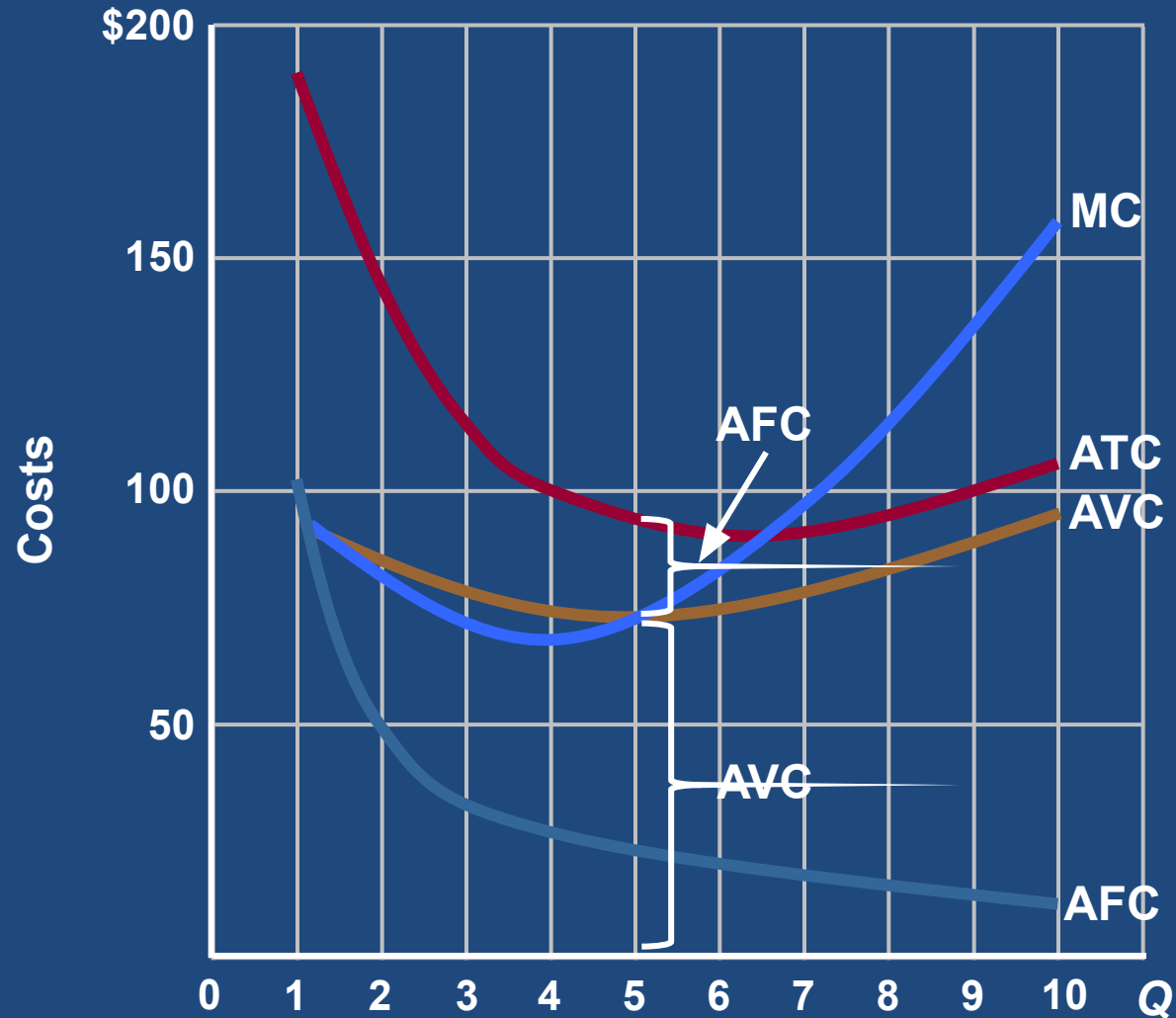
Short-Run Production Costs

Total Cost, Fixed and Variable Costs



Short-Run Production Costs

Average and Marginal Costs

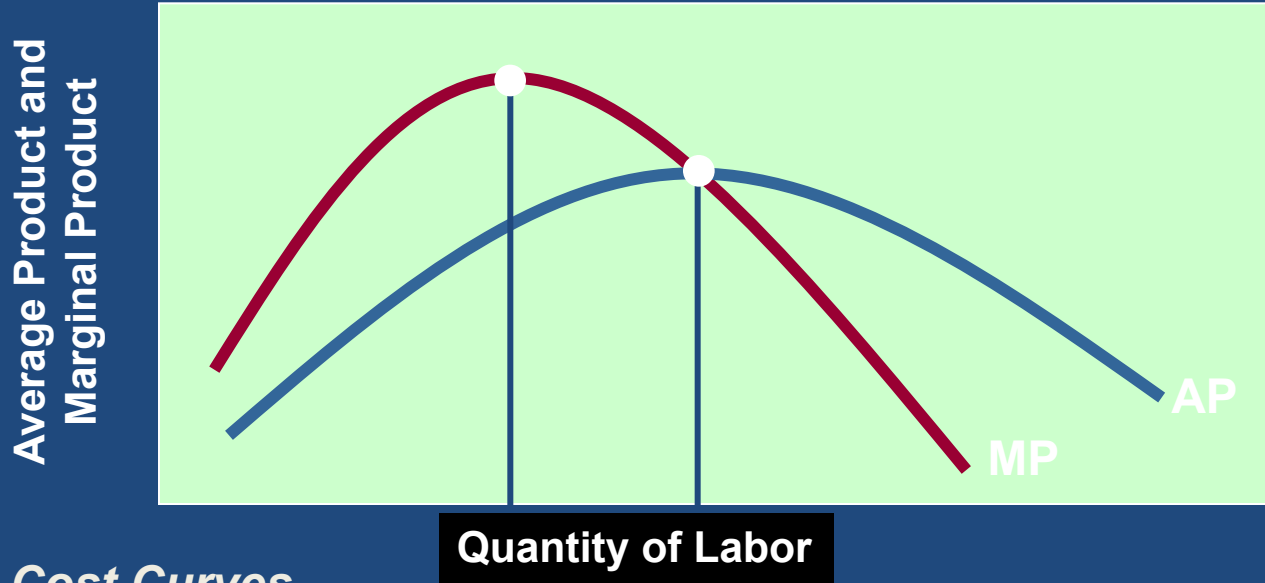


Short-Run Production Costs

