

CHAPTER 11

Production and Cost Analysis I

Chapter Goals

- Explain the role of the firm in economic analysis.
- Describe the production process in the short run.
- Calculate fixed costs, variable costs, marginal costs, total costs, average fixed costs, average variable costs, and average total costs.
- Distinguish the various cost curves and describe the relationships among them.

The Role of the Firm

- Firms transform the factors into goods and services to consumers.
- In the supply process, people offer their factors of production, such as land, labor, and capital, to the market.
- **Production** is the transformation of factors into goods.
- Ultimately, all supply comes from individuals because they control the factors of production.

The Role of the Firm

A **firm** is an economic institution that transforms factors of production into goods and services.

Firms:

1. Organize factors of production and/or
2. Produce goods and services and/or
3. Sell produced goods and services

Some firms don't have a physical location and don't "produce" anything; they simply subcontract out all production.

Actual production is more and more being done by contract manufacturing and contract fulfillment companies such as Amazon.

Firms Maximize Profit

The goal of a firm is to maximize profits.

$$\text{Profit} = \text{Total revenue} - \text{Total cost}$$

For economists, **total cost** is explicit payments to the factors of production plus the opportunity cost of the factors provided by the owners of the firm.

For economists, **total revenue** is the amount a firm receives for selling its product or service plus any increase in the value of the assets owned by the firm.

Firms Maximize Profit

Economists and accountants measure profit differently.

Accountants focus on explicit costs and revenues.

Accounting profit = Explicit revenue – Explicit cost

Economists focus on both explicit and implicit costs and revenue.

Economic profit =

(Explicit + Implicit revenue) – (Explicit + Implicit cost)

The Production Process

The production process can be divided into the long run and the short run.

The terms long run and short run do not necessarily refer to specific periods of time, but to the flexibility the firm has in changing its inputs.

Short Run versus Long Run

Short Run

- A firm is constrained in regard to what production decisions it can make.
- Some inputs are fixed.

Long Run

- A firm chooses from all possible production techniques.
- All inputs are variable.

Production Tables and Production Functions

Firms combine factors of production to produce goods and services.

A **production table** is a table showing the output resulting from various combinations of factors of production or inputs.

Real-world production tables are complicated.

This analysis will concentrate on short-run production in which one of the factors is fixed.

A Production Table

# of workers	Total Output	Marginal Product	Average Product
0	0		---
1	4	4	4
2	10	6	5
3	17	7	5.7
4	23	6	5.8
5	28	5	5.6
6	31	3	5.2
7	32	1	4.6
8	32	0	4.0
9	30	-2	3.3
10	25	-5	2.5

Average product is the output per worker.

Marginal product is output per worker the additional output that will be forthcoming from an additional worker, other inputs constant.

