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1.1 Goals of this class

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- Learn fundamentals of production and costs in order to think about optimal producer behavior.
- Learn a framework for understanding production.
- Learn a framework for understanding costs.

2 Short-run Production Decisions

2.1 Measuring Production

Short-Run Production

- Short-run decisions: we'll be considering changing only one factor of production, eg: labor.
- Long-run decisions: expand, buy new capital, new buildings, new land, contract, leave industry, new firms enter industry.
- **Total Product:** maximum output that can be produced with given quantities of labor.
- **Marginal Product of Labor (MP_L):** additional output that can be produced when labor is increased by one unit.
- **Average Product of Labor (AP_L):** average output per worker.

$$MP_L = \frac{\Delta Q}{\Delta L} \quad AP_L = \frac{Q}{L}$$

2.2 Example

Example

Labor (L)	Total Product (Q)	MP_L	AP_L
0	0		
2	20		
4	36		
6	48		
10	56		
12	60		

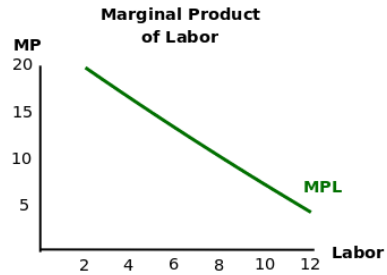
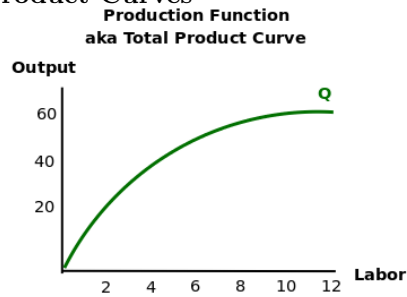
2.3 Relationship Between Marginals and Averages

Marginal and Average Product

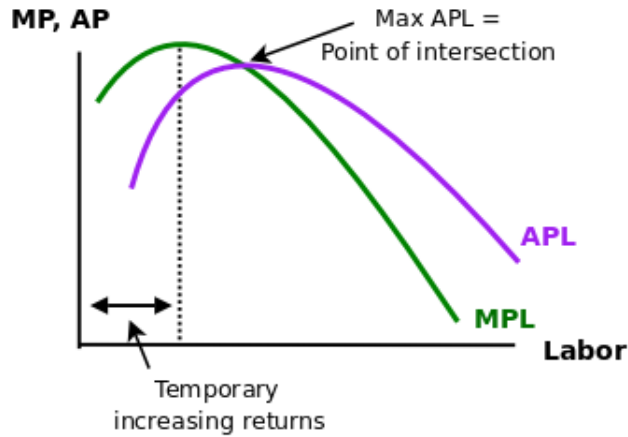
- **Law of Diminishing Marginal Product:** aka law of diminishing returns, as the quantity of labor increases, the marginal product of labor decreases.
- When graphing the total product curve, diminishing marginal product gives it a flattening curve.
- Often, at very low levels of production, marginal product is actually increasing.
- Relationship between average and marginal:
 - When the $MP_L > AP_L$ and as labor increases, does the average product increase or decrease?
 - When the $MP_L < AP_L$ and as labor increases, does the average product increase or decrease?

2.4 Product Curves

Product Curves



Product Curves



3 Short-Run Costs

3.1 Measures of Cost

Total Costs

- **Total Cost (TC):** the cost of *all* the factors of production committed to producing a good.
- **Total Fixed Cost (TFC):** the cost of factors of production that are fixed in the *short-run*.
 - Examples: cost of owning capital, cost of renting land and buildings, cost of using buildings.
- **Total Variable Cost (TVC):** the cost of the variable factors, i.e. factors of production that can be changed in the short run.
 - Example: labor
- $TC = TFC + TVC$

Marginal and Average Cost

- **Marginal Cost (MC):** the additional total cost from producing one additional unit of labor.

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

- **Average Total Cost (ATC):** the average cost of producing the good.

$$ATC = \frac{TC}{Q}$$

- **Average Variable Cost (AVC):** the average variable cost of producing the good.

$$AVC = \frac{TVC}{Q}$$

Fixed Costs

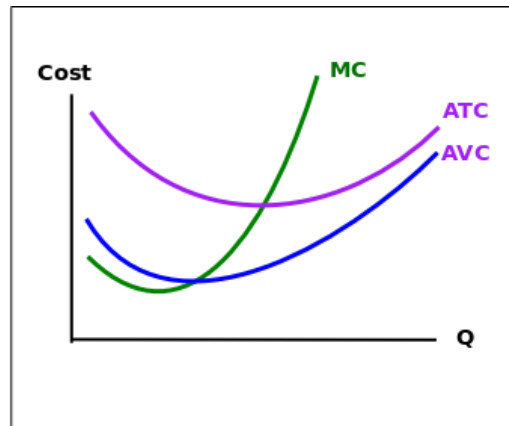
- **Average Fixed Cost (AFC):** the average fixed cost of producing the good.

