

Important SOP + MCQs

SCALE OF PRODUCTION → اجرائی And PRODUCTION FUNCTION

Scale of production plays a vital role in determining cost of production. Scale of production includes the size of a business, quantity of inputs used and volume of production. If a firm has a large capacity and especially when it produces goods with the help of modern machines, we call it large-scale production. For example, the manufacturing of cloth in a big textile mill is large-scale production. On the other hand, if cloth is produced in limited quantity on a handloom, it is known as small-scale production. When market for a good is large to sell it, producers prefer to produce on large scale. Increase in the scale of business reduces average cost of production and increases profits. The advantages, which a firm gets by expanding its size and capacity, are called economies of scale.

Factors determining size of a firm

1. **Financial Resources** Capital is required for all kinds of business, big or small. The larger the scale, the larger would be the expenditure on machines, building, raw materials, advertisement etc. If the organiser himself owns large amount of capital or if he expects to collect enough amount through bank credit, he will plan the business on large scale, otherwise he will start with small scale. Single owners usually have limited amounts of capital, so they adopt small scale. On the other hand joint stock companies by selling shares can collect huge resource and can adopt large scale. e.g. BATA produces millions of shoes, Toyota manufactures millions of cars, Sony millions of TV sets etc.

2. **Extent of Market** Goods are produced to be sold. More demand means more inducement to produce. Some goods have a limited market because either few people use them or the goods cannot be sent to far off places. On the other hand, if a commodity is in wider use, and it is possible to send to distant places, large scale will be adopted.

3. **Elasticity of demand** also influences the decision. If the demand is elastic i.e. by lowering price, sales can be increased, large scale will be preferred. Increased production will reduce the unit cost of output and bring in higher profits.

4. **Transport Facilities** Development of transport facilities expands the market. Goods can be supplied to far off places quickly. Raw material can be brought from distant but cheaper markets. In this way, improvement in transport facilities encourages large scale production.

5. Technical Possibility Every business has many technical aspects. These relate to production, storage, transport and commercial matters. Some goods technically cannot be produced on small scale e.g. cement, steel, so large scale is essential. Some goods like shoes can be produced at any scale. Goods like embroidery, because of the nature of work are preferred to produce on small scale. A few years ago, when trucks with freezers were not available, ice cream was produced and sold on small scale, e.g. on shops.

6. Organizational Ability The ability of the organiser plays important role in selection of scale. If the organiser is ~~ambitious~~; can take risk; has experience to supervise large business; knows how to deal with people; has courage to compete with rival firms; then he will prefer large scale. Since it is difficult to combine all these qualities in one individual he can hire people with specialised training (e.g. MBAs). Individual proprietors mostly work on small scale while joint stock companies opt for large scale. They manage greater production by splitting business into departments manufacturing and marketing units etc

LARGE SCALE PRODUCTION

Producing at large scale brings many advantages for the business firm. As a result, average cost of the production falls. Large scale production has a few disadvantages too.

Advantages

1. Economies of Buying and Selling Large scale producers can buy raw materials and other inputs at cheaper rates and favourable terms. Because large-scale producer can afford lower margin of profit, he is able to boost sales resulting in higher profit. A large producer will buy in cheaper market and will sell in dearer market. A firm like BATA, but not a small shoemaker, can buy leather from any cheaper market; domestic or international.

2. Use of High-Tech Machines Bigger firms can afford and have greater scope for use of expensive modern and computerised machines (even robots) which help them lower unit cost and improve the quality of the product.

3. Division of Labour Large scale producers organise their production on the basis of division of labour. They follow the principle 'right man for the right job'. Specialised labour produces larger and high quality output at a lower cost. A SUZUKI car reaches buyers after going through the hands of hundreds of workers or even robots.

4. Experiments and Research Big firms can afford expensive research and experiments. Ultimately they reap its benefits in the form of lower costs, new products and more efficient processes of production. Toyota and Philips companies employ hundreds of scientists/researchers to improve their products. Frequently, they bring new models and better quality products.

5. Advertisement and Publicity Large scale producers, attract their buyers through extensive advertisement and salesmanship. As their output is quite large, the cost of advertisement per unit of output is not high. Advertisement at the scale done by WALLS and SONY can not be afforded by small producers.

6. Use of By-products Big businesses can easily manage to use their by-products or waste materials. Such use helps them in reducing the average cost of production of the main product e.g. sugar mills use the stock of molasses for preparing power alcohol.

7. Face Adverse Times Large firms can face the adverse and unfavourable situations effectively. A small-scale producer simply collapses and is forced to close the business during such hard times. PIA runs into loss many a time but still continues business, since it can cover the loss in future years.

8. Credit Facility Another merit of big businesses is that they can easily avail of the opportunities of cheap credit and other privileges from financial institutions while the small firms cannot. SHELL Petroleum or Pakistan Steel can get easy credit from banks.

9. Economy in Fixed Cost Due to larger output of big firms, their per unit cost on account of administration, rent and interest on loans is reduced. Lahore College for Women University and Frontier College Peshawar have expanded much but they have still only one post of principal.

10. Repairs and Maintenance Because of large scale operations, the firms can establish their own facilities for the maintenance and repairs of their machines. A large Transport company like DAEWO establishes its own workshop and petrol pump.

Disadvantages

1. Individual Choice Ignored Large firms produce standardised products. This lack of variety reduces consumer's choice. You can select shoes at Bata, but cannot get it changed according to your taste. From a small shoemaker you can do so.

2. Difficulty in personal supervision It is difficult for big manufacturers to be aware of all details of business. They remain busy in tackling major problems. Dishonesty prevails among employees and they cause damage and waste of materials.

3. Possibility of Over-Production Due to mis-calculation of future market, the big businesses may produce more than what can be sold at current prices. Thus, over-production occurs and unemployment takes place.

4. Lack of Personal Contact with employees Large scale producers cannot remain in touch with the individual grievances of employees. Misunderstanding develops between both parties, which leads to strikes and lockouts. The workers do not remain loyal to their employer's interests.

5. Lack of Adaptability It is difficult for big concerns to make necessary adjustments according to changing conditions. In periods of depression, only small producers can easily shift to some new business.

6. Close Competition Big firms frequently indulge in wasteful competition which ultimately proves harmful to them. Diamond Foam and Molty Foam may lose profit in the fight to oust each other.

