

Production

Introduction

- **Production** refer to an **economic** term to describe the inputs that are used in the **production** of goods or services in the attempt to make an **economic** profit.
- The factors of **production** include land, labor, capital and entrepreneurship.

Theory of production

- **Theory of production**, in economics, an effort to explain the principles by which a **business firm decides how much of each commodity that it sells (its “outputs” or “products”)** it will produce, and how much of each kind of **labour, raw material, fixed capital good, etc., that it employs** (its “inputs” or “factors of production”) it will use.
- The theory involves some of the most fundamental principles of economics. These include the relationship between the prices of commodities and the prices (or wages or rents) of the productive factors used to produce them.

The Organization of Production

- Inputs
 - Labor, Capital, Land

Fixed Inputs and Variable Inputs

- Short Run
 - At least one input is fixed
- Long Run
 - All inputs are variable

Production Function

- An input is a good or service that goes into the production process.
- An output, on the other hand, is any good or service that comes out of a production process.
- A firm's long run production function is of the form:

$$Q = f(L_d, L, K, M, T, t)$$

—where L_d = land and building; L = labour; K = capital; M = materials; T = technology; and, t = time.

Production Function

- $Q = f(K, L)$
- Increasing production, Q , will require K and L , and whether the firm can increase both K and L or only L will depend on the time period it takes into account for increasing production, that is, whether the firm is thinking in terms of the short run or in terms of the long run.
- In the **short run** firms can increase production only by increasing **labour**, since the supply of capital is fixed in the short run.
- In the **long run**, the firm can employ more of both **capital and labour**, as the supply of capital becomes elastic over time.

Short-Run Production Function

- **Following assumptions are made:**
 - The firm operates in a short-run production period where labor is variable, capital is fixed.
 - The firm uses both the inputs to produce a single product.
 - The firm operates with a fixed level of technology.
 - The firm operates at every level of output in the most efficient way.
 - The short-run production function is affected by the law of diminishing returns.

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- In the short run, capital is fixed Only changes in the variable labor input can change the level of output.
- Labor is homogeneous.
- Input prices are given.
- Short run production function:

$Q=f(L, K)$, where K is constant

$$Q= bL$$

$$b= \Delta Q/ \Delta L$$

Production Function with Two Inputs

$Q = f(L, K)$

K							Q
6	10	24	31	36	40	39	
5	12	28	36	40	42	40	
4	12	28	36	40	40	36	
3	10	23	33	36	36	33	
2	7	18	28	30	30	28	
1	3	8	12	14	14	12	
	1	2	3	4	5	6	L

Production Function with One Variable Input

Total Product

$$TP = Q = f(L)$$

Average Product

$$AP_L = \frac{Q}{L}$$

Marginal Product

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

- MP is change in total production, when we increase one worker, eg: from 3 workers now we have 4 $MP = (4 - 3 = 1)$