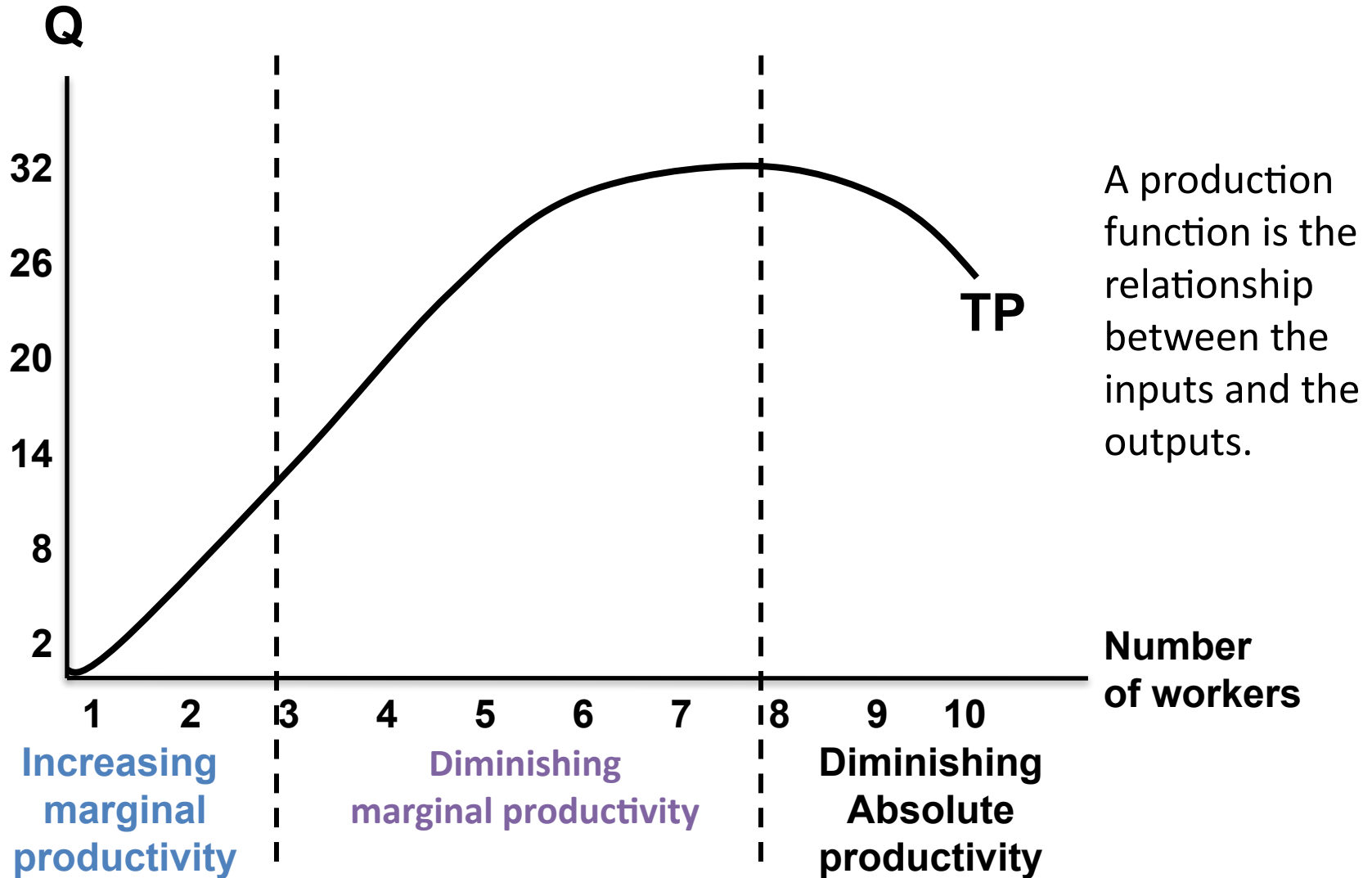
A Production Function

A **production function** is the relationship between the inputs (factors of production) and outputs.

