

Production Function

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Production

It is the transformation of resources into outputs of goods and services. Firms transform inputs into outputs.

Inputs can be classified broadly into labour (L) or human resources, capital (K) or investment goods, land (N) or natural resources and entrepreneurship, (E)

$$Q = (L, K, N, E)$$

Fixed and Variable Inputs

Inputs can be further classified into fixed and variable.

- 1 Fixed inputs are those that cannot be varied or can be varied only with excessive cost during the time period under consideration.
- 2 Variable inputs, on the other hand are those that can be varied easily and on short notice during the time period under consideration.

Short run and Long run

- The time period during which at least one input is fixed is called the short run
- The time period during which all inputs are variable is called the long run.

Laws of Production Function

- The laws of production describe the technically feasible ways of increasing the level of production.
- Output may increase in various ways.
- Output can be increased by changing all factors of production. This is possible only in the long run. The laws of returns to scale refer to the long run analysis of production.
- In the short run output may be increased by using more of the variable factor, while others are kept constant. The expansion of output with one factor constant is described by the law of diminishing returns of the variable factor.

Features of Production function

Features

- 1 Substitutability: it is possible to vary the total output by changing the quantity of one or a few inputs, while the quantities of all other inputs are held constant.
- 2 Complementarity: the two or more variables are to be used together as nothing will be produced if the quantity of either of the inputs used in the production process is zero.
- 3 Specificity: inputs are specific to the production of a particular product.

$$AP = \frac{TP}{L}$$
$$MP = \frac{\Delta TP}{\Delta L}$$

Units of Labour	Total Product	Average Product	Marginal Product
1	3	3	3
2	8	4	5
3	12	4	4
4	14	3.5	2
5	14	2.8	0
6	12	2	-2

Table: Total Product, Average Product and Marginal Product

Law of Variable Proportions

Definition

as the proportion of the factor in a combination of factors is increased, after a point, first the marginal and the average product of that factor will diminish.

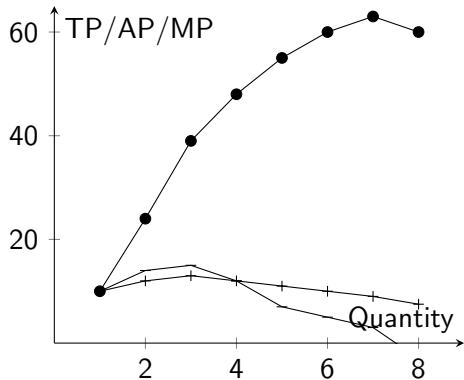
- 1 The state of technology is assumed to be given and constant.
- 2 The law assumes that factor proportions are variable.
- 3 The units of variable factor are homogeneous.
- 4 The law operates in the short-run when it is not possible to vary all factor inputs.

Law of Variable Proportions

Land	Labour	TP	AP	MP
2 Acres	0	0	0	0
2 Acres	1	10	10	10
2 Acres	2	24	12	14
2 Acres	3	39	13	15
2 Acres	4	48	12	12
2 Acres	5	55	11	7
2 Acres	6	60	10	5
2 Acres	7	63	9	3
2 Acres	8	60	7.5	-3

Table: Law of Variable Proportions

Law of Variable Proportions



Law of Variable Proportions

Relationship between TP, MP & AP

Stage I: $MP > 0$, AP rising, Therefore $MP > AP$ and the TP increases at increasing rate.

Stage II: $MP >$, but AP is falling. $MP < AP$ and TP is increasing at a decreasing rate.

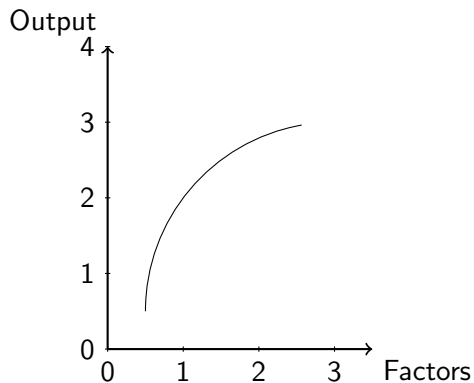
Stage III: $MP < 0$, AP continues to diminish but will always be greater than zero. TP diminishes.

