

# Production Theory

Firms maximize profits -  $\pi = R(Q) - C(Q)$

1. Total costs need to be minimized
2. Firm needs to select profit maximizing price and output

**Factors of Production (inputs)** - are the ingredients mixed together by a firm through its technology to produce output  
Land, Labor, and Capital

**Production Function** - is the relationship between the amount of inputs (factors of production) and the maximum amount of output that can be produced with those inputs given technological efficiency.

$$Q = f(L,K)$$

**Short Run** - involves production with fixed inputs

**total product** - the total amount of output produced given various amounts of inputs

**average product** - of an input is total product divided by the amount of the input used to produce that output

- depends on the amount of other inputs

**marginal product** - of an input is the change in total product that results from a change in the amount of the input, holding the quantities of other inputs constant

$$\Delta TP / \Delta \text{input } x$$

**Law of Diminishing Marginal Returns** – holds that as the amount of some input is increasing in equal increments, while technology and other inputs are held constant, the resulting incremental increases in output will eventually begin to decrease

**Long run** - is a period of time in which the firm can vary all its inputs

**isoquant** - is a curve that shows all the combinations of inputs that, when used in a technologically efficient way, will produce a certain level of output

#### **4 characteristics**

1. The isoquants must have a negative slope as long as both inputs are productive
2. Isoquants to the northeast represent greater output levels
3. 2 isoquants can never intersect
4. Isoquants will generally be convex

**marginal rate of technical substitution** ( $MRTS_{XY}$ ) - is the amount by which input y can be reduced without changing output when there is a unit increase in the amount of input x

- isoquants also show diminishing marginal returns to both inputs

$$MRTS_{LK} = - \Delta K / \Delta L = MP_L / MP_K$$

$$\Delta Q = \Delta K * MP_K$$

$$\Delta Q = \Delta L * MP_L$$

$$\Delta K * MP_K = \Delta L * MP_L$$

$$\Delta K / \Delta L = MP_L / MP_K$$

## Returns to Scale

**increasing returns to scale** - output more than doubles when inputs are doubled, tends to occur when firms are small

reasons -

1. Specialization and division of labor
2. Arithmetical relationships
3. Large scale technologies - complex and expensive techniques or equipment may be feasible only when output is sufficiently high

**constant returns to scale** - doubling of inputs doubles output, tends to occur in intermediate scale operations

**decreasing returns to scale** - output will increase less than in proportion to inputs, tends to occur in large scale production

reasons -

1. The inefficiency of managing large operations

## Costs of Production

**opportunity cost** - the value the resources would generate in their best alternative use, reflects both explicit and implicit costs

**total fixed cost (TFC)** - is the cost that does not vary with output, expenditures on inputs the firm cannot vary in the short run

**average fixed cost (AFC)** - is total fixed cost divided by the amount of output

$$\text{TFC} / \text{Q}$$

**total variable cost (TVC)** - costs that do change with the quantity of output produced, cost associated with the variable inputs

**average variable cost (AVC)** - is total variable cost divided by the amount of output

$$\text{TVC} / \text{Q}$$

**total cost (TC)** - the sum of the total fixed and total variable costs at each output level

$$\text{TFC} + \text{TVC} = \text{TC}$$

**average total cost (ATC)** - is total cost divided by output, or sum of average fixed cost and average variable cost

$$\text{TC} / \text{Q}$$

$$\text{AFC} + \text{AVC} = \text{ATC}$$

**marginal cost (MC)** - is the change in total cost that results from a one unit change in output, shows how much additional cost a firm will incur if it increases output by one unit

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

## Long Run Cost

**isocost line** - identifies all combinations of inputs that can be purchased at a given total cost

$$TC/r = TC/w$$

$$TC = rK + wL$$

$$K = TC/r - w/r L$$

- points of tangency show the maximum output attainable at a given cost as well as the minimum cost necessary to produce that output

golden rule of cost minimization - to minimize costs the firm should employ inputs in such a way that the marginal product per dollar's worth of all inputs is equal

$$MRTS_{LK} = w/r$$

$$MP_L/MP_K = w/r$$

$$MP_L/w = MP_K/r$$

**expansion path** - is formed by connecting the tangency points, and identifies the least costly input combination for each output. It is generally upward sloping.

- per-unit costs can vary as a result of changing output when input prices are constant (movement along the cost curves), or they can vary as a result of a change in input prices (a shift of the cost curves)

Economies of scale - refer to the case where a firm can increase its output more than in proportion to its total input cost

diseconomies of scale - apply when a firm's output increases less than in proportion to its total input cost

minimum efficient scale - the scale of operation at which average cost per unit reaches a minimum

economies of scope - are present if it is cheaper for one firm to produce products jointly than it is for separate firms to produce the same products independently

diseconomies of scope - are present if a set of products is cheaper to produce by separate independent firms than jointly under the same firm

# Perfect Competition

four characteristics of a perfectly competitive firm:

1. Large numbers of buyers and sellers.
2. Free entry and exit.
3. Product homogeneity.
4. Perfect information.

**Price taker** - the firm takes the price as given and does not expect its output decision to affect price

**average revenue (AR)** - or total revenue divided by output, is the same as price for the perfectly competitive firm

$$TR/Q$$

**marginal revenue (MR)** - is defined as the change in total revenue when there is a one-unit change in output, is the same as price for the perfectly competitive firm

$$\Delta TR/\Delta Q$$

**total profit** - is the difference between total revenue and total cost, total profit is maximized when:

$$MR = MC$$

**shutdown point** - if price falls below the minimum point of the AVC then the firm will cease operations in the short run

## Well-being

**consumer surplus** - is a measure of the net gain to a consumer or consumers from purchasing a good

**producer surplus** - is the net gain to producers from selling a product

- the net gains to production will accrue to the owners of inputs that have up-sloping supply curves

**total surplus** - the net gain to those who participate in this market, the sum of consumer and producer surplus

- the change in total surplus is taken as the gain or loss in well-being

**efficiency in output** - requires that output be expanded to the point where marginal benefit equals marginal cost (total surplus is maximized). This outcome is produced in competitive markets.

**Deadweight loss** - measures the overall efficiency loss

- the more inelastic the supply curve, the smaller is the tax burden on consumers, the larger the tax burden on producers, and the smaller the reduction in output

- the more inelastic the demand curve, the greater the tax burden on consumers, the smaller the tax burden on producers, and the smaller the reduction in output