Production or
Output Elasticity

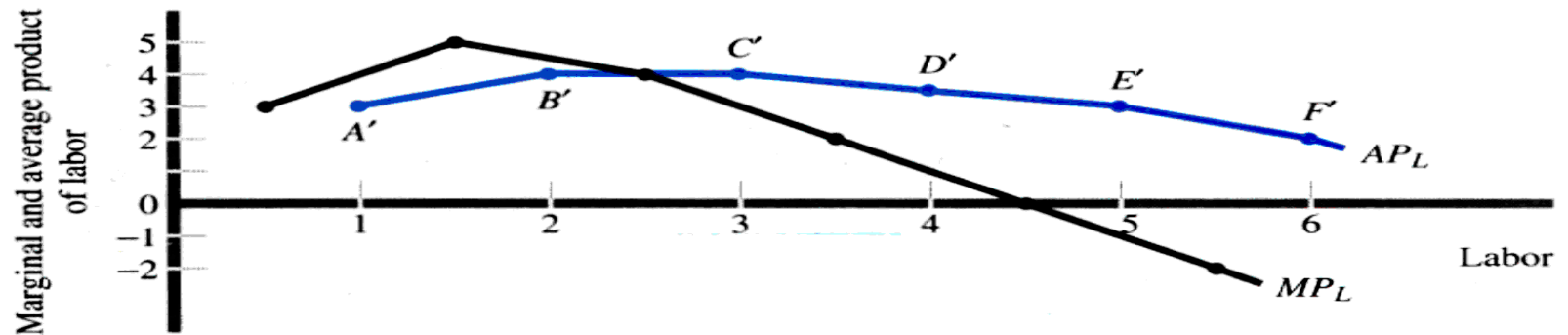
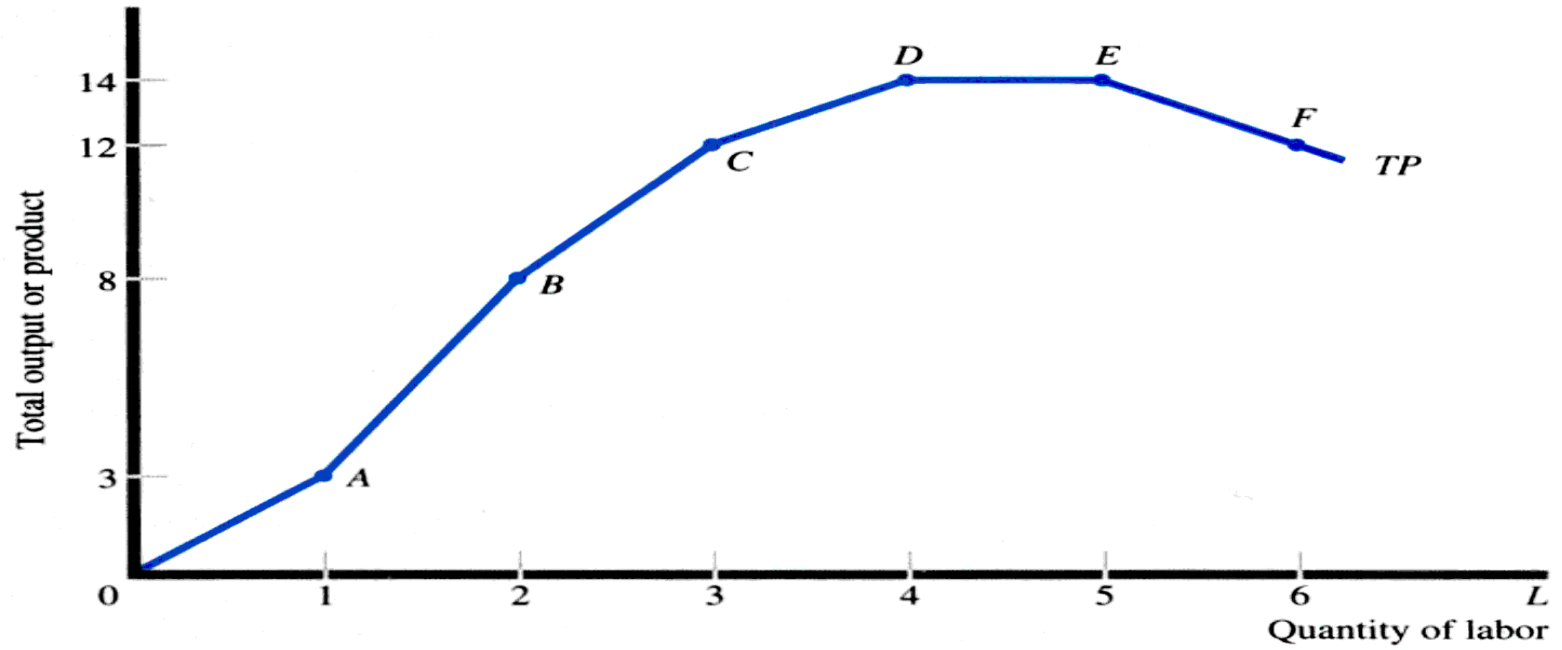
$$E_L = \frac{MP_L}{AP_L}$$

