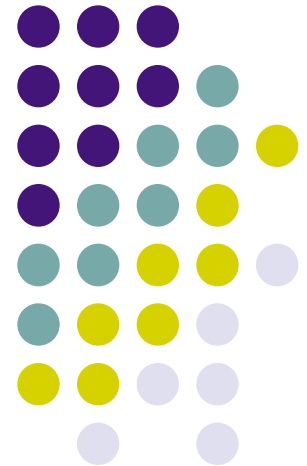
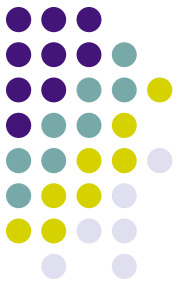


The Production and Cost

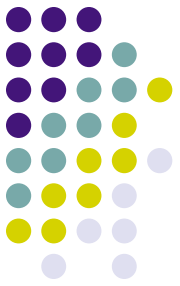




The Role of the Firm

- The *firm* is an economic institution that transforms factors of production into consumer goods. It ...
 - Organizes factors of production.
 - Produces goods and services.
 - Sells produced goods and services.

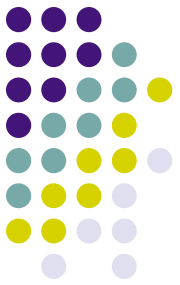
The Firm's Objective



The economic goal of the firm is to maximize profits.



A Firm's Profit

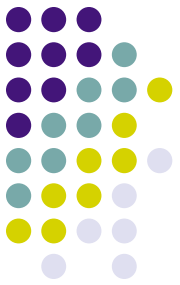


Profit is the firm's total revenue minus its total cost.