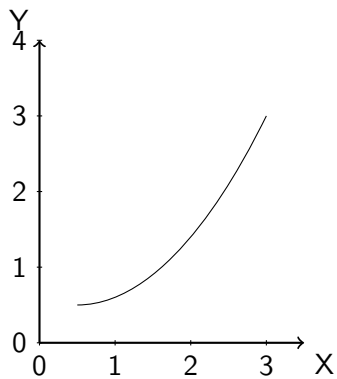
Law of Returns to Scale

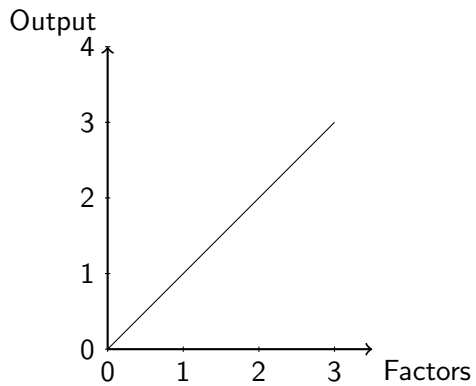
In the long run all factors of production are variable. No factor is fixed. Hence the scale of production can be changed by changing the quantity of all factors of production.

- 1 Constant returns to scale refers to the situation where output changes by the same proportion as inputs.
- 2 Increasing returns to scale refers to the case where output changes by a larger proportion than inputs.
- 3 With decreasing returns to scale, output changes by a smaller proportion than inputs.

Law of Returns to Scale



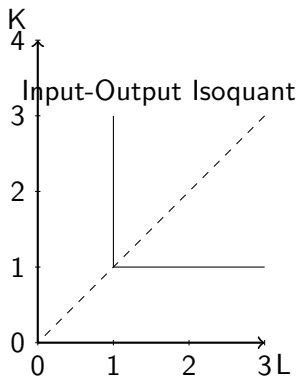
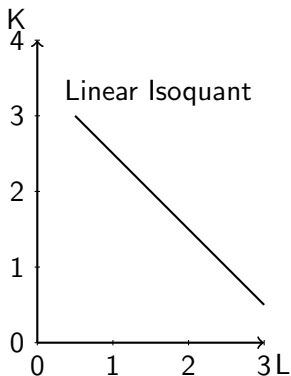




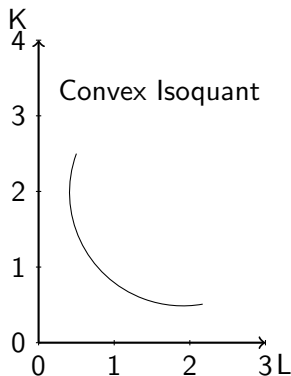
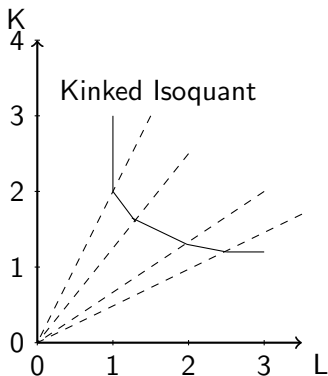
Isoquants

- The word *iso* is of Greek origin and means equal or same. An isoquant is a curve along which quantity is the same.
- An isoquant shows the various combinations of two inputs that can be used to produce a specific level of output.
- Isoquants are also known as iso-product curves. An isoquant is the locus of all the technically efficient methods for producing a given level of output.

Types of Isoquants



Types of Isoquants



Assumptions

- 1 There are only two factors of production which are used to produce a commodity.
- 2 Factors of production can be divided into smaller units.
- 3 The technique of production is constant during the period of analysis.
- 4 The substitution between the two factors is technically possible.
- 5 The factors of production are used with maximum efficiency.