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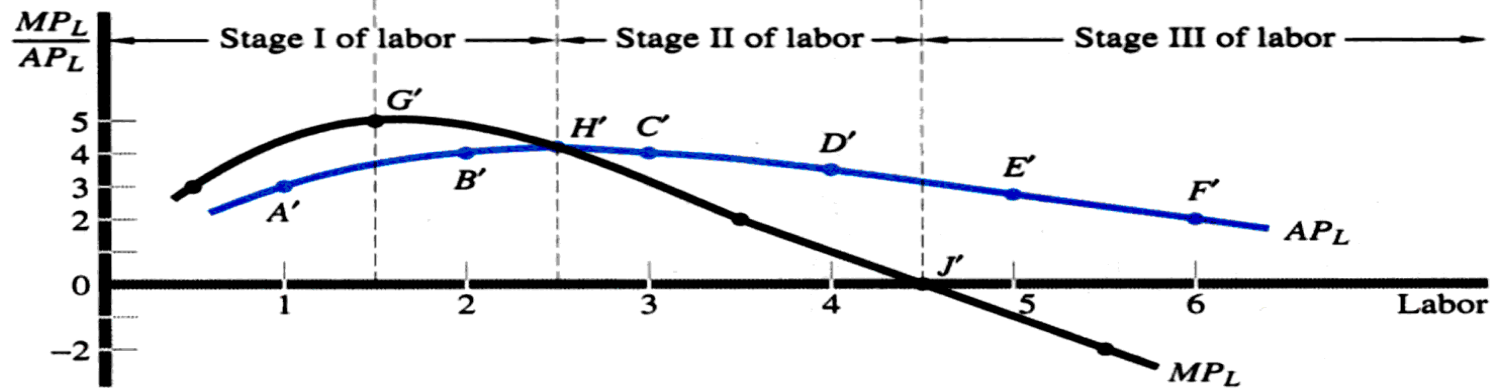
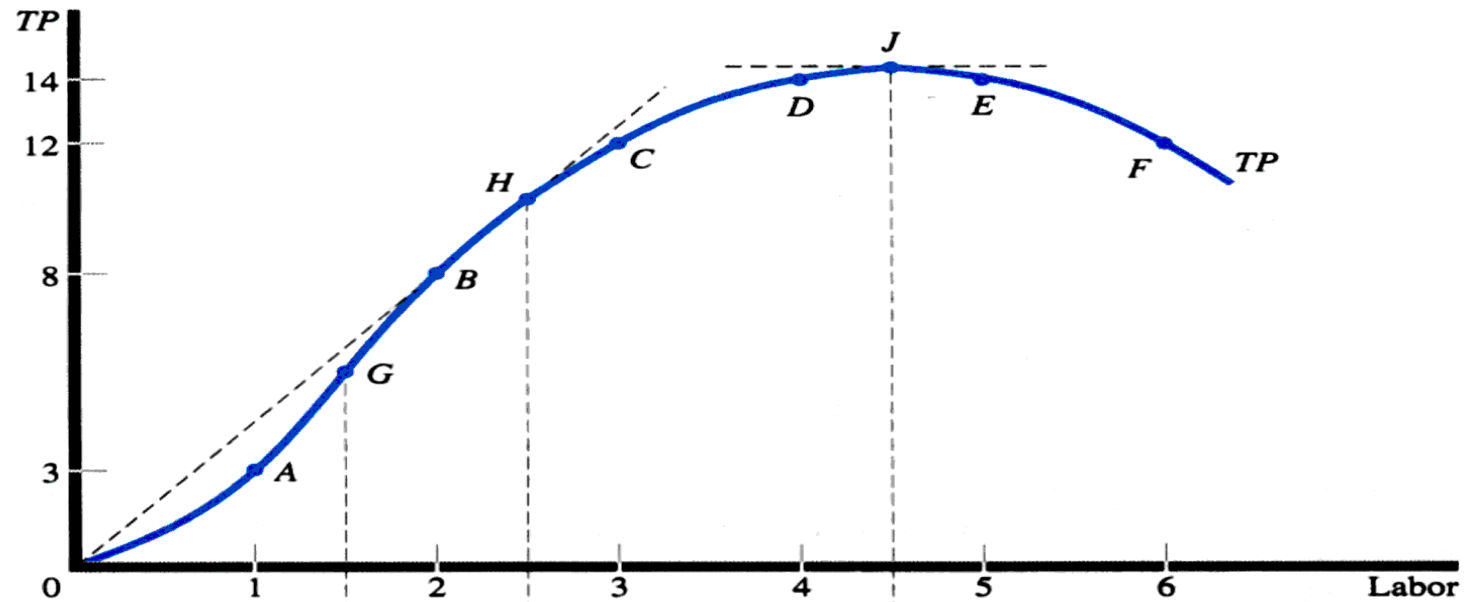
Total, Marginal, and Average Product of Labor, and Output Elasticity

L	Q	MP_L	AP_L	E_L
0	0	-	-	-
1	3	3	3	1
2	8	5	4	1.25
3	12	4	4	1
4	14	2	3.5	0.57
5	14	0	2.8	0
6	12	-2	2	-1

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Relationship among Total, Average and Marginal Products

Stages	Total Product	Marginal Product	Average Product
Stage I	Initially it increases at an increasing rate and then increases at a decreasing rate	At the beginning it increases, then reaches a maximum and starts to decrease	At the first instant it increases, then attains maximum
Stage II	It continues to increase at a diminishing rate and reaches maximum.	It continues to diminish and becomes equal to zero	It is equal to MP and then begins to diminish
Stage III	It diminishes	It becomes negative	It continues to diminish but always greater than zero (positive)

Law of Diminishing Return

- In this example, the number of workers changed, while the land used, seeds planted, water consumed, and all other inputs remained the same.
- If more than one input were to change, the production results would vary and the law of Diminishing returns may not apply if all inputs could be increased.