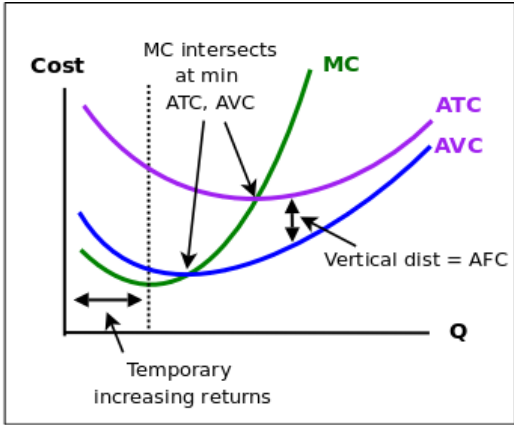
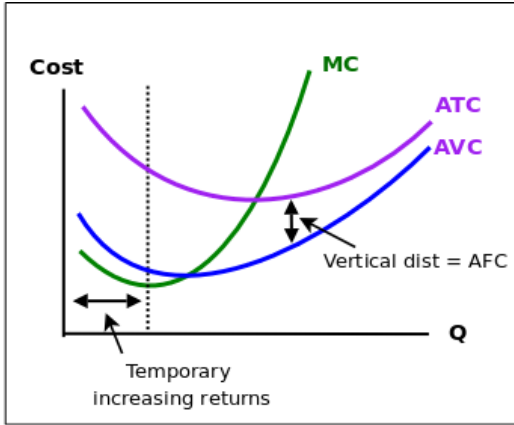
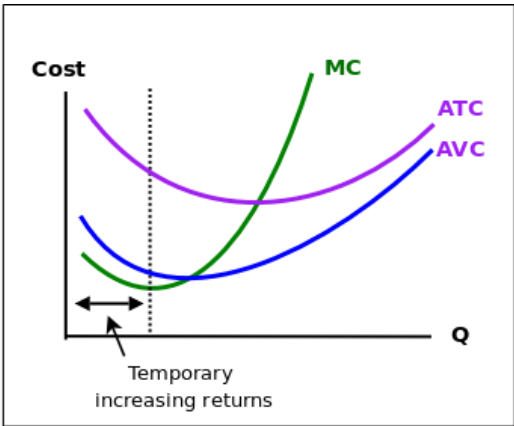
$$AFC = \frac{TFC}{Q}$$

- Since $TC = TFC + TVC$, it is also true that $ATC = AFC + AVC$
- What happens to the average fixed cost when production increases?
- What is the difference between marginal total cost and marginal variable cost?

3.2 Cost Curves

Cost Curves





Shifts in Product/Cost Curves

- Improvement in technology:

- Shifts production function, AP_L , and MP_L upward.
- Shifts average variable cost downward.
- Often new technology requires significant fixed costs \rightarrow increase in TFC, TVC.
- What do you predict is the impact on ATC?
- Increase in cost of factors of production.
 - Increase in cost of labor: shifts ATC, AVC, MC upward; others unchanged.
 - Increase in the cost of capital: shifts the AFC, ATC upward; others unchanged.

4 Long-Run Cost

4.1 Returns to Scale

Returns to Scale

- In the long-run, you can increase *all* factors of production.
- When a firm increases all of its factors of production by the same proportion and..
 - output increases by an even larger proportion, then there are **economies of scale**.
 - output increases by the same proportion, then there are **constant returns to scale**.
 - output increases by a smaller proportion, then there are **decreasing returns to scale**.

4.2 Long-Run Costs

Long-Run Costs

- When a firm expands, the ATC shifts to the right.
- The ATC may also shift somewhat downward or upward.
- **Long-run average total cost (LR-ATC)**: smallest short-run ATC that can be obtained for different scales.
- Relationship between LR-ATC and economies of scale:
 - When increasing scale lowers LR-ATC: economies of scale.
 - When increasing scale does not change LR-ATC: constant return to scale.
 - When increasing scale increases LR-ATC: diseconomies of scale.

Long-Run Average Total Cost

