

# PRODUCTION FUNCTION IN THE LONG-RUN

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# PRODUCTION FUNCTION

- Relationship between the amount of input required and the amount of output that can be obtained- Production function
- Specifies the maximum output that can be produced with a given quantity of inputs

# RETURNS TO SCALE

- Diminishing returns and marginal products refer to the response of output to an increase of a single input when all other inputs are held constant
- Changing all factors of production-changing scale
- Effects of increasing all inputs- returns to scale

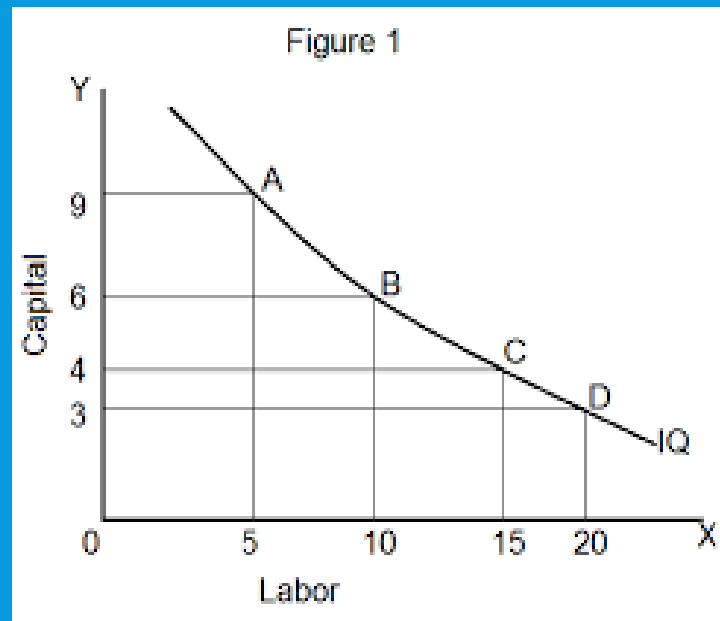
# ISOQUANT

- Also known as equal-product curve
- Represents all those input combinations which are capable of producing the same level of output

# ISOQUANT

Factor Combination	Labour	Capital
A	1	12
B	2	8
C	3	5
D	4	3
E	5	2

# ISOQUANT



# MARGINAL RATE OF TECHNICAL SUBSTITUTION

- The rate at which the producer is ready to exchange one factor for another-  
Marginal Rate of Technical Substitution (MRTS)
- Marginal Rate of Technical Substitution declines

# PRODUCT LINES

- A product line shows that movement from one isoquant to another as both factors or a single factor changes
- A product line is drawn independently of the prices of factors of production
- The product line describes the technically possible alternative paths of expanding output
- The product line passes through the origin if all factors are variable



# PRODUCT LINES

- If only one factor is variable, keeping other factors constant- the product line is a straight line parallel to the axis of the variable factor.

# EFFECTS OF RETURNS TO SCALE

- Constant returns to scale
- Increasing returns to scale
- Decreasing returns to scale

# CONSTANT RETURNS TO SCALE

- A case where a change in all inputs leads to a proportional change in output
- Example- if a labour, land, capital, and other inputs are doubled; then output would also be doubled
- Handicraft industries usually show constant returns

# CONSTANT RETURNS TO SCALE

Labour	Capital	Output
10	10	100
20	20	200

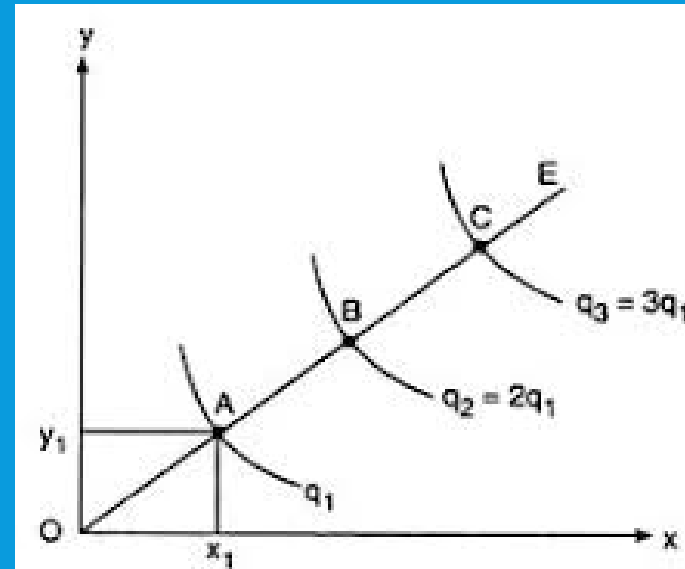


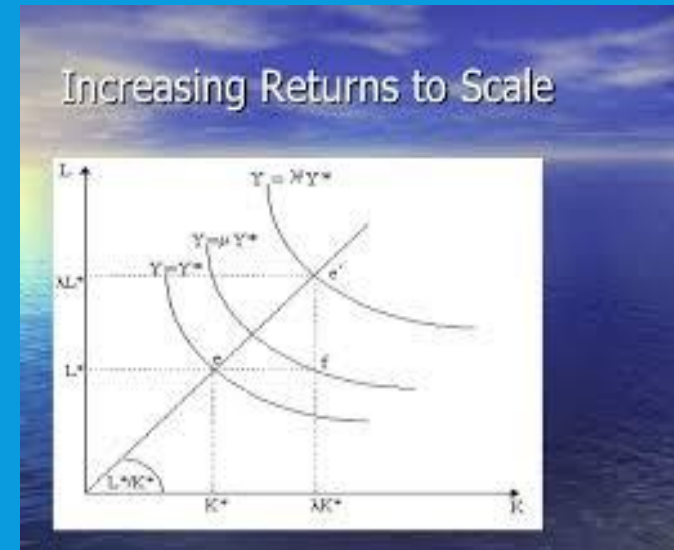
Fig. 8.22 Isoquants under constant returns to scale