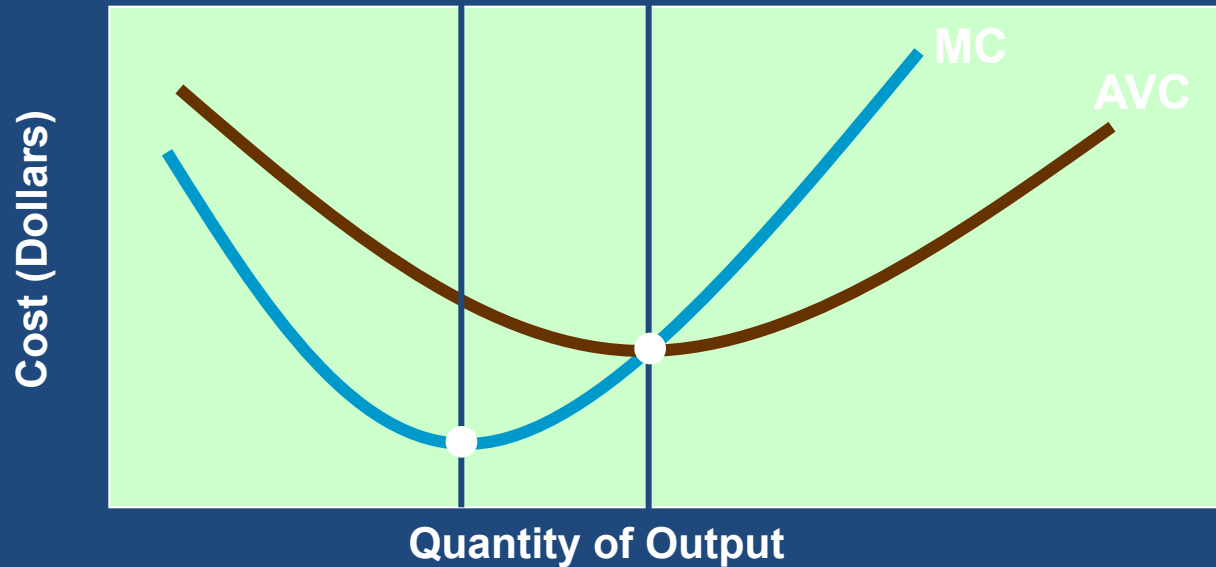
- MC and Marginal Product
- Marginal Decisions
- Relation of MC to AVC and ATC
- Relationship Between Productivity Curves and Cost Curves
- Shifts in Cost Curves
Graphically...