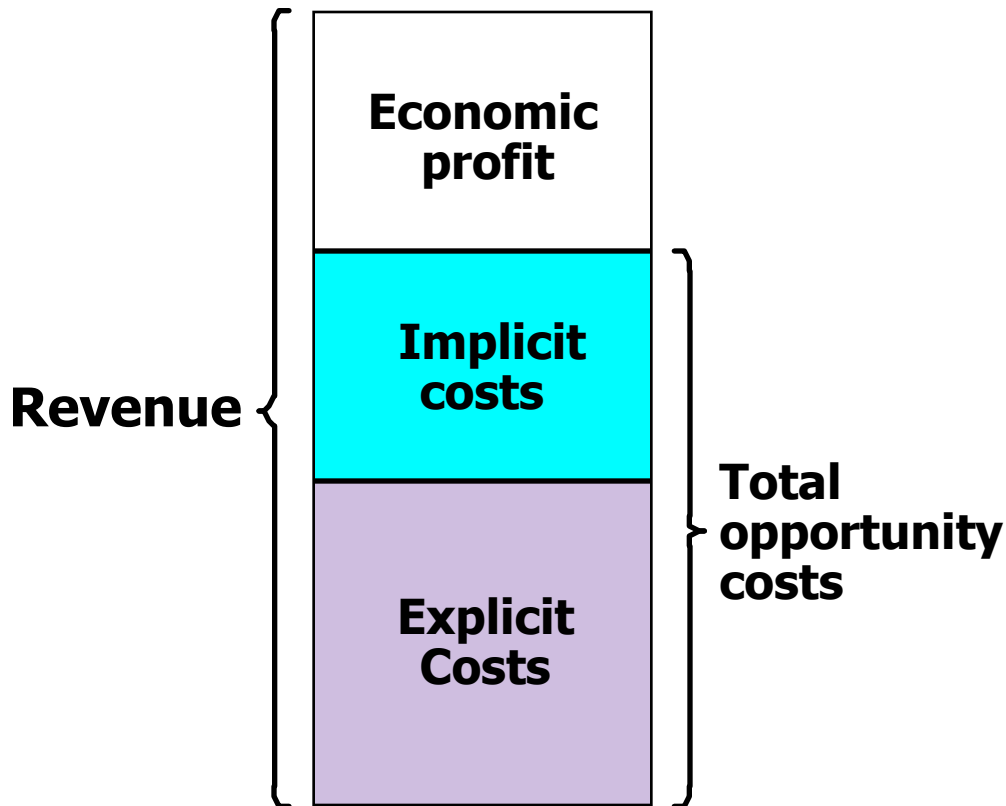
Profit = Total revenue - Total cost

Total cost includes all of the opportunity costs of production

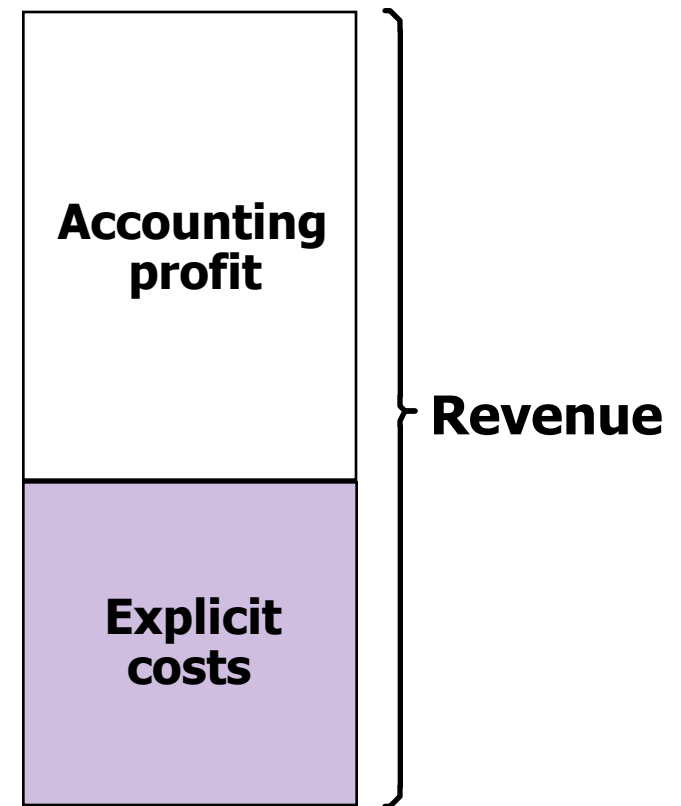
Economic Profit vs. Accounting Profit

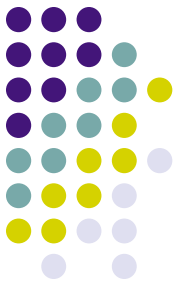


How an Economist Views a Firm



How an Accountant Views a Firm

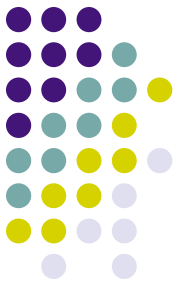




Costs and Profit

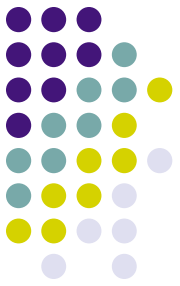
- **Explicit costs:** Monetary payments the firm makes for the use of resources owned by others. (What do we mean?)
- **Implicit costs:** Opportunity costs of using the firm's own self-owned, self-employed resources. (What do we mean?)
- **Normal profit:** The implicit cost of entrepreneurial talent.
- **Economic profit:** Total revenue minus economic costs.

Technology and Production Function

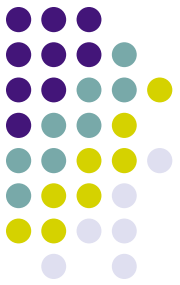


- **Technology:** Production process that defines how a firm can combine or convert inputs into outputs.
- **Production function:** Is a function that describes the efficient combination of inputs to produce a certain level of output (the maximum amount of any output a producer can get most efficiently, given a certain level of inputs; or the minimum amount of inputs required to produce a level of output).

Technology and Production Function



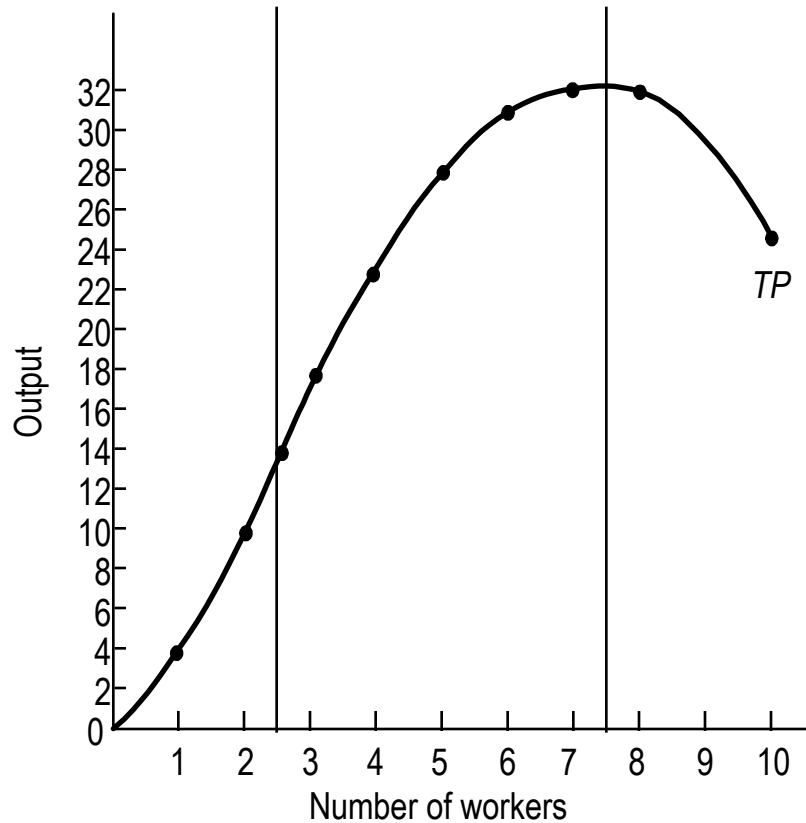
- ***Marginal product*** is the additional output that will be forthcoming from an additional unit of input, other inputs remaining constant.
- ***Average product*** is calculated by dividing total output by the quantity of the input.