# INCREASING RETURNS TO SCALE

- Increasing returns/ economies of scale
- When an increase in all inputs leads to a more than proportional increase in the level of output
- If labour, land, capital and other inputs are increased 10 per cent-output will increase more than 10 per cent

# INCREASING RETURNS TO SCALE

Labour	Capital	Output
10	10	100
15	15	200

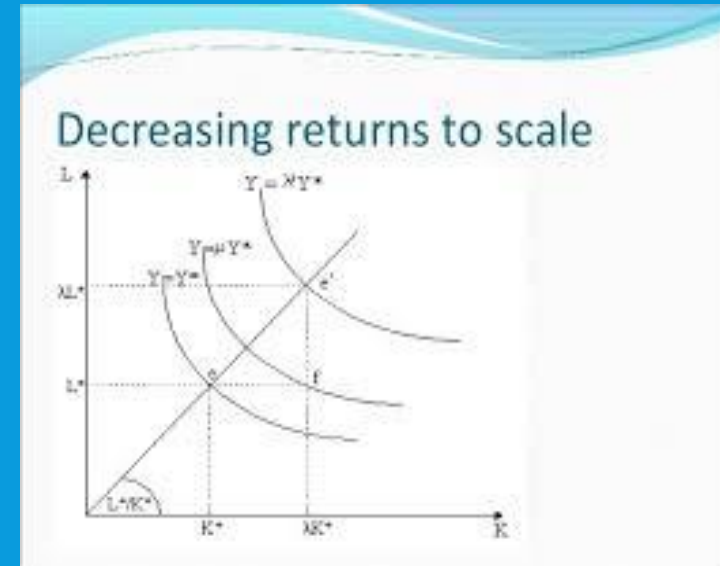


# DECREASING RETURNS TO SCALE

- Increase in all factors leads to a less than proportionate increase in outputs
- If labour, capital and other inputs increase 15 per cent- increase in output is less than 15 percent

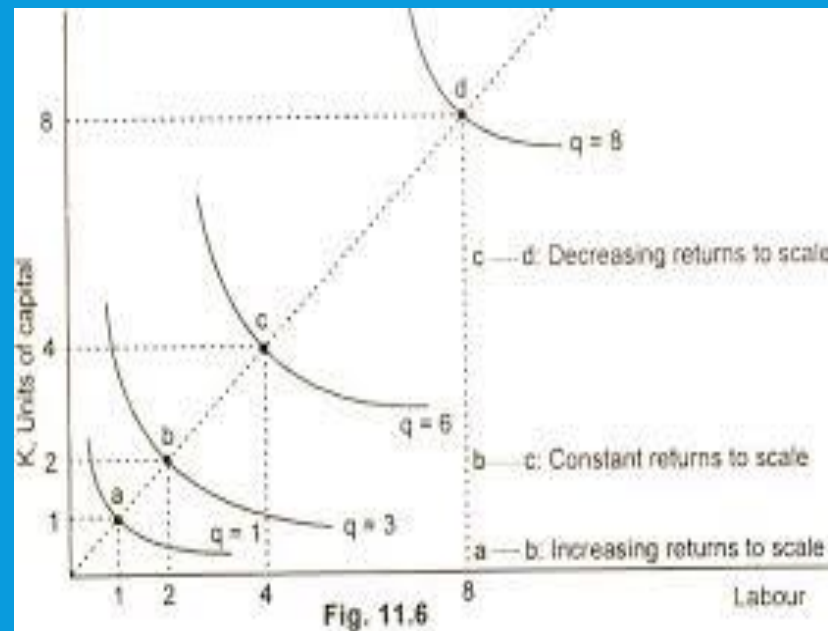
# DECREASING RETURNS TO SCALE

Labour	Capital	Output
10	10	100
25	25	200





# RETURNS TO SCALE IN ONE DIAGRAM



# REASONS OF INCREASING RETURNS TO SCALE

- Indivisibility of Factors
- Greater possibility of specialisation of Labour and capital

# DIMINISHING RETURNS TO SCALE

- Diseconomies of scale

# EXAMPLE

- A firm starts from an initial level of inputs and output
- $X_0 = f(L, K)$
- Increase all the factors by the same proportion  $m$  – clearly obtain a new level of output
- $X^*$  higher than the original level  $X_0$
- $X^* = f(mL, mK)$

# EXAMPLE

- If  $X^*$  increases by the same proportion  $m$  as the inputs- constant returns to scale
- If  $X^*$  increases less than proportionally with the increase in the factors- decreasing returns to scale
- If  $X^*$  increases more than proportionally with the increase in the factors- increasing returns to scale

# RETURNS TO SCALE AND HOMOGENEITY OF THE PRODUCTION FUNCTION

- Suppose we increase both factors  $X_0 = f(L, K)$  by the same proportion  $m$  and we observe the resulting new level of output  $X^*$
- $X^* = f(mL, mK)$
- If  $m$  can be factored out, then the new level of output  $X^*$  can be expressed as a function of  $m$  (to any power) and the initial level of output
- $X^* = m^a f(L, K)$
- Or  $X^* = m^a X_0$  (the production function is called homogeneous)

# RETURNS TO SCALE AND HOMOGENEITY OF THE PRODUCTION FUNCTION

- If  $m$  cannot be factored out, the production function is non-homogeneous
- The power  $a$  of  $m$  is called the degree of homogeneity of the function and is a measure of the returns to scale
- If  $a = 1$ , we have constant returns to scale
- If  $a < 1$ , we have decreasing returns to scale
- If  $a > 1$ , we have increasing returns to scale