7. Dependence on Foreign Markets Large scale firms usually have to depend on foreign markets. If due to war or strained relations, their markets are cut-off, the businesses suffer huge losses.

8. In large scale production, principle of division of

Big Business and Economies of Large Size
Bigness of firms, itself, is not bad. In many cases, the bigger firms are in the interest of the general public. For example, the cost of cars produced in small workshops rather than in giant factories would be higher. Similarly a multiplicity of firms in distributing electricity in a particular town would be very wasteful.

Multinational

Corporation (MNC)

A multinational company or corporation is a firm that operates in more than one country.

labour is applied. Each worker has a small part in final product. Workers feel unimportant because they cannot own the final product. So they have no sense of achievement.

[A worker of a large garment factory cannot say with a sense of pride that 'I have produced this shirt' since he may have done a very small part of it. But a tailor, working individually, proudly introduces the shirt tailored by him.]

S/Op + MCQs

SMALL SCALE PRODUCTION

Large scale production is charming and attractive, yet in many cases we find that 'small is beautiful' and efficient. Over the past century new technologies and improvement in means of transport and communication has encouraged expansion in scale of business. Some real giants in the business world like General Motors of USA and Toyota or Sony of Japan produce millions of units of output, employ millions of workers and earn huge profits. (some firms have budgets which higher than budgets of smaller countries). Still small business is flourishing side by side.¹ For many business activities small size and output is still most suitable e.g. retail general store, tailoring.

Advantages

Small Scale

1. Adaptability Small scale manufacturers can easily switch over to changed atmosphere. They do not face any difficulty and delay in taking quick and prompt decisions because they need not consult shareholders for such changes.

2. Contact with Consumers Small firms develop regular contacts with the consumers and, thus, do not ignore their interests and choices. Such attitude involves lesser amount of risk.

3. Sympathetic towards Workers Small business concerns are found sympathetic and considerate to their employees. They give patient hearing to their problems and grievances. The possibility of strikes and lockout is minimised.

4. Proper Supervision Small producers are mostly individual owners or partnerships. They can easily look after the business. Chances of fraud and wastage are reduced.

5. Variety of Product Small firms do not stick to the standardised products, rather they offer changing varieties and designs as demanded by the buyers. Go to some shopping centre and you will be surprised to see the variety in ladies and gents shoes.

Disadvantages

1. Old methods of production Due to scarcity of capital, small producers rely on old-fashioned methods of production. Quality of product remains poor and cost high.

2. Difficulty in Division of Labour Due to small operation, scope for the division of labour is reduced. Their per unit cost remains high. In small health centre, there is no scope for employing specialist doctors.

Average cost

¹ Vendor Industry: The practice of appointing vendors by big firms to supply of parts of their product also helps small firms to continue business. SUZUKI of Pakistan gets many parts of its cars manufactured by small firms in Lahore and Karachi.

3. Scarcity of Funds Small firms generally face the problem of scarcity of funds. Banks prefer to deal with bigger firms.

4. Wastage Small scale producer is unable to make proper use of by-products. They may go waste resulting in high cost of main product.

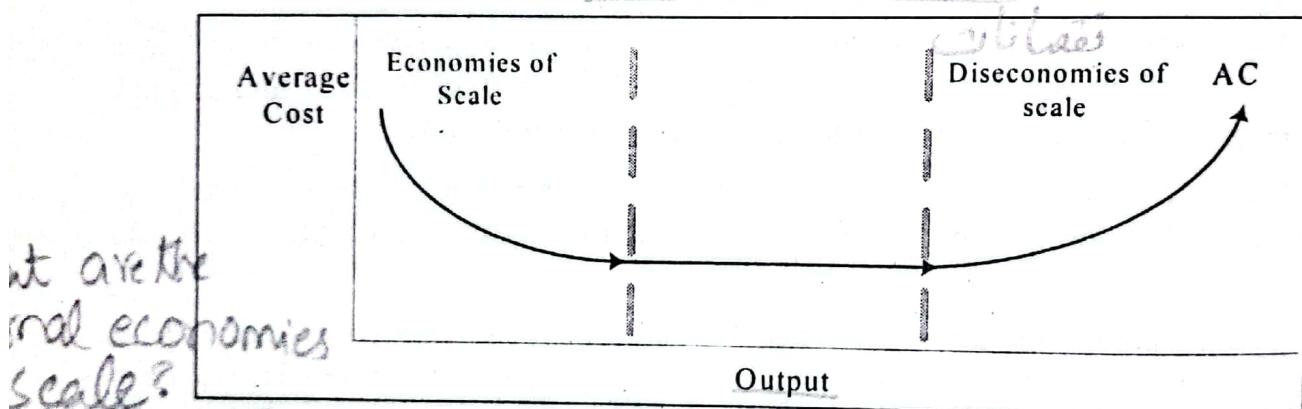
5. Diseconomy in Buying and Selling A small producer buys raw materials/inputs in small quantity. He has to pay a higher rate. Sometimes, he badly needs funds, so he sells his product at cheaper rates.

6. Less ability to face bad times Business conditions do not remain constant. The demand or prices of products may fall. In such cases, it is very difficult for a small producer to pull on and continue in the business.

ECONOMIES OF SCALE

The advantages which result from expansion in scale of business are called economies of scale. When firms grow, they are able to produce at lower average cost.

Economies of scale are those cost-saving advantages which firms get due to large-scale production.



Internal Economies

The advantages which a firm gets from the expansion of its business are called **internal economies**.²

Internal economies are classified under five heads.

A. Technical economies arise when it is possible to use larger or more efficient machinery

(i) **Increased specialisation and division of labour.** Large firms can break down the production process into different small jobs and can hire specialists for each job. This increases efficiency of labour. Example: in a Riksha one person is both a driver as well as conductor i.e. one person manages two passengers. But in a bus, the two jobs (driving and conducting) are performed by different persons so two workers can manage 50 passengers. Thus, cost per passenger is reduced.

In a small furniture shop, one person makes the chair and polishes it. But in a large workshop, the two jobs are given to different people. This reduces cost per chair. Repeating a specialised job again and again increases efficiency of labour.