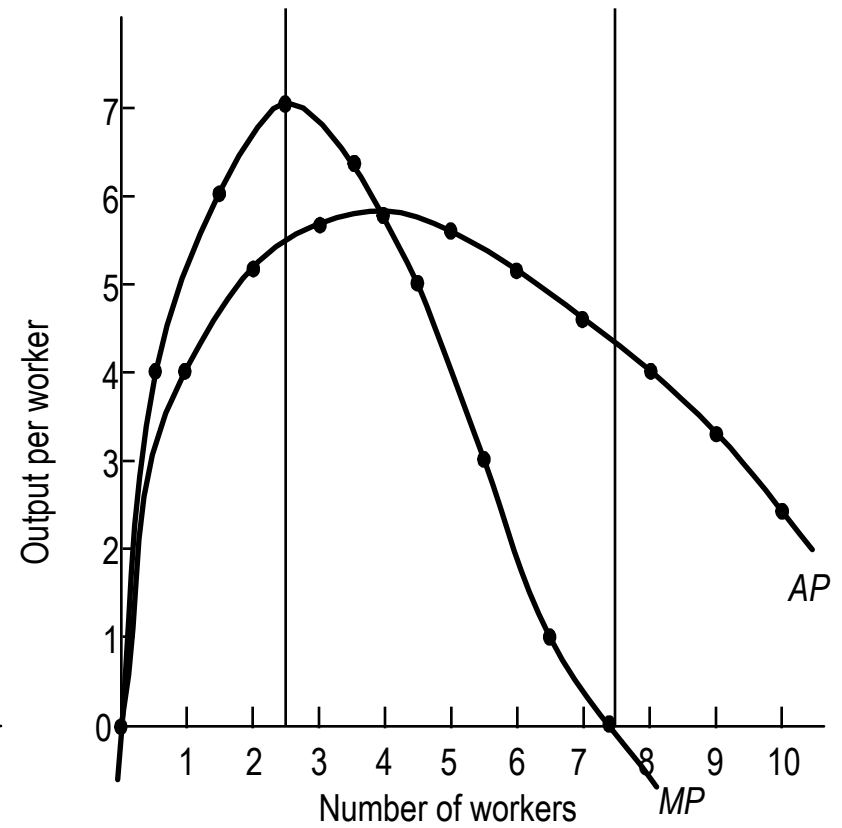
A Production Table

| Number 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 |

Graphical Representation of TP, AP, and MP curves

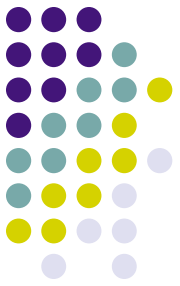


(a) Total product



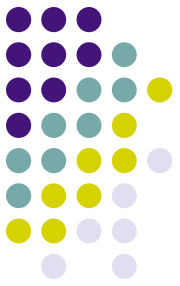
(b) Marginal and average product

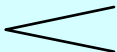
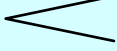





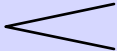

The Law of Diminishing Marginal Productivity



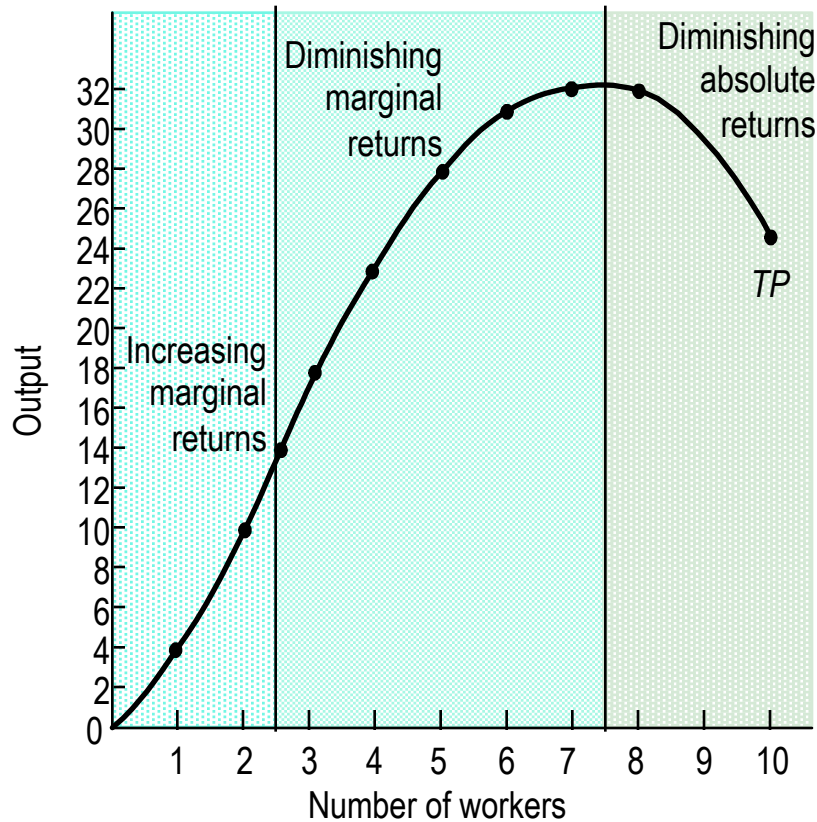
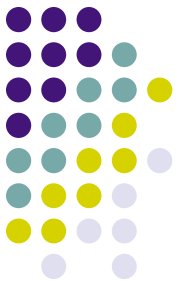
- Both marginal and average productivities initially increase, but eventually they both decrease.
- This means that initially the production function exhibits increasing marginal productivity.
- Then it exhibits diminishing marginal productivity.
- Finally, it exhibits negative marginal productivity.

