We have talked about consumer behavior and how that relates to the demand curve. Now, we will start talking about producer behavior that underlies the supply curve.

The amount of a product supplied depends on 2 factors:
1. cost of scarce resources + their productivity (quantity needed to produce a given output)
2. the price output can be sold for.

Today we focus on 1.

The cost of production is best measured as opportunity cost.
- Resources are scarce to be used in the production of 1 good, they cannot be used in the production of another.
- The opportunity cost of a resource used in producing a good is its best alternative use.

Economic (opportunity) costs are those payments a firm must make, or incomes it must provide, to resource suppliers to attract the resources away from alternative production opportunities.

2 types of costs:
1. Explicit - opportunity costs that take the form of payments to outside suppliers, workers, or others who do not share in the firm's ownership.
2. Implicit - opportunity costs of using resources owned by the firm as contributed by its owners.

- Ex. Forgone interest on financial capital. Forgone rent on firm owned building. Forgone wages from alternative job.

Accounting profit vs. Economic profit:
- Accounting profit - total revenue minus explicit costs.
- Economic profit - total revenue minus all costs (both explicit + implicit).

Entrepreneurial income - this is also a resource that could be used elsewhere. Therefore, it must be included as an implicit cost. (This is referred to as normal profit)

Short-run (SR) vs. Long-run (LR):
- SR - a time horizon in which output can be adjusted only by changing the amounts of variable inputs used while fixed inputs remain unchanged.
- Usually it is assumed that only labor is variable in the SR. We will stick to this convention.
- Plant capacity is assumed (in particular) to be fixed in the SE.
- LR - a time horizon that is long enough to permit changes in both fixed & variable inputs.
- All inputs are variable in the LR & plant capacity (in particular) can be adjusted.

- SE
- Productivity of resources - the amount needed to produce a given amount of output. This relationship between inputs & output is determined by technology.
- Total product (TP) - total output of a firm measured in physical units.
- Marginal product (MP) - the extra output or added product associated with adding a unit of a variable resource (we'll use labor) in the production process: (ceteris paribus)
  \[ MP = \frac{\Delta \text{in TP}}{\Delta \text{in L}} \]
- Average product (AP) - output per unit of labor input (also called labor productivity):
  \[ AP = \frac{TP}{L} \]
- Law of diminishing returns - the principle that as one variable input is increased with all others remaining fixed, a point will be reached beyond which the MP of the variable input will begin to decrease.

* - Relationship between TP, MP, & AP (see Table 22-1 + Figure 22-2)
- Note that MP intersects AP at its (AP's) maximum. [relationship between M & A]
- MP ↑ as TP increases at an increasing rate & MP↓ when TP is increasing at a decreasing rate.
- When TP is at its max, MP is zero.
- When TP ↓, MP < 0

- Costs - 1st costs - costs which do not vary with a change in output. They cannot be avoided in the SE. Ex. rent on a plant, interest on debt, insurance premiums. (TFC)
- Variable costs - costs that change with the level of output. (TVC) [Behavior of variable costs is related to the behavior of MP] at 1st variable cost will increase at a decreasing rate, then it will start rising by an increasing amount.
- When MP ↑ VC ↑ at decreasing rate, when MP↓ VC↓ at increasing rate.
(3) total costs - sum of fixed cost + variable cost at each level of output. (TC)

* (see Table 22-2 + Figure 22-3 for relationship between these total costs)

- average costs - (1) average fixed cost (AFC) = \( \frac{TFC}{Q} \). Since fixed costs are

\[ \text{by definition fixed, AFC will decline as } Q \uparrow. \]

(2) average variable cost (AVC) = \( \frac{TVC}{Q} \). MP, + hence TVC reflect the

law of diminishing returns, so AVC does as well. U-shaped.

1st declines + then increases. \[ \text{[AVC + ATC get closer + closer, together as } Q \uparrow \text{ because} \]

\[ \text{AFC approaches } \theta. \]

AFC will never equal \( \theta \)

- Marginal cost (MC) - the additional cost of producing one more unit of output: \( MC = \frac{\Delta \text{in } TC}{\Delta \text{in } Q} = \frac{\Delta \text{in } TVC}{\Delta \text{in } Q} \) (since fixed costs don't \( \Delta \))

- (see fig. 22-5) MC intersects both AVC + ATC curves at their minimum.

- Marginal average rule - marginal cost must equal average costs (either variable or total) at its minimum.

- (see fig. 22-6) MP + MC are mirrors of one another, as are AP + AVC.

- Shifting cost curves - (1) fixed costs - if they \( \uparrow \) AFC + ATC \( \uparrow \), but AVC + MC curves will remain unchanged. (2) variable costs - if they \( \uparrow \), AVC, ATC, + MC \( \uparrow \) but AFC remain unchanged. (3) technology change -

\[ \text{an improvement in technology will } \downarrow \text{ costs (generally the same as } W/ \# 2 \text{ above).} \]

- Marginals decisions are used to make production decisions

- Ave. costs don't reflect the cost of producing an additional unit.

- Both fixed costs + sunk costs will be irrelevant in decision making in the SR + sunk costs will be irrelevant in the LR as well.

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- All costs are variables in the LR + the law of diminishing returns doesn't apply.

- In the LR, a firm can choose their overall level of production (plant size) which will affect their ATC, up to a point, increased capacity will \( \uparrow \) ATC, but eventually ATC will begin to \( \uparrow \)

*(see fig. 22-3) - Use 21.8 in your book*

* - LR ATC curve is an envelope of 8 potential SR ATC curves (see fig. 22-8)

- Shows the least average total cost at which any output can be produced after firm has had time to make all appropriate adjustments
in plant size.
- economies of scale - a situation where LR ATC ↑ as output ↑
- why might this occur?
  ① labor specialization
  ② managerial specialization
  ③ efficient capital
  ④ start-up costs / advertising 
- constant returns to scale - a situation in which there are neither economies or diseconomies of scale. Range over which LR ATC doesn’t change.
- diseconomies of scale - a situation in which LR ATC ↑ as output ↑.
- main factor is the difficulty in controlling & coordinating operations as firm gets larger.
- opportunities for shrinking