² Internal economies and diseconomies are conditions that bring about decrease or increase in a firm's long run average costs as a result of changes in size within the firm

(ii) Large scale producers can also use *specialised machinery and reduce unit cost*. For example, while constructing a small house, the mixing of cement and concrete is done by hands. But while constructing a large building or plaza, the firm may use the machine like a concrete mixer. A big firm like Pepsi Cola will use automatic bottle washer while a person selling a few home made bottles of 'sharb' (cold drink) cannot do so. (In a modern car assembly plant different jobs are done through computerised machines and robots).

(iii) The *initial cost and the operating costs* of one large machine may be lower than two or more small machines doing the same work. For example, the cost of running a bus will be less than if the same passengers are transported by two wagons.

(iv) Production on large scale means *less wastage of materials and energy*. e.g. for transporting and storing oils, if bigger tanker are used, average wastage will be reduced. *By-products* can be effectively used. [Sugar mills can manufacture alcohol from molasses.]

(v) *Research and development* departments of large firms innovate and introduce new products which increase their total profits.

2. Managerial

In large-scale production, management can be split into **specialised jobs**, employing an expert for each one. There are production manager, marketing manager, purchase manager, sales manager, accounts manager etc. In this way, per unit cost is lower.

Suppose, the monthly output of a firm is 1000 shirts. It has one manager with a salary of Rs. 50,000 p.m. The management cost per shirt is $50000/1000 = 50$ rupees. Later the firm increases output level to 2000 shirts per month and there is still one manager. Managerial cost is now $50000/2000 = 25$ rupees per shirt.³

3. Commercial (or Marketing economies)

Bata

A large firm buys from cheaper market and sells in dearer market. When a firm buys raw materials in bulk, it gets **concessional rate**. For example, if Bata purchases shoe polish from Kiwi, it will be charged a lower rate than normal.

A small farmer having a few tons of wheat has to sell it locally at low rate. But a big landlord with, say, 500 tons of wheat can bring the same to a town grain market and get good price. Very large firms can even export their output to get higher prices. They can stock raw materials to face expected shortage in supply. NOKIA of Japan is sells mobile phones all over world through its own network of marketing and sales centres.

Publicity and advertisement are easier for large firms. They spend huge amounts on publicity yet their average cost does not rise because of larger sales. They can use expensive media to advertise.

4. Financial Large firms can get easy credit from banks on more favourable terms. So, it is easier and cheaper for UNILEVER to get a bank loan of 500 million rupees than for a small soap factory to get a loan of 50 thousand rupees.

5. Risk Bearing Large firms "do not put all eggs in one basket". Often they produce a whole variety of goods. So, their chances to meet bad times are brighter. Small firms usually produce a particular good or service. If for some reason, demand for their product falls, they are in trouble. Companies like Samsung and Phillips do not confine themselves to a single product. They produce fridges, TV sets, bulbs, computers etc. And sell in hundreds of markets all

Economies of scale cause a fall in long run average cost of the firm.

³ Suppose, now the firm splits the job of manager into production manager and marketing manager with equal pay for each. At the same time, the total output increases to 8000 shirts per month. The unit cost of management per shirt is further reduced to $80000 / 8000 = 10$ rupees.

over the world. The capacity of such firms to successfully overcome difficult times increases. Loss in one product or in one market may be covered from other products or markets. A company making only bulbs and selling only in Pakistan does not have this advantage.⁴

Diseconomies of scale

The disadvantages of expansion in the scale of production which raise the cost are called diseconomies of scale.

Diseconomies mostly occur when the size of business becomes too large.

1. Management Diseconomies The main factor causing diseconomies of scale is related to *problems in administration and decision-making*. Large firms are divided into many small specialist departments, for example, design, production, sales, accounts etc. In the presence of many departmental managers it will take a long time to reach a management decisions.⁵ Top management may not be in close touch with actual production operations of the plant. Internal communication and co-ordination suffers.

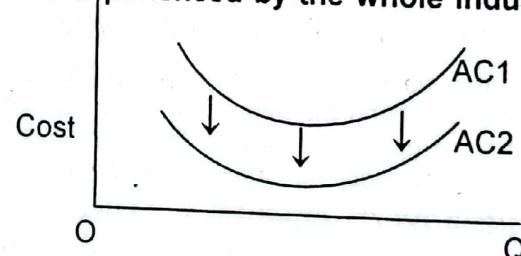
Larger firms can also face loss of flexibility and they find it harder to react effectively to changing market conditions. Decisions of various subordinates will fail to work. Industrial relations can also deteriorate with large labour force. The result is low efficiency and rising average costs.

2. Labour diseconomies In large firms labour is divided up into many specialised tasks. In such situations labourers have to do a monotonous job, so they may become bored and less attentive to their work.⁶

What are the external import of L/O economics of scales (EXTERNAL ECONOMIES)

External economies mean the favourable effects which reduce average cost of product as *industry* grows.⁷ The fall in cost is experienced by the whole industry and not just an individual firm.

Average cost of the whole industry falls



⁴ When because of economies of scale resources are more efficiently used the whole society benefits.

⁵ **Externality:** It is a side effect—good or bad—of production or consumption. Or it is the cost or benefit borne by a third party i.e. someone other than the immediate producer or consumer. For example a smoker against cholera not only saves himself but also affects the others sitting by. A person who gets him vaccinated in his own house improves environment for himself as well as for others living in his neighbourhood. Parents who educate their child increase welfare of the whole society. **Pollution is a negative externality.** As a steel plant produces smoke in addition to steel. Steel is a 'good' but smoke is a 'bad'. The firms do not have to bear any cost whereas the society has to. Now a days the question how to compel private firms to reduce pollution has got increased attention of the govt. and the economists.

⁶ After considering both economies and diseconomies of scale we should note that achieving the best size of business is not simply a question of bigger, but of attaining the optimal size of business or plant. The typical best size will vary from industry to industry.

⁷ Economies of scale are also called **economies of mass production**.

External economies are of three classes.

1. **Economies of Concentration** As industry expands and firms concentrate in an area, it becomes easier for them to get specialised skilled labour, raw materials and services of specialised institutions. There is
 - Establishment of **Subsidiary** industries
 - Establishment of related workshops
 - Expansion of network of **transport** and communication facilities
 - Increase in **banking** services
 - A whole **network of suppliers** and specialists comes up.

External economies and diseconomies are the outside factors that cause a rise or fall in a firm's long run average cost. A single firm has no control over them.