Iso-Product Schedule

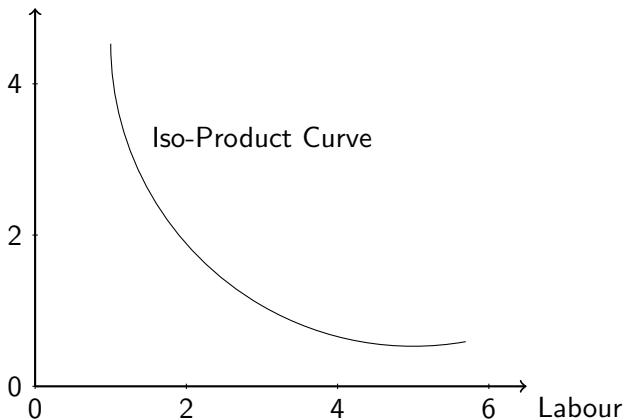
An iso-product schedule shows the different combinations of the two inputs that yield the same level of outputs as shown here.

Combination No.	Capital	Labour
1	2	15
2	4	10
3	7	7
4	11	5
5	17	4

Table: Iso-product Schedule

An iso-product curve represents all those combinations of two inputs which are capable of producing the same level of output.

Capital



Properties of Isoquants

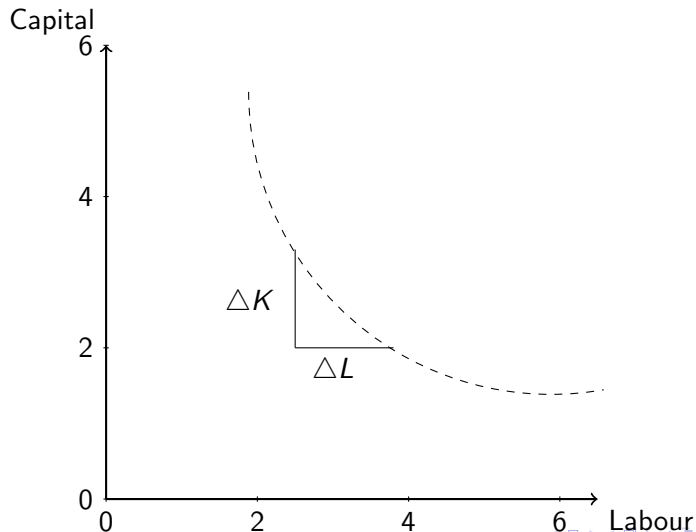
- 1 Isoquants slope downward to the right
- 2 The isoquants are convex to the origin
- 3 Isoquants cannot intersect each other
- 4 A higher isoquant represents a higher level of production than a lower isoquant
- 5 Isoquants need not be parallel to each other
- 6 No Isoquant can touch either axis

Marginal Rate of Technical Substitution

- If capital and labour are the only inputs used for production, MRTS is the amount of capital that can be replaced by an extra unit of labour, without affecting the total output.
- The slope of the isoquant defines the degree of substitutability of the factors of production.
- The slope of the isoquant decreases as we move downwards along the isoquant, showing the increasing difficulty in substituting K for L.
- The slope of the isoquant is called the Marginal rate of technical substitution.

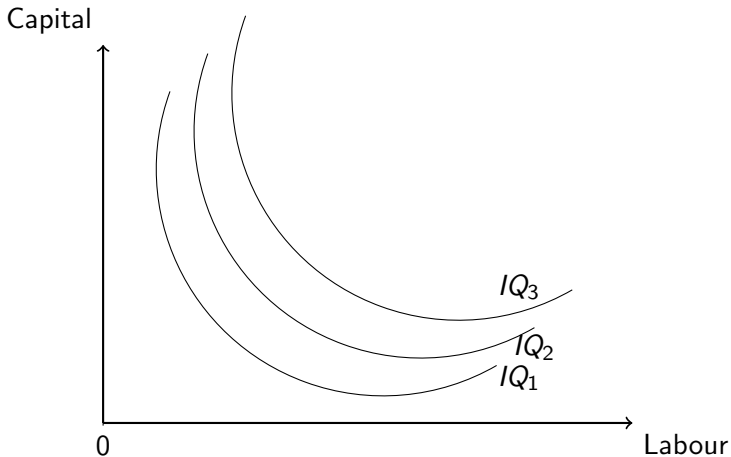
$$\frac{\Delta K}{\Delta L} = MRTS_{L,K}$$