The Law of Diminishing Marginal Productivity

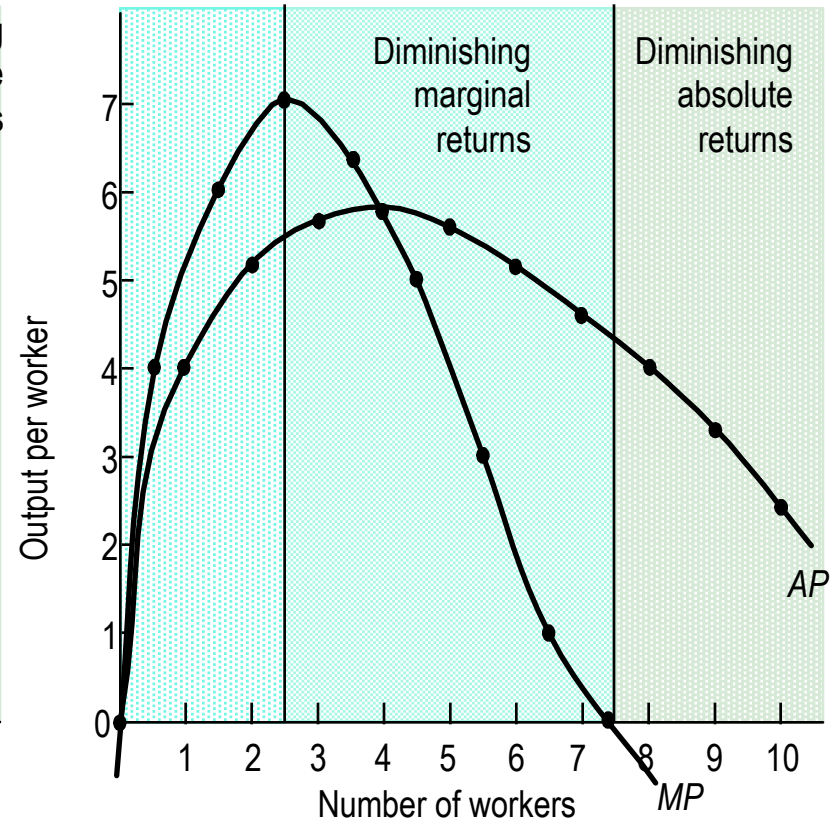


| Number of workers | Total output | Marginal product | Average product | |
|-------------------|--------------|---|-----------------|------------------------------|
| 0 | 0 | | — | |
| 1 | 4 |  | 4 | Increasing marginal returns |
| 2 | 10 |  | 5 | |
| 3 | 17 |  | 5.7 | |
| 4 | 23 |  | 5.8 | Diminishing marginal returns |
| 5 | 28 |  | 5.6 | |
| 6 | 31 |  | 5.2 | |
| 7 | 32 |  | 4.6 | |
| 8 | 32 |  | 4.0 | Diminishing absolute returns |
| 9 | 30 |  | 3.3 | |
| 10 | 25 | | 2.5 | |

The Law of Diminishing Marginal Productivity

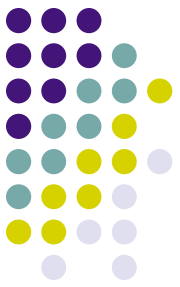


(a) Total product



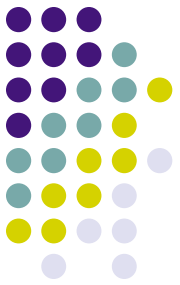
(b) Marginal and average product

Fixed Costs, Variable Costs, and Total Costs



- **Fixed costs** are those that are spent and cannot be changed in the period of time under consideration.
 - In the long run there are no fixed costs since all costs are variable.
 - In the short run, a number of costs will be fixed.
- Workers represent **variable costs** – those that change as output changes.

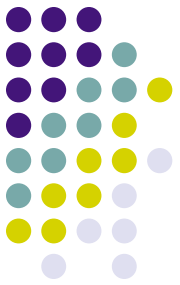
Family of Total Costs



- ◆ Total Fixed Costs (TFC)
- ◆ Total Variable Costs (TVC)
- ◆ Total Costs (TC)

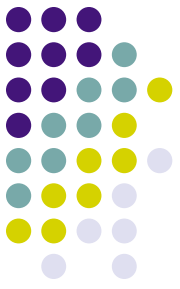
$$TC = TFC + TVC$$

Family of Total Costs



| Quantity | Total Cost | Fixed Cost | Variable Cost |
|----------|------------|------------|---------------|
| 0 | \$ 3.00 | \$3.00 | \$ 0.00 |
| 1 | 3.30 | 3.00 | 0.30 |
| 2 | 3.80 | 3.00 | 0.80 |
| 3 | 4.50 | 3.00 | 1.50 |
| 4 | 5.40 | 3.00 | 2.40 |
| 5 | 6.50 | 3.00 | 3.50 |
| 6 | 7.80 | 3.00 | 4.80 |
| 7 | 9.30 | 3.00 | 6.30 |
| 8 | 11.00 | 3.00 | 8.00 |
| 9 | 12.90 | 3.00 | 9.90 |
| 10 | 15.00 | 3.00 | 12.00 |

Average Costs



- **Average fixed cost** equals fixed cost divided by quantity produced.