In Sialkot sports industry is concentrated. It requires little effort to get trained workers and raw material to make footballs while it may be a difficult job to do so in Quetta.⁸

2. **Economies of Information** Expansion of industry encourages spread of information and research. Journals and publications about a particular industry appear. The firms come to know new methods and processes. In Pakistan, textile is the largest industry. Many publications about its problems and performance are available.

3. **Economies of Disintegration** When industry grows, specialised firms are established. Electric fan industry is concentrated in Gujranwala and Gujrat. Here more and more firms are specialising in production of only some particular part of fans. Some are producing electric motors only. Some specialise in regulators. This disintegration lowers cost of production. Similarly, with expansion of auto industry in Pakistan, specialisation is increasing. Some firms are engaged in producing clutches or gears while others supply plastic parts.

External diseconomies

1. **Diseconomies of pollution** The *localisation* of an industry in a particular place or region pollutes the environment. It affects the health of labourers and raises **social cost of production**. Leather tanneries in the town of Kasoor (near Lahore) has played havoc with environment there.

2. **Diseconomies of over-used infrastructure** Expansion of the industry puts excessive pressure on transport, electric power or gas supply in the region. Transportation of raw materials and products gets delayed and cost of production rises.

3. **Diseconomies of high factor prices.** Expansion of industry increases competition among firms for land, labour and capital. Their prices rise and affect cost of production

Quiz: There are two communities. In first community, people prefer to be self-sufficient depending less on others. Everybody wants to complete the whole work himself. In the second community, there is much division of labour and specialisation. People are too much dependent on each other's work. Which of the communities will be wealthier?

⁸ In Urdu Bazaar Lahore, printing, publishing and marketing is done extensively. All kinds of paper, materials, printing presses and allied industries are available easily. A big paper market exists nearby to support the publishing business. So, cost of producing books there is much less than at Islamabad or Multan.

Important LAWS OF RETURNS

OR *Laws of variable* LAWS OF PRODUCTION

The relationship between the quantity of factor inputs⁹ and the quantity of resulting output is called production function.¹⁰

The relationship between inputs and output is affected by the time period available. When firms plan to increase production, they have two options.

(i) **Increase all factor inputs in the same proportion.** This is called change in **Scale of Production** and is generally available in long period. For example, if quantities of all factor inputs; land, labour and capital are doubled, we say that scale has doubled. The laws, which explain the effect of change in scale, are called *laws of returns to scale*. (These are outside the scope of this book.)

(ii) **Increase the amount of some factors keeping others as constant.** This means a change in the ratio or proportion of factor inputs. During short period, the firms cannot increase fixed factors because they require long period to make any change. When the firms decide to increase output by changing only a variable factor, they have to face the **law of variable Proportions** i.e. the change in output does not occur at a uniform rate, but at variable rate. Existence of fixed factor(s) is the cause of this particular behaviour of output

Don't Confuse

Laws of Returns are different from Laws of Returns To Scale

There are only **TWO** laws of returns. They operate in **short run**.

- (i) Law of Increasing Returns
- (ii) Law of decreasing Returns

There are **THREE** laws of return to scale. They operate in long run.

- (i) Law of increasing returns to scale
- (ii) Law of constant returns to scale
- (iii) Law of decreasing returns to scale

LAW OF VARIABLE PROPORTIONS

Or Law of Returns to a single variable factor

The law of variable proportions describes the behaviour of output as the quantity of one factor is increased keeping the quantity of others as fixed.¹¹

Every producer tries to use inputs in the ratio or proportion which brings higher output. In this regard a number of possibilities exist.¹² His choice depends upon whether he is planning for short or long period. In short period, generally some factors are fixed and it is not easy to increase their quantity e.g. factory building. If the market demand for the product rises, the only way output can be increased is to change the quantity of the factor, which is easy to vary. In such a situation, the behaviour of output is described under the law of variable proportions. According to this law, with increase in variable factor, the output does not increase at a uniform rate. In the beginning, increase in output will be *more than proportional* and later, beyond a point, *less than proportional*. We can define the law as:

⁹ Inputs are land, labour and capital.

¹⁰ Production function for any commodity is an equation, table or graph showing the (maximum possible) quantity of a commodity that can be produced per unit of time for each of a set of alternative inputs, when the best of techniques available are used.

¹¹ Law of variable proportion is an explanation of short run production function where some factors remain unchanged.

¹² Consider a case when one person is put to work on 50 acres of land or a case that 50 persons are given one acre to work at. Both these situations do not represent correct combinations of factors.

Scale of Production

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Capital and Land

"As more units of a variable factor of production are combined with fixed factors, the total product rises, at first more in proportion to increase in variable factor, then less in proportion and finally decreases".

or

"As the quantity of one variable input in a production process is increased, with quantities of other inputs remaining fixed, marginal physical product firstly increases, then after reaching a maximum, starts decreasing and finally becomes negative".

[Essential point to remember] Law of variable proportions explains the technical aspect of production. It is expressed in *physical units of output* and prices of inputs or output do not enter into discussion.

Example: Cultivation of land

To explain this law, we make some assumptions.

- (a) Land is fixed factor. (it includes some capital like tube well)
- (b) Labour is variable factor.
- (c) Workers are equally efficient.
- (d) The time period available is short so the method of production does not change. (e.g. agricultural technology)
- (e) Wheat is grown on the farm.

Short Run is the period of time in which at least one factor is fixed in supply.