Short-Run Production Costs

Production Curves



Cost Curves



Long-run

- **In the long-run, all production costs are variable, i.e., long-run costs reflect changes in plant size and industry size can be changed (expand or contract).**
- **Can change inputs and plant size.**

Economies of Scale

- a.k.a. Economies of mass production
- As plant size increases, a number of factors will for a time lead to lower average costs of production.
 - Labor Specialization
 - Managerial Specialization
 - Efficient Capital
 - Other Factors

Diseconomies of Scale

- Over time, the expansion of a firm may lead to diseconomies of scale and therefore higher average total costs.
 - Cause – difficulty of efficiency controlling & coordinating a firm's operations as it becomes large.

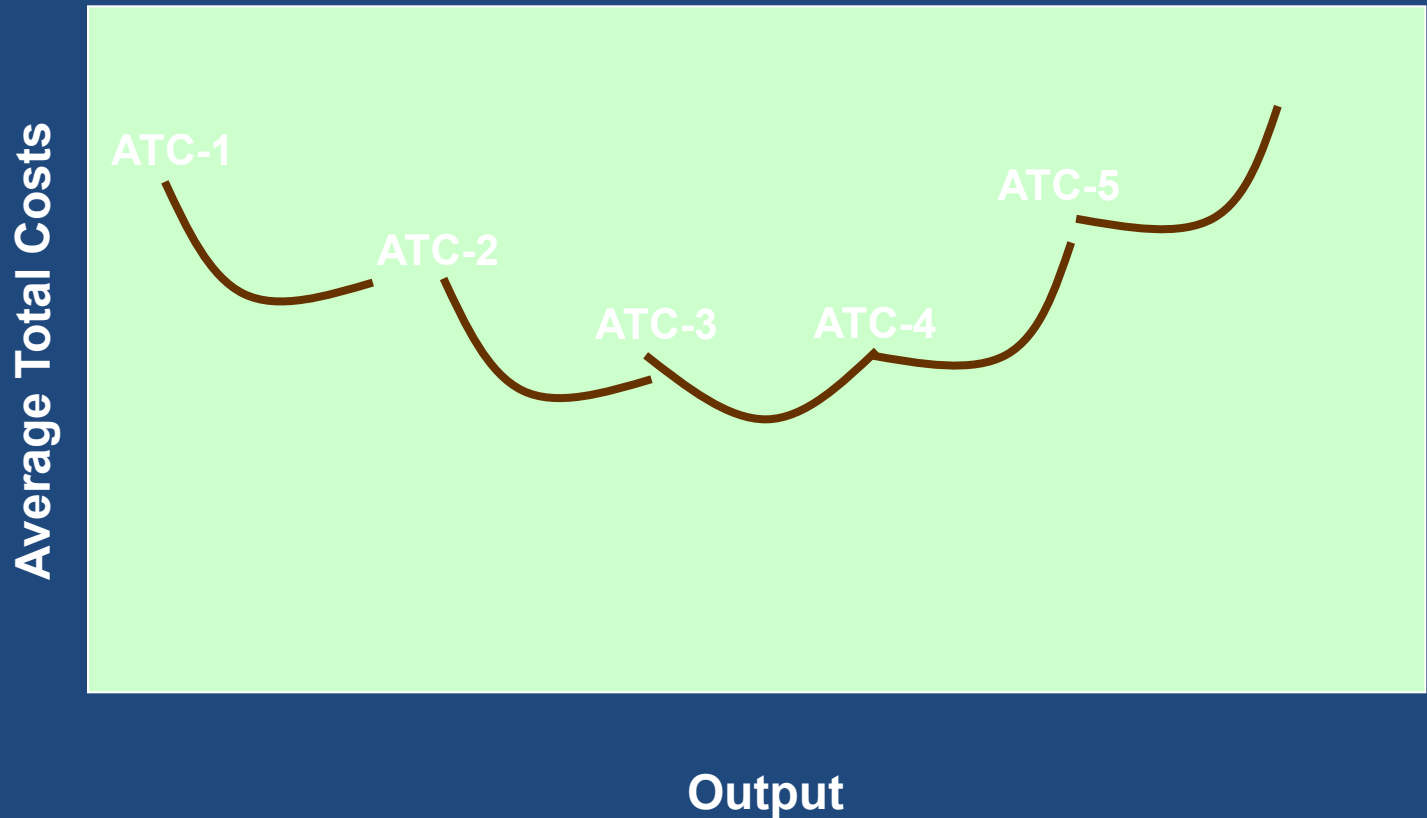
- Economies or diseconomies of scale exist in the long run.
 1. Economies of scale or economies of mass production explain the downward sloping part of the long-run ATC curve, i.e. as plant size increases, long-run ATC decrease.
 - a. Labor and managerial specialization is one reason for this.
 - b. Ability to purchase and use more efficient capital goods also may explain economies of scale.
 - C. Other factors may also be involved, such as design, development, or other “start up” costs such as advertising and “learning by doing

Long-Run Production Costs

- Firm Size and Costs
- Long-Run Cost Curve
- Economies of Scale
 - Labor Specialization
 - Managerial Specialization
 - Efficient Capital
- Diseconomies of Scale
- Constant Returns to Scale