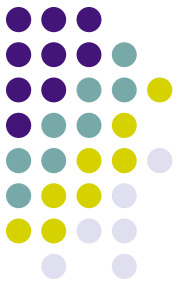
$$AFC = FC/Q$$

- **Average variable cost** equals variable cost divided by quantity produced.

$$AVC = VC/Q$$

- **Average total cost** can also be thought of as the sum of average fixed cost and average variable cost. $ATC = TC/Q$

$$ATC = AFC + AVC$$

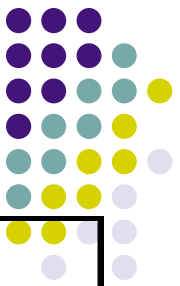


Marginal Cost

- ***Marginal cost*** is the increase (decrease) in total cost of increasing (or decreasing) the level of output by one unit.

$$\text{MC} = \frac{\text{(Change in total cost)}}{\text{(Change in quantity)}}$$

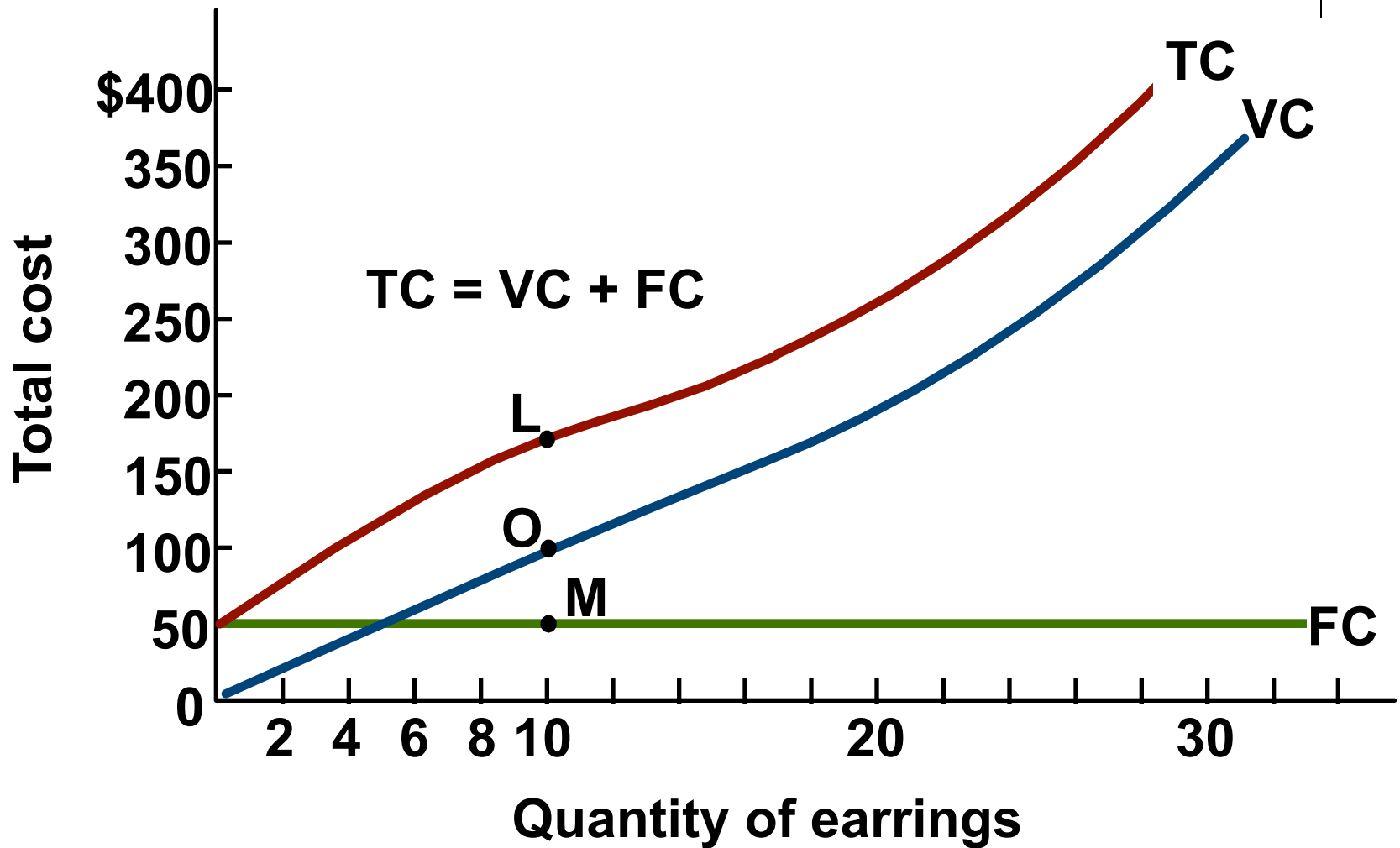
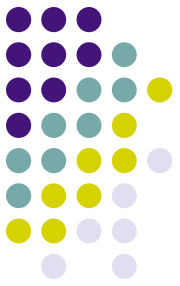
$$= \frac{\Delta \text{TC}}{\Delta \text{Q}}$$