Determining Optimum employment of labor

- How many workers will the firm employ for maximum profit.
 - Number of workers to be employed depends upon the output that maximizes the firm's profit.
 - $MC=MR$ (Marginal cost = marginal revenue)
 - In the short run, labor is only variable input, so marginal cost = marginal wages, i.e., $MC=MW$
 - MRP (Marginal revenue productivity) = $MPL * P$
[MPL , Marginal physical productivity of labor multiplied by Price (P) of the product.]

Long run

- All inputs are variable.
- Output changed by varying usage of all inputs

Average & Marginal Products

- Average product of labor:

$$AP = Q/L$$

- Marginal product of labor:

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

Average product of Capital:

$$AP = Q/K$$

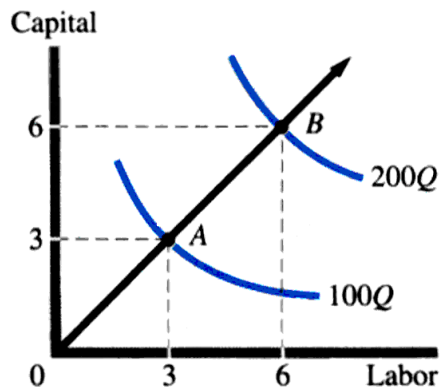
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Marginal product of Capital

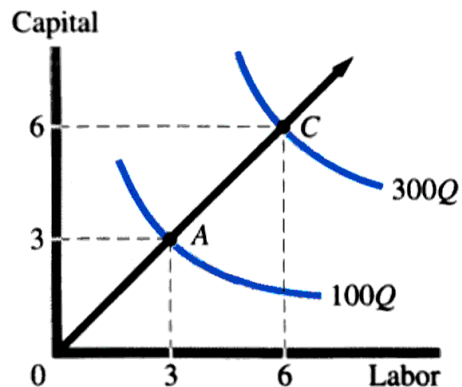
$$MPK = \frac{\Delta Q}{\Delta K}$$

Returns to Scale

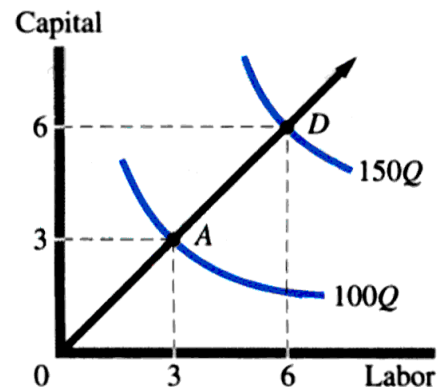
Constant
Returns to
Scale



Increasing
Returns to
Scale



Decreasing
Returns to
Scale



Returns to Scale

- When a firm expands its scale, i.e., both the inputs proportionately then there are three possibilities:
 - Total output may increase more than proportionately,
 - Total output may increase proportionately,
 - Total output may increase less than proportionately

Increasing Returns to Scale

- When inputs K, and L are increased at a certain proportion and output increases more than proportionately, it exhibits increasing returns to scale.
 - Eg: if quantities of both the inputs, K & L are successively doubled the resultant output is more than doubled, the returns to scale is said to be increasing.
 - $3K + 3L$ to $6k + 6L$, Q changed from 100 to 300, that is increase of more than 150%.

Reasons for increasing returns to scale

- Technical and managerial indivisibility
- Higher degree of specialization
- Dimensional relations

Constant Returns to Scale

- When increase in input is proportionate to increase in output, it exhibits constant returns to scale.
 - $3K + 3L$ to $6k + 6L$, Q changed from 100 to 200, that is when input is doubled, output is doubled.
- This is attributed to the limits of the **economies of scale**.
- It occurs where factors of production are perfectly divisible. And technology is such that labor- capital ratio is fixed.
- When the factors of production are perfectly divisible, showing constant returns to scale.

Decreasing Returns to Scale

- When a proportionate increase in inputs, K & L, leads to a less than proportionate increase in output.
- When inputs are doubled and output is less than doubled, then it terms as a decreasing returns to scales.
 - $3K + 3L$ to $6k + 6L$, Q changed from 100 to 150, K & L, are increased by 100% but output increase only by 80%.

Diseconomies of scale

Reason

The diminishing return to management, that is managerial economies.

- As the size of the firms expands, managerial efficiency decreases.
- Limitedness or exhaustibility of the natural resources.
 - Eg: doubling of coal mining plant may double the coal output because of limitedness of coal deposits.