Long-Run Production Costs

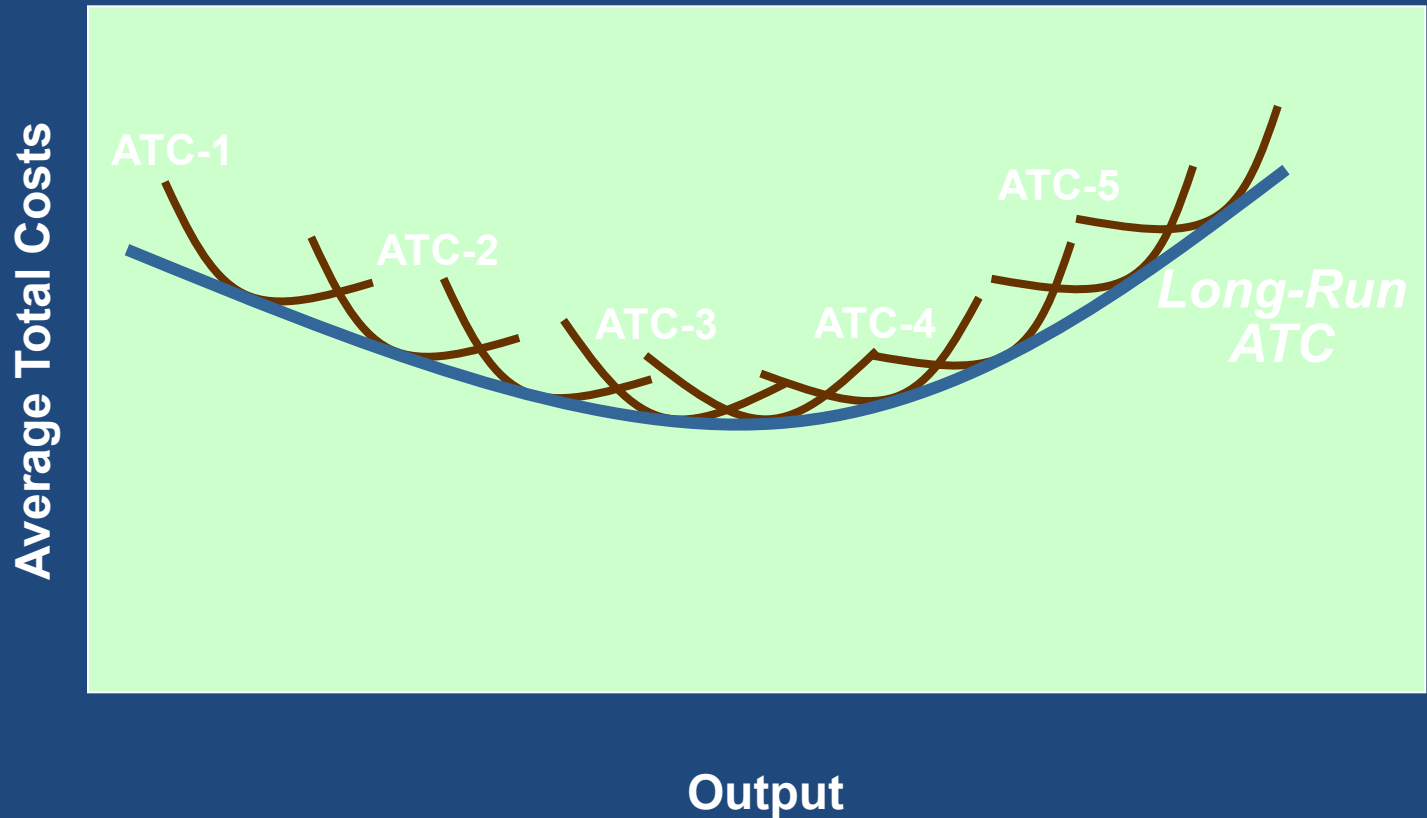
Long-Run ATC Curve



***Any Number of Short-Run Optimum
Size Cost Curves Can Be Constructed***

Long-Run Production Costs

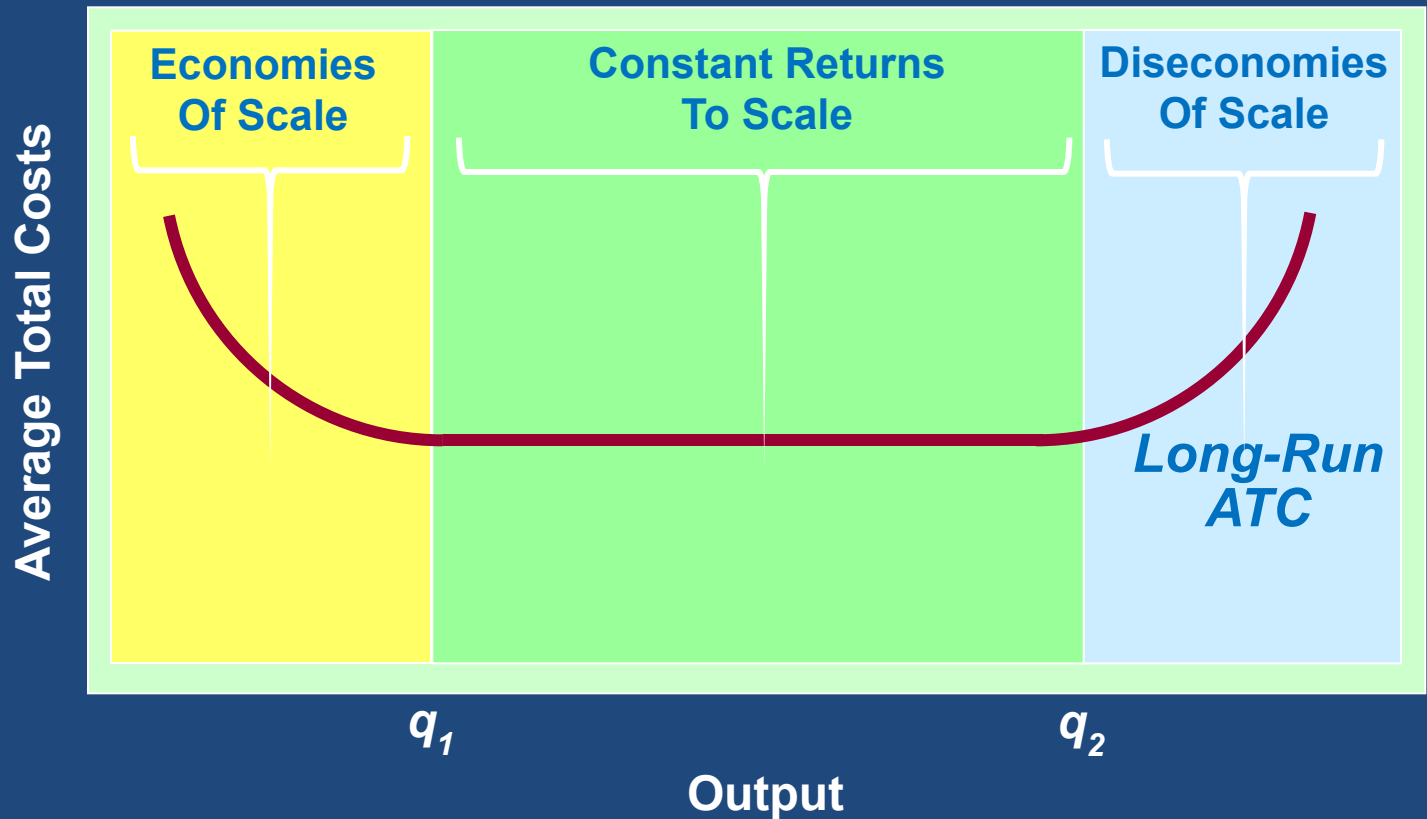
Long-Run ATC Curve



*The Long-Run ATC Curve Just
“Envelopes” the Short Run ATCs*

Long-Run Production Costs