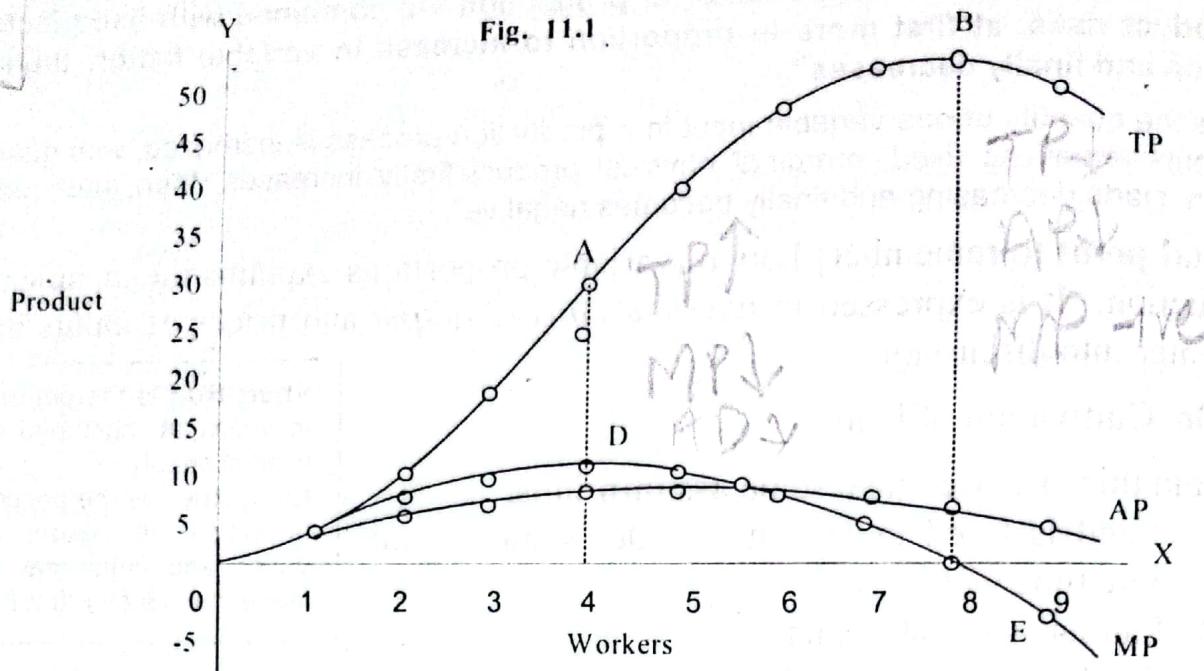
Long Run is the period of time in which all factors may be varied and firms may enter or leave the industry at will.

Table 11.1 Relation between Labour Input and Wheat Output

Land and Capital (Units of fixed factor)	Workers (Units of variable factor)	Total product (TP) (Tons of wheat)	Marginal Product (MP)	Average Product (AP)
10	0	0	-	-
10	1	4	4	4.0
10	2	11	7	5.5
10	3	20	9	6.6
10	4	30	10	7.5
10	5	39	9	7.8
10	6	46	7	7.6
10	7	50	4	7.1
10	8	50	0	6.2
10	9	45	-5	5.0

Since land is fixed, as we add more and more labour, the proportion in which different factors are combined is changed. In the beginning, addition of workers creates opportunities for division of labour. Different jobs can be given to different workers. So productivity of labour rises. Up to 4th worker, the marginal product (MP) is increasing i.e. every new worker is adding more to total product (TP) than the previous one. This stage is called law of increasing returns. The MP of 5th worker is less than that of 4th. Thus, from this point, law of diminishing returns starts operating. Finally at 8th worker, MP is zero. It becomes negative from 9th worker.

The relationship of variable input (workers) and output has been shown in fig. 11.1.



The figure shows that initially up to point A, TP increases at increasing rate. This part represents law of increasing marginal returns. Against point A, marginal product is maximum. From point D to E, the MP curve is falling. This is the phase of diminishing marginal returns.

Law of variable proportions consists of three phases.

(i) **Increasing returns.** In many cases, the increase in variable factor is initially followed by increasing marginal returns i.e. **total output increases more than proportionally to the variable factor.** This phase does not last longer.

(ii) **Decreasing returns.** If increase in variable factor is continued, the marginal product starts falling i.e. the law of decreasing returns sets in. This law is more universal and lasts longer. No business can escape this law. Sooner or later every economic activity comes under this law.

(iii) **Negative returns.** When a business experiences decreasing returns and the quantity of variable factor continues to increase, the marginal return becomes negative.

Law of decreasing returns is the most important part of the law of variable returns.

Rationale (Reason) The reason for non proportional change in output is that **different factors of production are not perfect substitutes** for each other. They can be substituted only up to a certain extent in limited quantities. When some factor is less in quantity as compared to others, the combination of factors is not correct. All factors are not fully utilised and their productivity is low. In the above table, initially, land is in abundance as compared to small amount of labour. Full use of land's productive capacity is not possible. By increasing labour, we apply the principle of division of labour i.e. we go towards the best combination of land and labour. When this stage is reached at 4th worker, MP is maximum. After this point, if we add more workers, labour becomes more abundant as compared to fixed amount of land. So, MP starts falling.

All production requires the use of inputs or factors of production. However, these can often be combined in a variety of ways, sometimes by using more of one factor relative to another, and vice versa. Profit maximising firms will combine the factors of production so as to minimize the cost of producing any given output

Law of variable proportions consists of two parts viz. increasing returns and decreasing returns. But the most important part of variable proportions is the law of diminishing marginal returns.

We have explained the law of variable proportions by taking labour as variable factor. We could easily do the same by keeping labour as constant and taking land or capital as variable.

Stages of Production

Law of variable proportions shows a particular pattern of changes in output. From the behaviour of TP, MP and AP, we can divide the whole production process into three stages as shown below

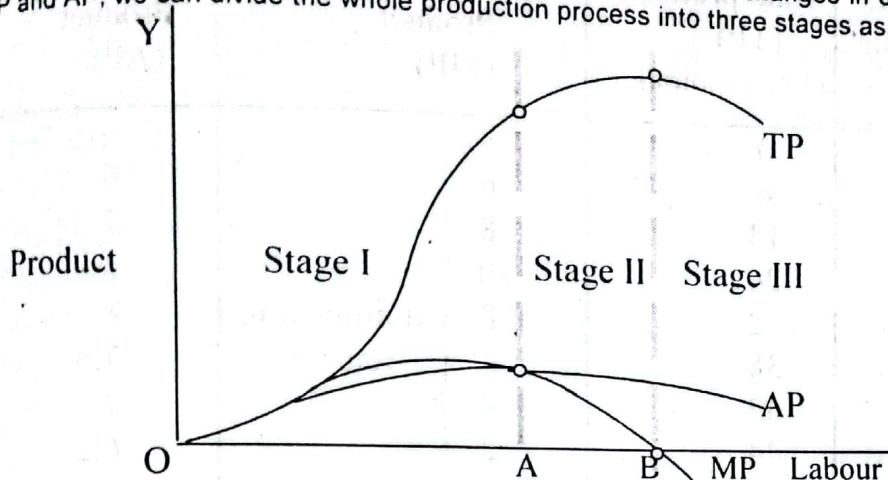


Fig. 11.2

During stage I, up to OA number of workers, average product is increasing. A firm cannot stop production in this stage. By using more labour it can increase average product of all workers. So, why not to expand? In stage III, after OB workers, marginal product becomes negative and total product starts falling. It means that if the firm works in this stage, it is a loser. Why should it employ a person who adds nothing in total product or even causes a decrease in previously achieved TP? Thus, the firm has one choice only; that is, it must produce somewhere in stage II, where marginal product is decreasing but is positive. The actual number of workers will be decided after considering the wages of labour.