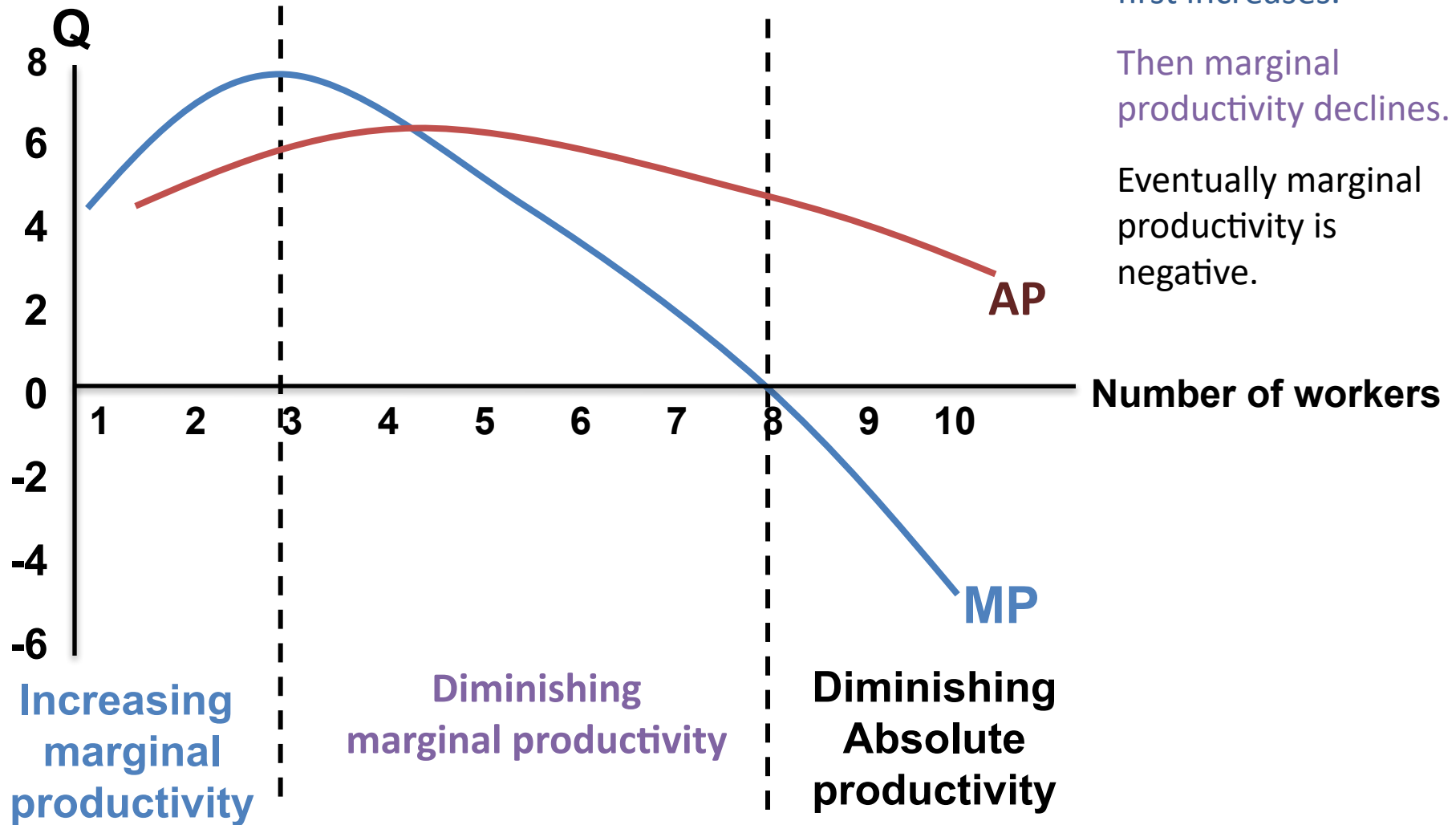
It tells the maximum amount of output that can be derived from a given number of inputs.

A production function can be seen in the next few slides.

Graphing a Production Function



Graphing Marginal and Average Productivity



Law of Diminishing Marginal Productivity

# of workers	Total Output	Marginal Product	Average Product
0	0	4	---
1	4	6	4
2	10	7	5
3	17	6	5.7
4	23	5	5.8
5	28	3	5.6
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10	25		2.5

Law of diminishing marginal productivity states as more of a variable input is added to an existing fixed input, after some point the additional output from the additional input will fall.

Increasing marginal productivity

Diminishing marginal productivity

Diminishing Absolute productivity

Fixed Costs

Fixed costs (FC) are those that are spent and cannot be changed in the period of time under consideration.

In the short run, a number of inputs and their costs will be fixed.

In the long run, there are no fixed costs since all inputs (and therefore their costs) are variable.

Examples of fixed costs are buildings and machinery.

Variable Costs

Variable costs (VC) are costs that change as output changes.

Examples of **variable costs (VC)** are labor, utility bills, and the materials for producing your product.

Total Costs

The sum of the variable and fixed costs are **total costs (TC)**.

$$TC = FC + VC$$

Average Costs

Average fixed costs (AFC) equal fixed cost divided by quantity produced:

$$AFC = FC/Q$$

Average variable costs (AVC) equal variable cost divided by quantity produced:

$$AVC = VC/Q$$

Average total costs (ATC) equal total cost divided by quantity produced:

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

Marginal Cost

Marginal cost (MC) is the increase in **total cost** when output increases by one unit.