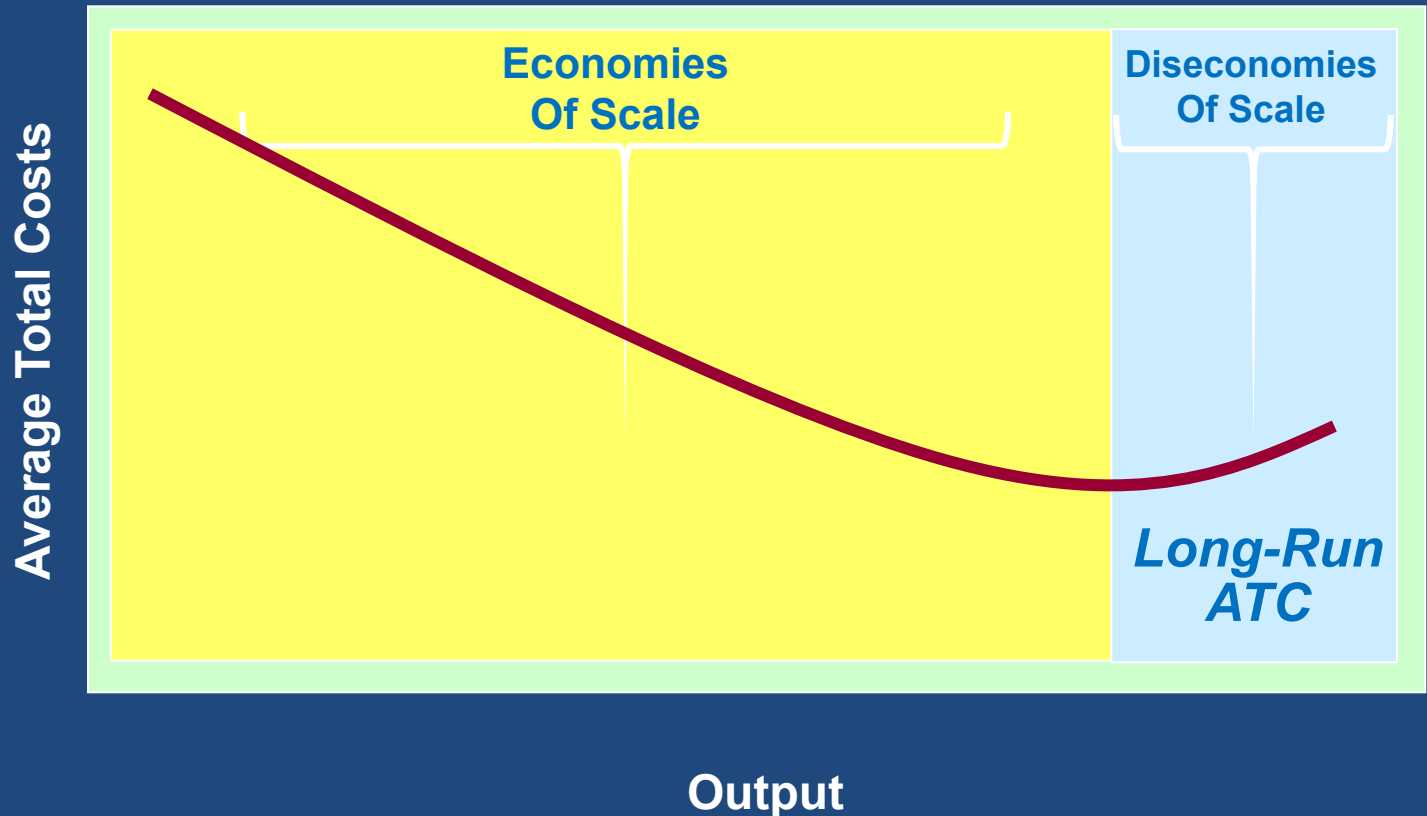
Alternative Long-Run ATC Shapes



Long-Run ATC Curve Where Economies Of Scale Exist

Long-Run Production Costs

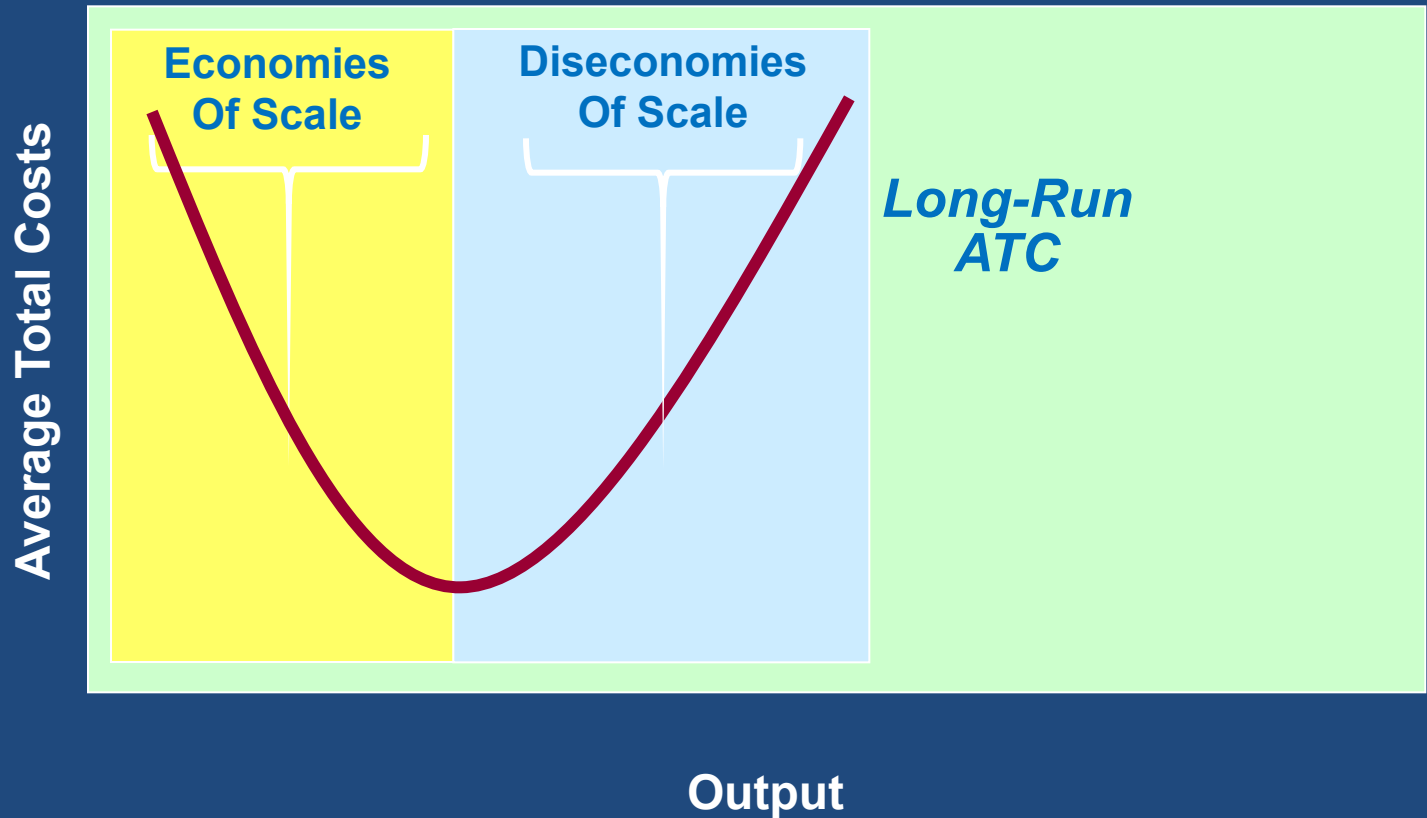
Alternative Long-Run ATC Shapes



Long-Run ATC Curve Where Costs Are Lowest Only When Large Numbers Are Participating

Long-Run Production Costs

Alternative Long-Run ATC Shapes



Long-Run ATC Curve Where Economies Of Scale Exist, are Exhausted Quickly, And Turn Back Up Substantially

Minimum Efficient Scale and Industry Structure

- Minimum Efficient Scale (MES)
- Natural Monopoly
- Applications and Illustrations
 - Rising Cost of Insurance and Security
 - Successful Start-Up Firms
 - The Verson Stamping Machine
 - The Daily Newspaper
 - Aircraft and Concrete Plants



Don't Cry Over Sunk Costs

Sunk Costs Irrelevant in Decision Making

- Once Incurred, They Cannot Be Recovered
- Compare Marginal Analysis to Find MC and MB
- Previously Incurred Costs Do Not Impact the $MB=MC$ Decision
- Sunk Costs Are Irrelevant!

End Chapter 20