NOTE: When the students are asked to discuss Law of Increasing returns, they can explain Law of variable proportions as answer by indicating that Law of increasing returns is the first phase of it.

LAW OF DIMINISHING (DECREASING) RETURNS

The term return of a factor means the product of a factor in physical units. When in a process of production, the phase of increasing returns (or in some cases, phase of constant returns) has ended, the phase of diminishing returns starts. This happens when the point of optimum combination of factors has been crossed. This law is the third and the most important phase of the *law of variable proportions*.

Statement

"During a process of production, if one factor is made variable while others are held constant, the marginal product firstly increases and after reaching a maximum starts decreasing. The decreasing phase is named as diminishing returns".

OR

"When increasing quantities of a variable factor are used in combination with a fixed factor, the marginal and average product of the variable factor will eventually decrease".

Law of diminishing returns applies to short run situations, in which the firm employs more of one input only keeping other inputs constant. It shows the relationship of physical quantities of inputs and output without considering their prices.

Assumptions To explain this law, we take an example with the following assumptions:

1. Labour is variable while other factors are constant.
2. Units of the variable factor are homogeneous (all workers are of equal efficiency).
3. Land and capital stock are constant.
3. Production technology does not change. (If technology is changed, output can change even without change of inputs.)

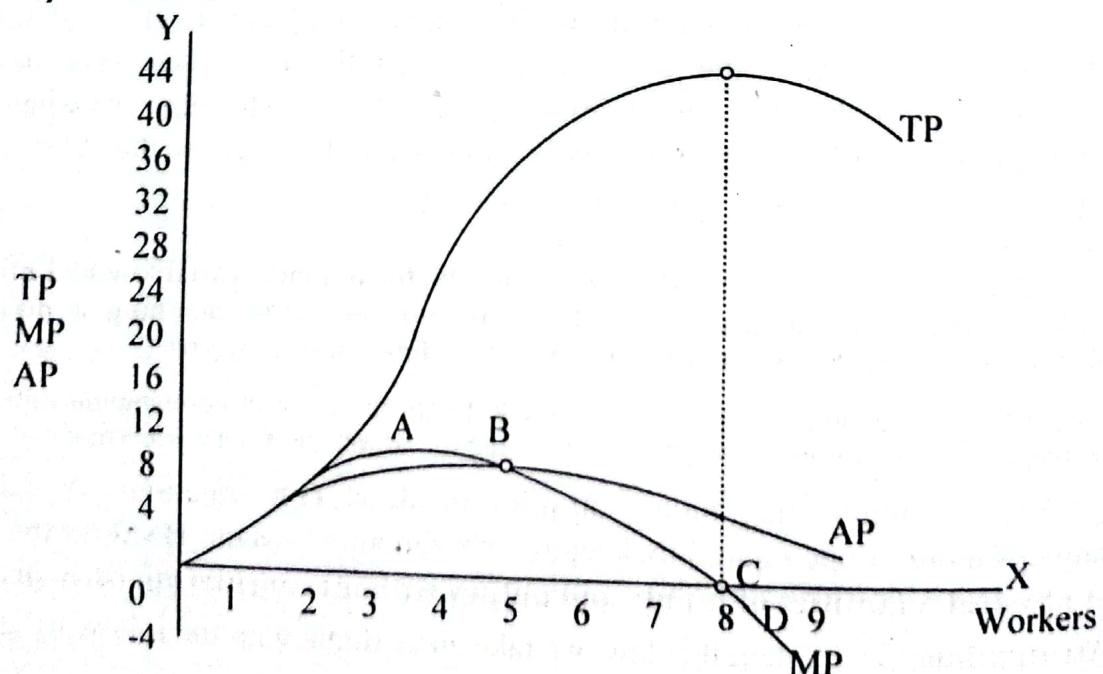
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20	4	32	8	8
20	5	38	6	7.6
20	6	42	4	7
20	7	44	2	6.2
20	8	44	0	5.5
20	9	42	-2	4.8

If no labour is applied, land and capital produce nothing. When first person works on land, its output is 6 units. When a second person is added, division of work becomes possible and efficiency of labour increases. Up to third worker, marginal product is rising but after that it goes on falling. As more and more labour is applied, land and capital become scarce compared to labour. So, additional labour is not properly utilised. Addition to total production becomes smaller. Overcrowding on the fixed land causes fall in marginal product.

When the various quantities of the above table are shown in a graph, we get following shape of curves:

Fig. 11.3



Up to OA, marginal returns increase. After point A, marginal product starts decreasing. From A to D, falling curve indicates diminishing marginal returns. When marginal product is zero at C, total product is maximum. When number of workers is increased to the point that MP becomes negative, total product decreases.

Cause: Law of diminishing marginal returns appears because each successive unit of the variable factor has less of the fixed factor to work with. Different productive factors are substitutable only in limited quantities. If we use too much of some factor it will be only wastage of resources. In the above example when workers become too many, they are unable to use their full production capacity. New addition of workers can not make up the shortage of land and capital.

Application Law of diminishing returns was first stated in connection with agriculture. It was thought that some factors like sunshine and weather are determined by nature, so any increase in labour or fertiliser can not increase production in the same proportion. However, now we know that the law of diminishing returns has universal application. Wherever, for any reason, the quantity of some factors cannot be increased along with variable factor, diminishing returns will follow (after the stage of optimum or best combination has reached). It is the scarcity of some factors in relation to a factor, which is root cause of this law. This situation can arise in agriculture, mining or industry. The law of diminishing returns is "*as universal as the law of life itself.*"

Importance The law of diminishing returns has much practical importance and is supported by empirical study. If diminishing marginal returns had not existed, the whole population could have been fed by growing crops on a tiny piece of land by applying more and more amount of labour and capital. This law also forms the basis of a number of economic doctrines like **Malthusian theory** of population, **Ricardian theory** of rent and **marginal productivity theory** of factor pricing. This law explains why average cost (AC) and marginal cost (MC) curves of a firm start rising after touching a minimum.)