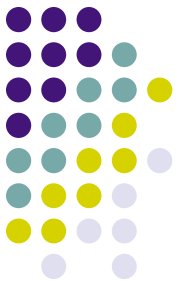
The Cost of Producing Earrings

| Output | FC | VC | TC | MC | AFC | AVC | ATC |
|--------|----|-----|-----|----|-------|-------|-------|
| 3 | 50 | 38 | 88 | — | 16.67 | 12.66 | 29.33 |
| 4 | 50 | 50 | 100 | 12 | 12.50 | 12.50 | 25.00 |
| 9 | 50 | 100 | 150 | — | 5.56 | 11.11 | 16.67 |
| 10 | 50 | 108 | 158 | 8 | 5.00 | 10.80 | 15.80 |
| 16 | 50 | 150 | 200 | — | 3.13 | 9.38 | 12.50 |
| 17 | 50 | 157 | 207 | 7 | 2.94 | 9.24 | 12.18 |
| 22 | 50 | 200 | 250 | — | 2.27 | 9.09 | 11.36 |
| 23 | 50 | 210 | 260 | 10 | 2.17 | 9.13 | 11.30 |
| 27 | 50 | 255 | 305 | — | 1.85 | 9.44 | 11.30 |
| 28 | 50 | 270 | 320 | 15 | 1.79 | 9.64 | 11.42 |

Total Cost Curves

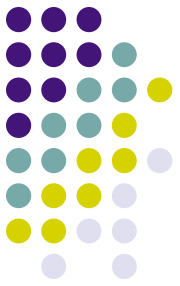


Average and Marginal Cost Curves



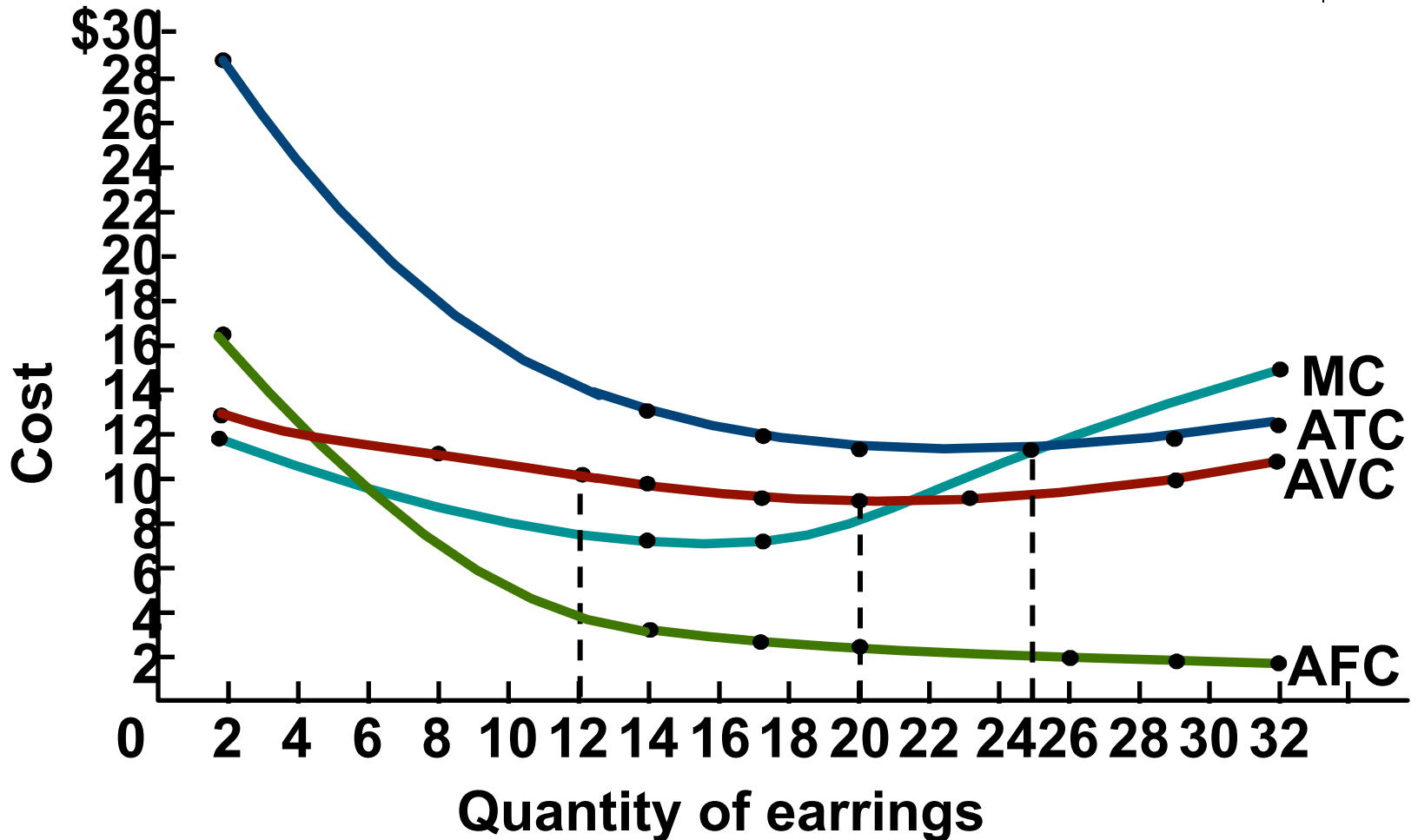
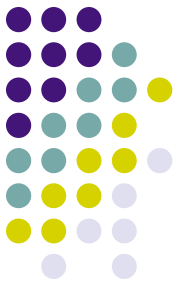
- The marginal cost curve goes through the minimum point of the average total cost curve and average variable cost curve.
- Each of these curves is U-shaped.
- The average fixed cost curve slopes down continuously.
- It tells us that as output increases, the same fixed cost can be spread out over a wider range of output.