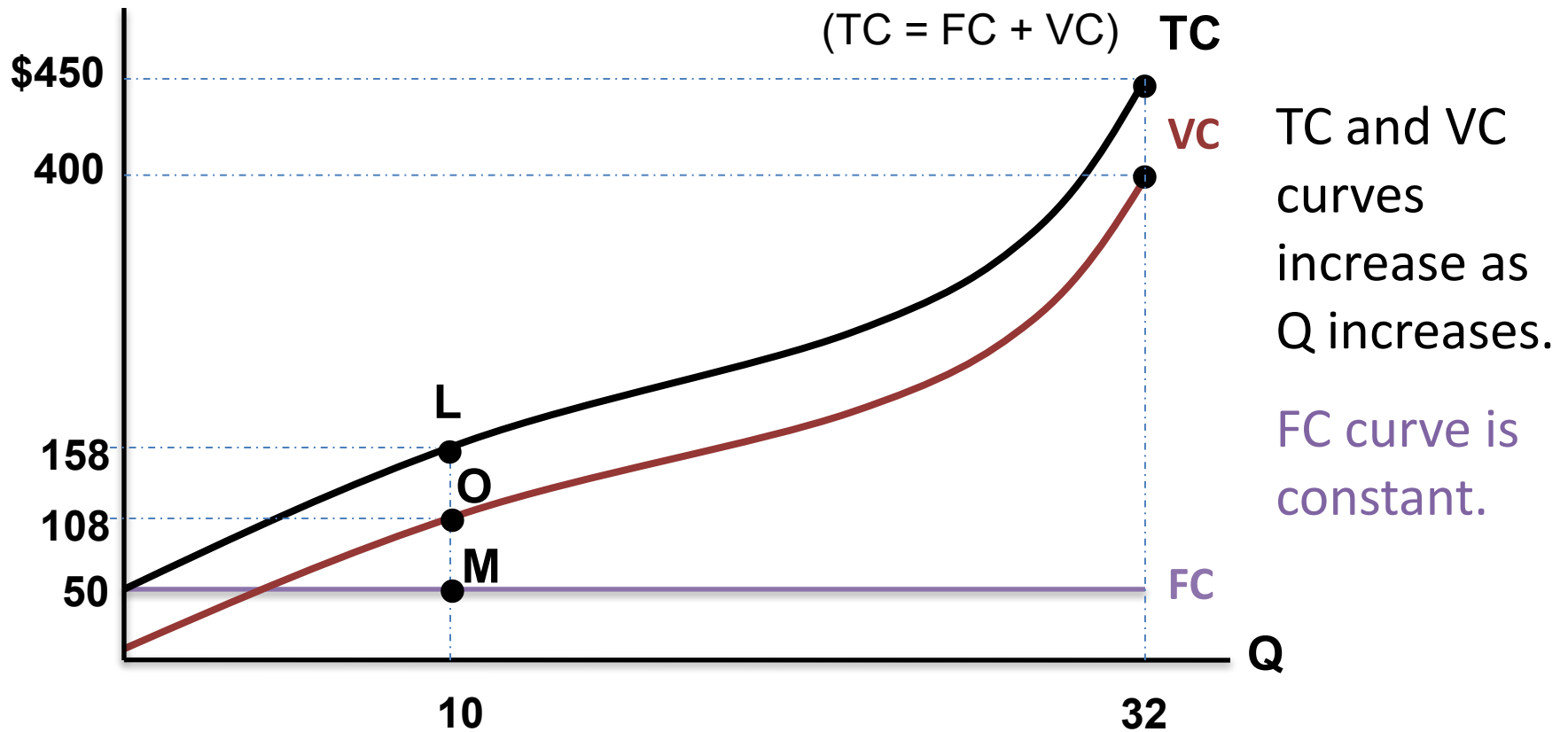
$$MC = \Delta TC / \Delta Q$$

Costs of Production Table

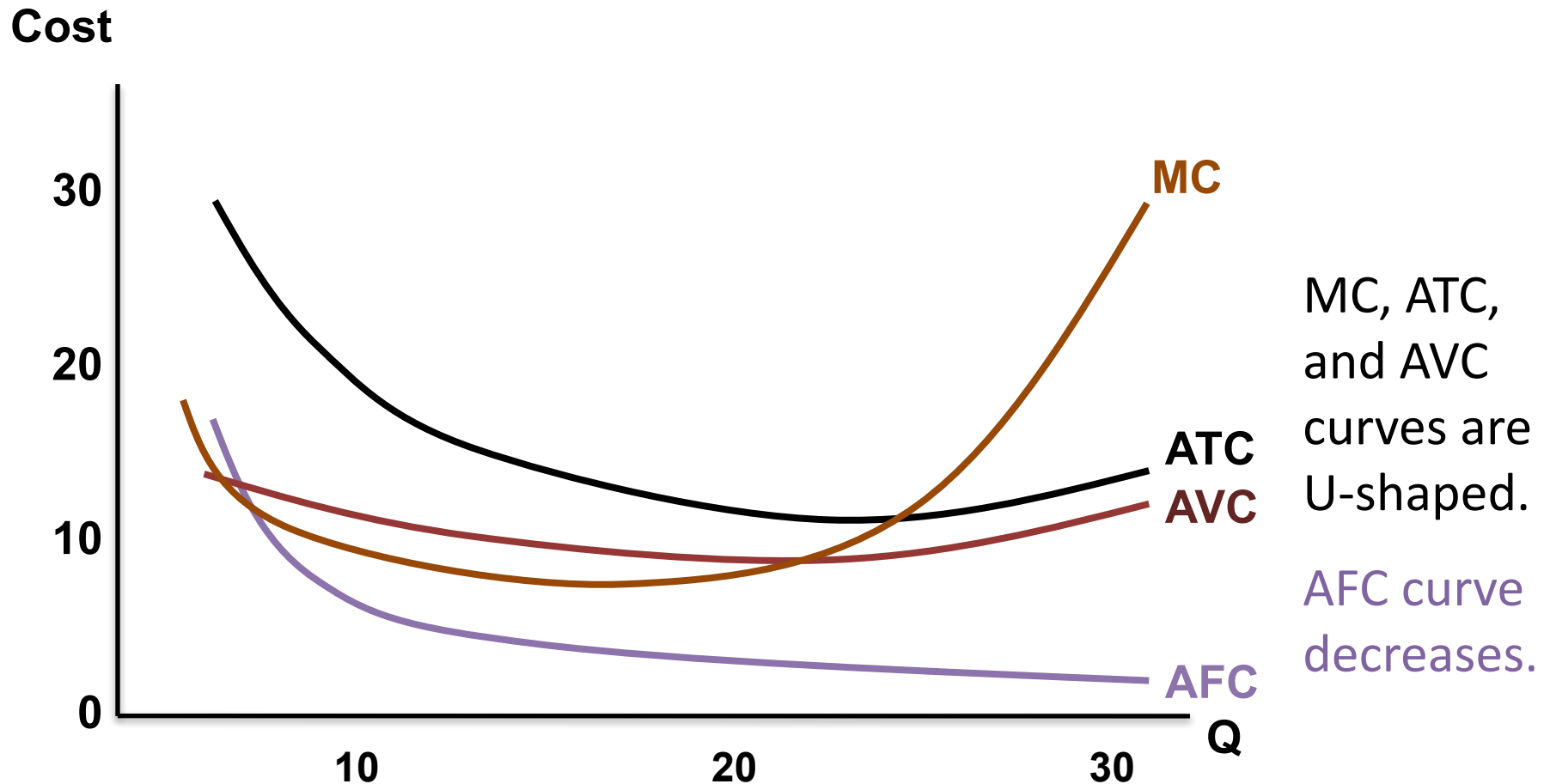
Output	FC (\$)	VC (\$)	TC (\$)	MC (\$)	AFC (\$)	AVC (\$)	ATC (\$)
3	50	38	88	12	16.67	12.66	29.33
4	50	50	100		12.50	12.50	25.00
9	50	100	150	8	5.56	11.11	16.67
10	50	108	158		5.00	10.80	15.80
16	50	150	200	7	3.12	9.38	12.50
17	50	157	207		2.94	9.24	12.18
22	50	200	250	10	2.27	9.09	11.36
23	50	210	260		2.17	9.13	11.30
27	50	255	305	15	1.85	9.44	11.29
28	50	270	320		1.79	9.64	11.43
32	50	400	450		1.56	12.50	14.06