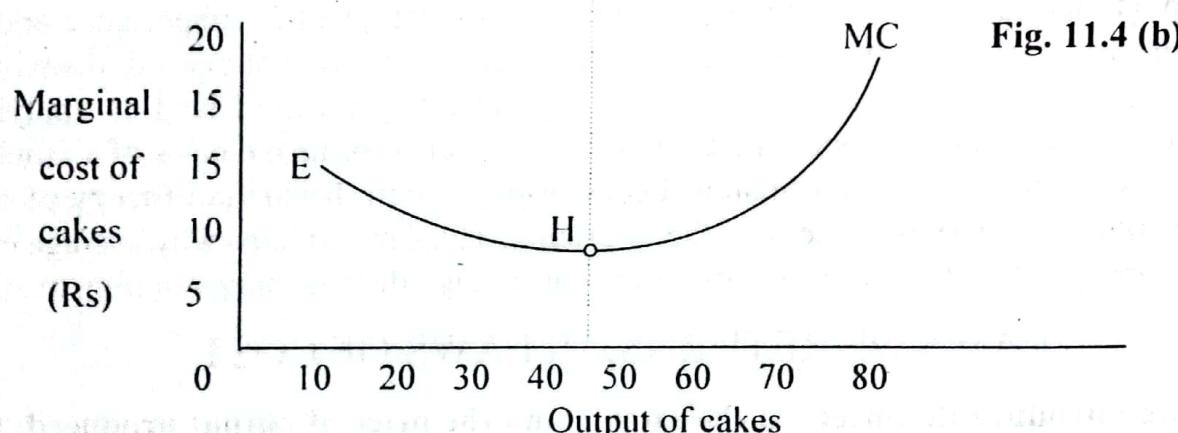
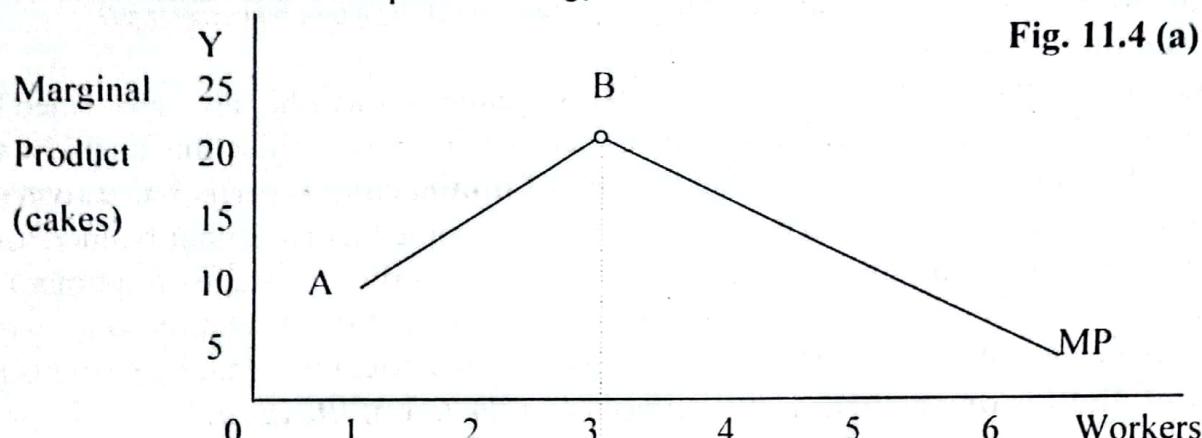
LAW OF RETURNS AS LAWS OF COST

If we introduce the prices of the factors and the price of output produced, the laws of returns give rise to laws of cost. When production is taking place in the stage of increasing marginal returns, the marginal cost decreases. So, this phase in production is also called law of diminishing marginal cost. Similarly, the increasing marginal cost is obtained during the phases of diminishing marginal returns. This is illustrated in the table given below. Suppose the wages of a worker is Rs. 100, and total and marginal product (number of cakes) are as shown in table 11.3.

Table 11.3.

Workers	TP (cakes)	MP	Cost of one worker (wages)	Marginal cost of output (Rs./cake), MC = Cost/MP
1	10	10	100	10
2	25	15	100	6.6
3	45	20 (highest)	100	5 (lowest)
4	60	15	100	6.6
5	70	10	100	10
6	75	5	100	20

The values have been plotted in fig. 11.4 (a) and (b).



We see that in fig (a) MP increases from A to B. In this phase, MC of output shows falling tendency [from point E to H in fig. (b)]. Against the phase of decreasing returns, MC is rising. Thus, we see that the U-shape of the marginal cost is actually determined by the laws of increasing and decreasing marginal returns in production of goods.

TOTAL, AVERAGE & MARGINAL QUANTITIES

Total, average and marginal quantities always bear a definite relationship to each other. So, if value for one are given, the other two can be derived. For example, if schedule of total utility is given we can easily find out the schedules of marginal and average utilities and vice versa. Similarly, we can derive marginal and average product from total product.

(a) **Relation between Marginal and Total Quantity**

1. Marginal quantity shows the rate of change of total quantity.
2. When marginal quantity increases, total quantity increases at increasing rate.
3. When marginal quantity decreases, total quantity increases at decreasing rate.
4. When total quantity is maximum, marginal quantity is zero.
5. When total quantity falls, marginal quantity is negative,

(b) **Relation between Average and Marginal Quantity**

1. When average quantity is increasing, marginal quantity is greater than average quantity.
2. When average quantity is decreasing, marginal quantity is less than average quantity.
3. When average quantity is neither increasing nor decreasing, marginal is equal to average.