The U Shape of the Average and Marginal Cost Curves

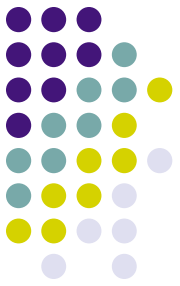


- The law of diminishing marginal productivity sets in as more and more of a variable input is added to a fixed input.
- Marginal and average productivities fall and marginal costs rise.
- When average productivity of the variable input falls, average variable cost rises.
- The average total cost curve is the vertical summation of the average fixed cost curve and the average variable cost curve.

Per Unit Output Cost Curves



Relationship Between Marginal and Average Costs



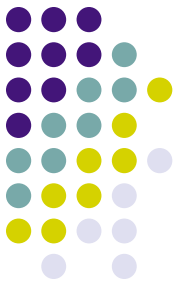
- To summarize:

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

If $MC = ATC$, then ATC is at its low point.

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

Relationship Between Marginal and Average Costs



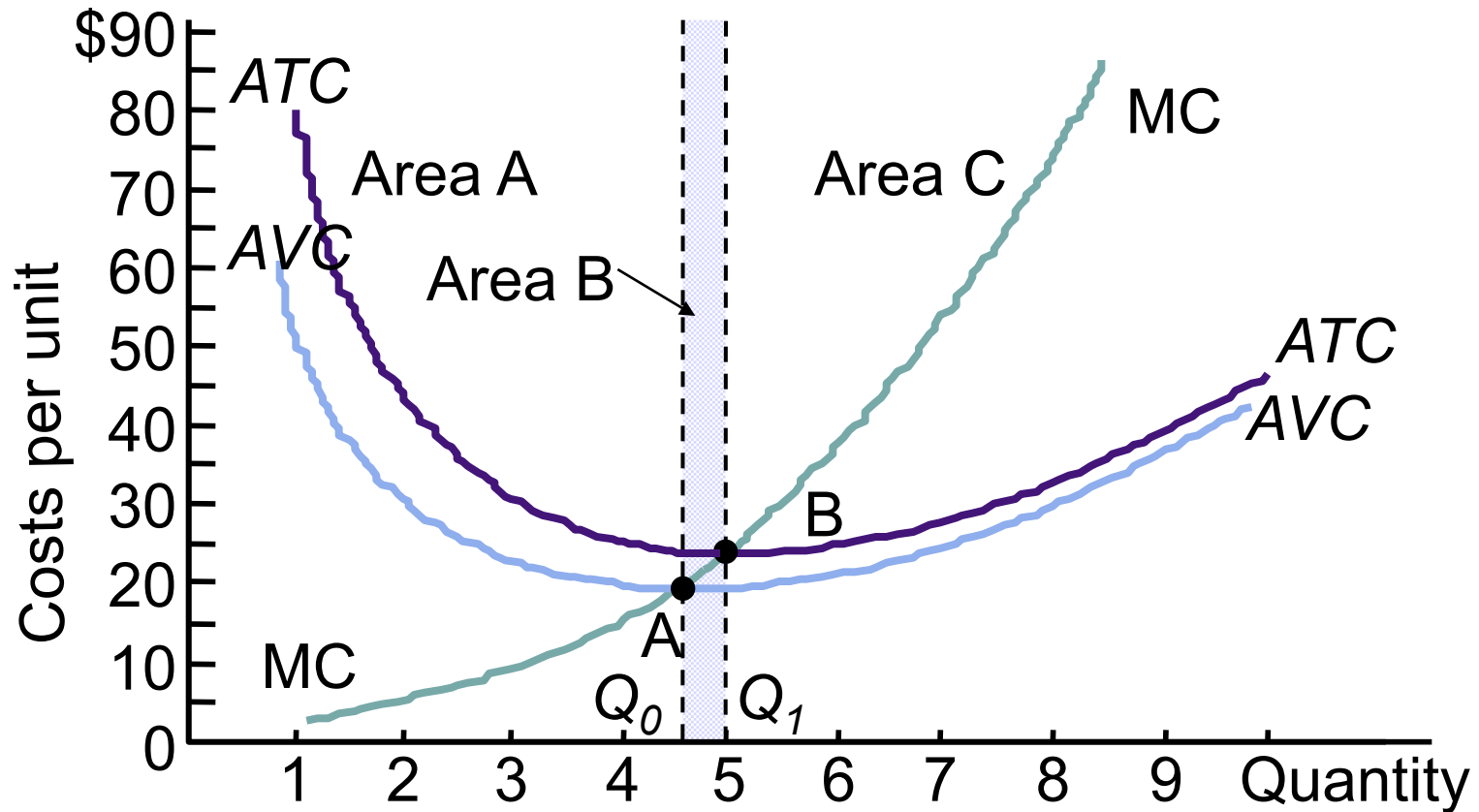
- Marginal and average total cost reflect a general relationship that also holds for marginal cost and average variable cost.