Marginal Rate of Technical Substitution



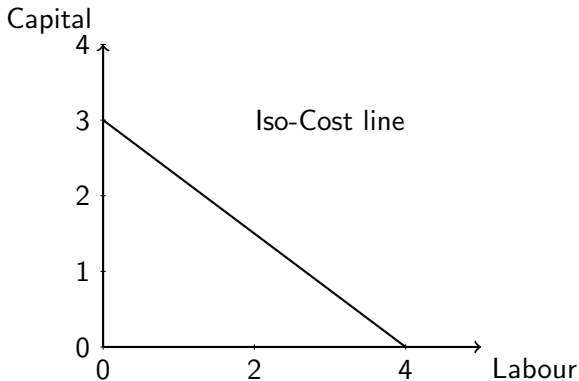
Isoquant Map

An isoquant map consists of a set of isoquants.



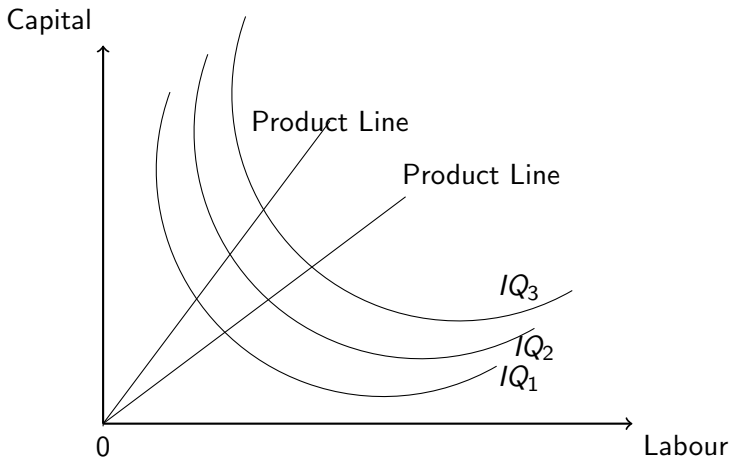
Iso-Cost Line

An Iso-cost line shows different possible combinations of two factors that the producer can afford to buy, given his total expenditure to be incurred on these factors and price of the factors.



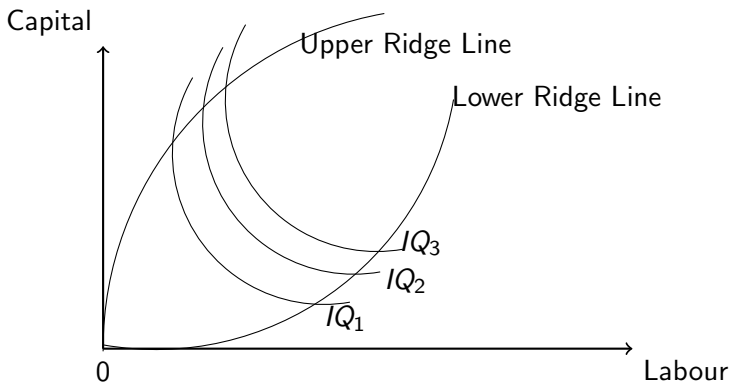
Product Line

A product line shows the physical movement from one isoquant to another as we change both factors or a single factor.



Ridge Lines

The locus of points of isoquants where the marginal products of factors are zero form ridge lines. The lower ridge line implies that the MP of labour is zero. The upper ridge line implies that the MP of capital is zero.



The object of the firm is to obtain the least-cost combination of the factors of production.

This can be drawn having the information of;

- i) iso-product map and
- ii) iso-cost line.

Producer's Equilibrium

With a given outlay and prices of two factors, the firm obtains least cost combination of factors, when the iso-cost line is tangent to an iso-product curve.

Producer's Equilibrium