Graphing Total Cost Curves

Total Cost



Graphing Per Unit Output Cost Curves



The Shapes of Cost Curves

- The variable and total cost (VC and TC) curves are upward sloping. Increasing output increases VC and TC.
- The fixed cost (FC) curve is always constant. Increasing output does not change FC.
- The average fixed cost (AFC) curve is downward sloping. Increasing output decreases AFC.
- The marginal cost (MC), average variable cost (AVC), and average total cost (ATC) curves are U-shaped. Increasing output initially leads to a decrease in MC, AVC, and ATC but eventually they increase.

The Shapes of the Average Cost Curves

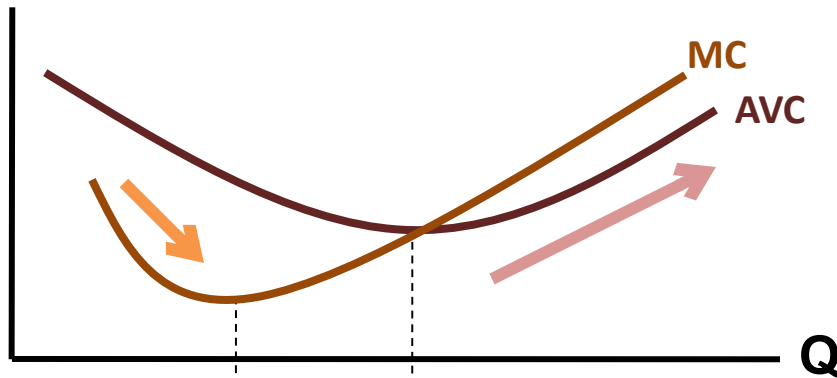
The U-shape of ATC and AVC curves is due to:

- When output is increased in the short run, it can only be done by increasing the variable input.
- The law of diminishing productivity causes marginal and average productivities to fall.
- As average and marginal productivities fall, average and marginal costs rise.

The marginal cost curve goes through the minimum points of the ATC and AVC curves.

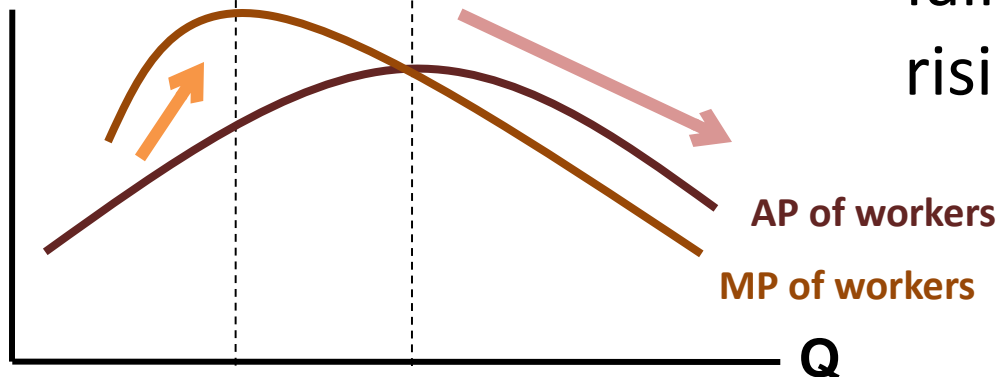
The Relationship Between Marginal Productivity and Marginal Costs

Costs
per unit



If marginal productivity is rising, marginal costs are falling.

Output
per worker



If average productivity is falling, average costs are rising.