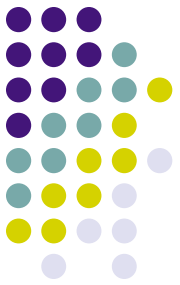
If $MC > AVC$, then AVC is rising.

If $MC = AVC$, then AVC is at its low point.

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

Relationship Between Marginal and Average Costs

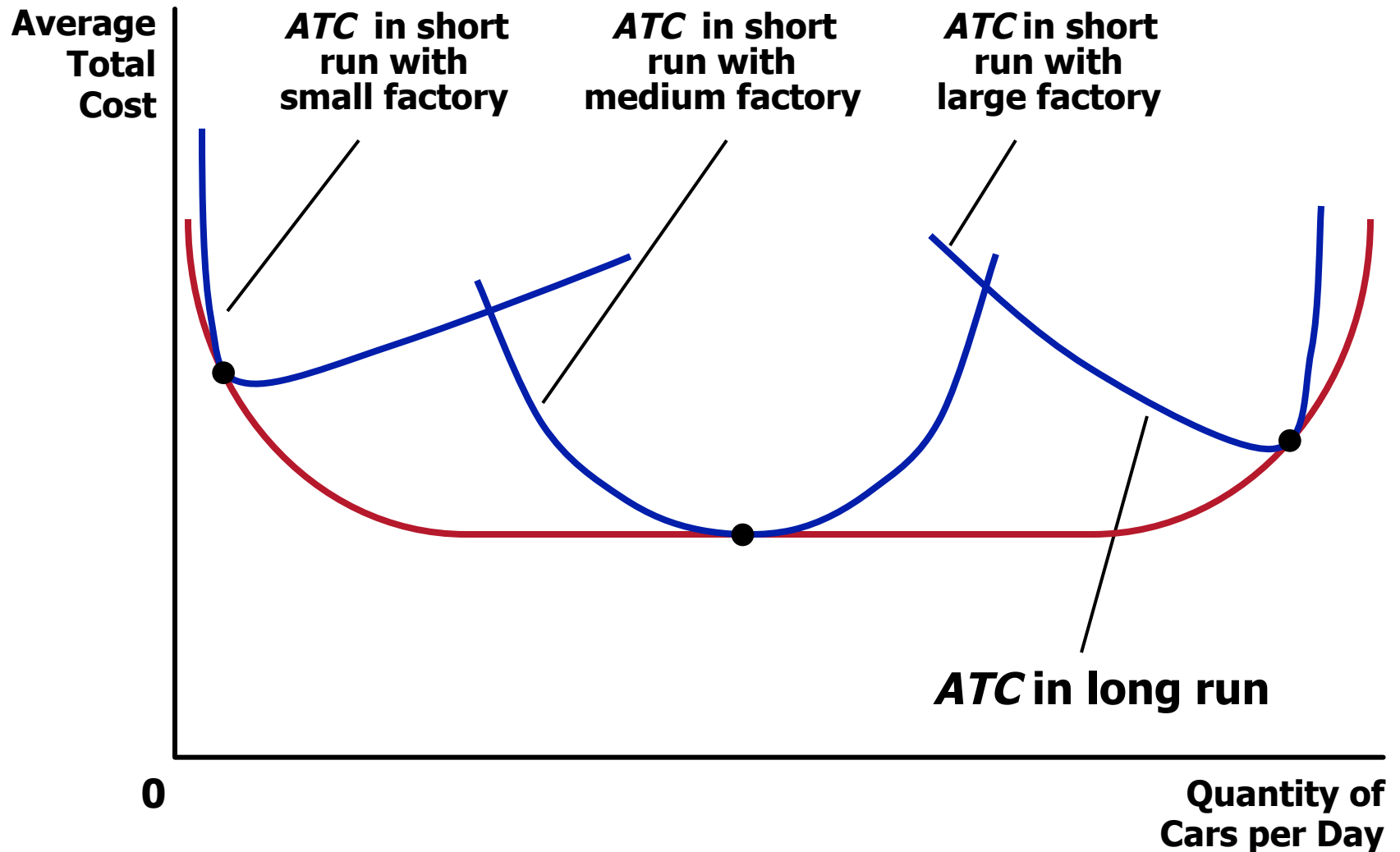
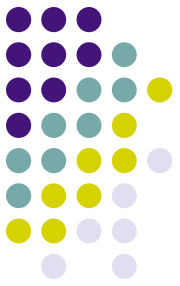




Costs in the Long Run

- ◆ For many firms, the division of total costs between fixed and variable costs depends on the time horizon being considered.
 - ◆ In the short run some costs are fixed.
 - ◆ In the long run fixed costs become variable costs.

Average Total Cost in the Short and Long Runs...



Economies and Diseconomies of Scale of Scale