The Relationship Between Marginal Cost and Average Cost

If $MC > ATC$, then ATC is rising.

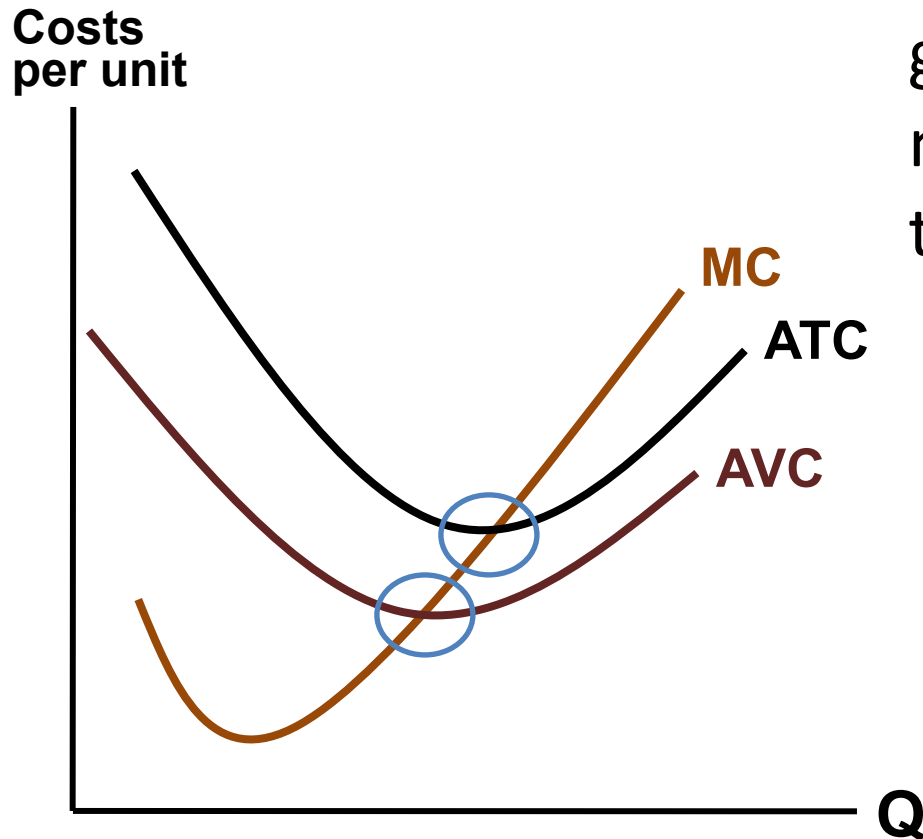
If $MC > AVC$, then AVC is rising.

If $MC < ATC$, then ATC is falling.

If $MC < AVC$, then AVC is falling.

If $MC = AVC$ and $MC = ATC$, then AVC and ATC are at their minimum points.

The Relationship Between Marginal Cost and Average Cost



The marginal cost curve goes through the minimum point of both the ATC and AVC curves.

Chapter Summary

Accounting profit is explicit revenue less explicit cost.

Economists include implicit revenue and cost in determining economic profit.

Implicit revenue includes the increases in the value of assets owned by the firm. Implicit costs include the opportunity cost of time and capital provided by owners of the firm.

In the long run a firm can choose among all possible production techniques. In the short run it is constrained in its choices because at least one input is fixed.

Chapter Summary

The law of diminishing marginal productivity states that as more of a variable input is added to a fixed input, the additional output will eventually be decreasing

Costs are generally divided into fixed costs, variable costs, and total costs.

$$TC = FC + VC$$

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

$$AFC = FC / Q$$

$$AVC = VC / Q$$

$$ATC = AFC + AVC$$

Chapter Summary

The average variable cost curve and marginal cost curve are mirror images of the average product curve and the marginal product curve, respectively.

The law of diminishing marginal productivity causes marginal and average costs to rise.

If $MC > ATC$, then ATC is rising.

If $MC = ATC$, then ATC is constant.

If $MC < ATC$, then ATC is falling.

MC curve goes through the minimum points of the AVC curve and ATC curve.