(c) **Relation between Total and Average Quantity**

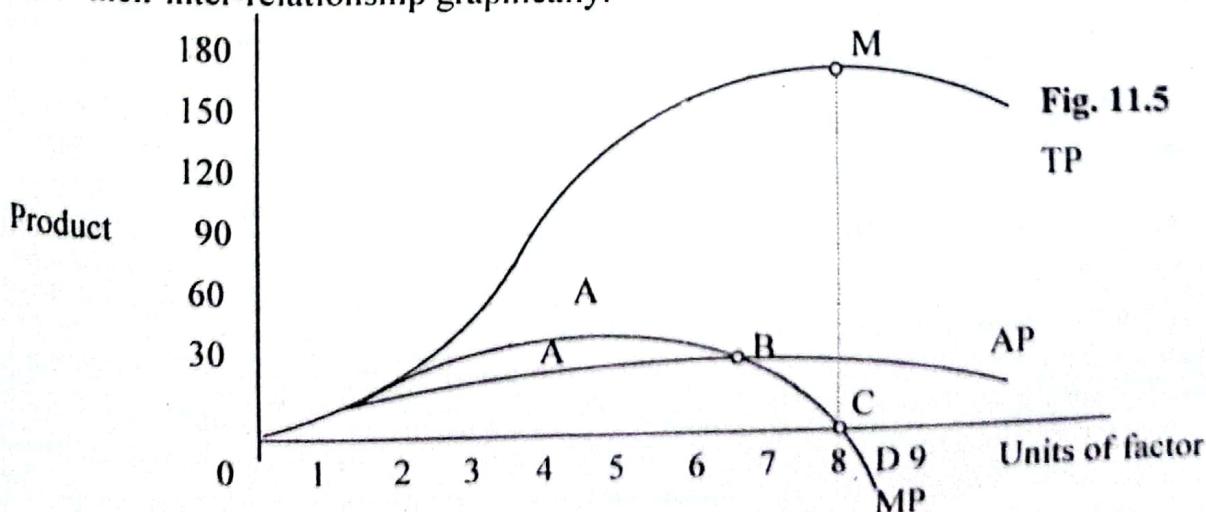
1. Average quantity is equal to the total quantity divided by the number of units of a factor employed. Average = Total/units.
2. When total quantity is zero, average is zero.

These relationships and derivation of various quantities from others are illustrated by example of production of wheat by labour.

Table 11.4

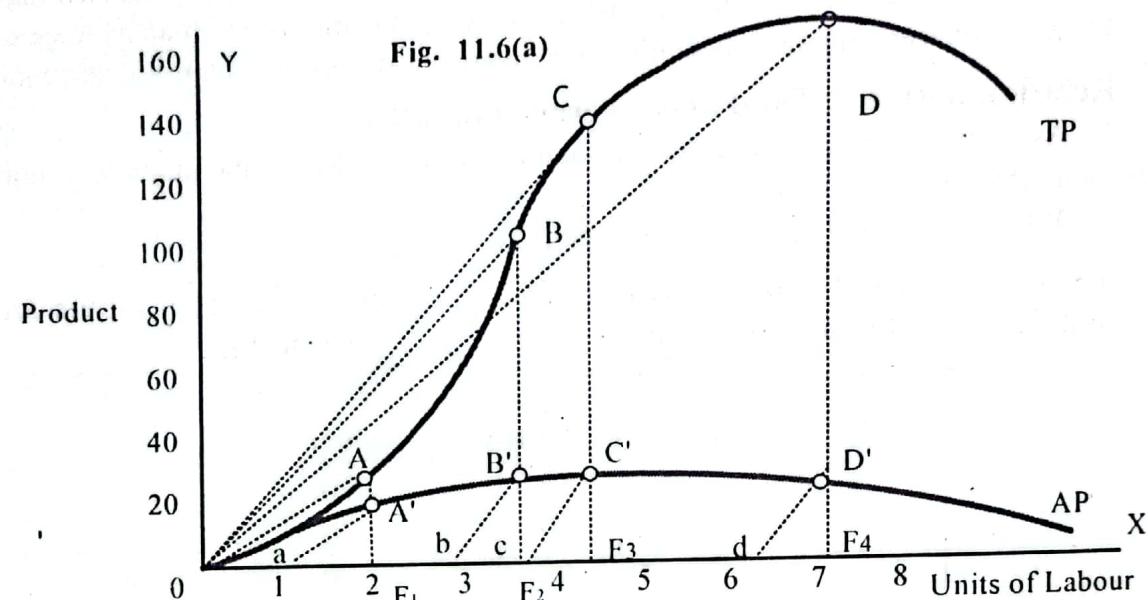
Units of factor (Labour)	TP (Quantity)	MP (Quantity)	AP
1	10	10	10
2	30	20	15
3	60	30	20
4	100	40	25
5	130	30	26
6	150	20	25
7	160	10	22.8
8	160	0	20
9	150	-10	6.6

Total product and marginal product values from the table are plotted in fig. below. To show their inter-relationship graphically.



Derivation of marginal and average quantities from total quantity with geometrical method, is also illustrated in fig. 11.6.

Derivation of Average Product Curve Average product curve is derived on the principle that the slope of a line formed by joining any point on total product curve with the origin shows average product at that point. Consider point A in fig. 11.6 (a) on TP curve. It shows that by using OF_1 units of the factor, we get total product AF_1 . Thus, $AP = \frac{\text{Total product}}{\text{units}} = \frac{AF_1}{OF_1} = \text{slope of OA}$.



We have found that slope of the line OA shows average product of the factor. If we draw some other line with the same slope as OA, it will also indicate average product of F_1 units of factor. With this fact in mind, we draw a line aA' (starting from a point, which is one unit less than OF_1) parallel to OA. It meets the perpendicular AF_1 at A' . The slope of aA' also represents average product, since its slope is the same as that of OA. Now slope of $aA' = A'F_1/1 = A'F_1$. In this way, we have found that if F_1 units of the factor are used, average product is $A'F_1$. Working in the similar way, we have found that average products against points B, C, D are $B'F_2$, $C'F_3$ and $D'F_4$ respectively. By joining points A' , B' , C' and D' we get the average product curve.

Derivation of MP curve
Marginal product curve is derived on the principle that the slope of a tangent at some point on TP curve indicates marginal product. In fig. 11.6(b), we have selected four points A, B, C and D and have drawn tangents T_1 , T_2 , T_3 and T_4 respectively. AF_1 , BF_2 , CF_3 and DF_4 are total products. AF_1 is the total product when F_1 units of the factor are used. Starting from one unit less than F_1 , we draw a line aA' parallel to T_1 line. Since slope of the two lines is the same, the slope of aA' will indicate marginal product. This is $A'F_1$. Thus, $A'F_1$ is marginal product against point A. Using the same principle,

RELATIONSHIPS

Total and marginal quantities

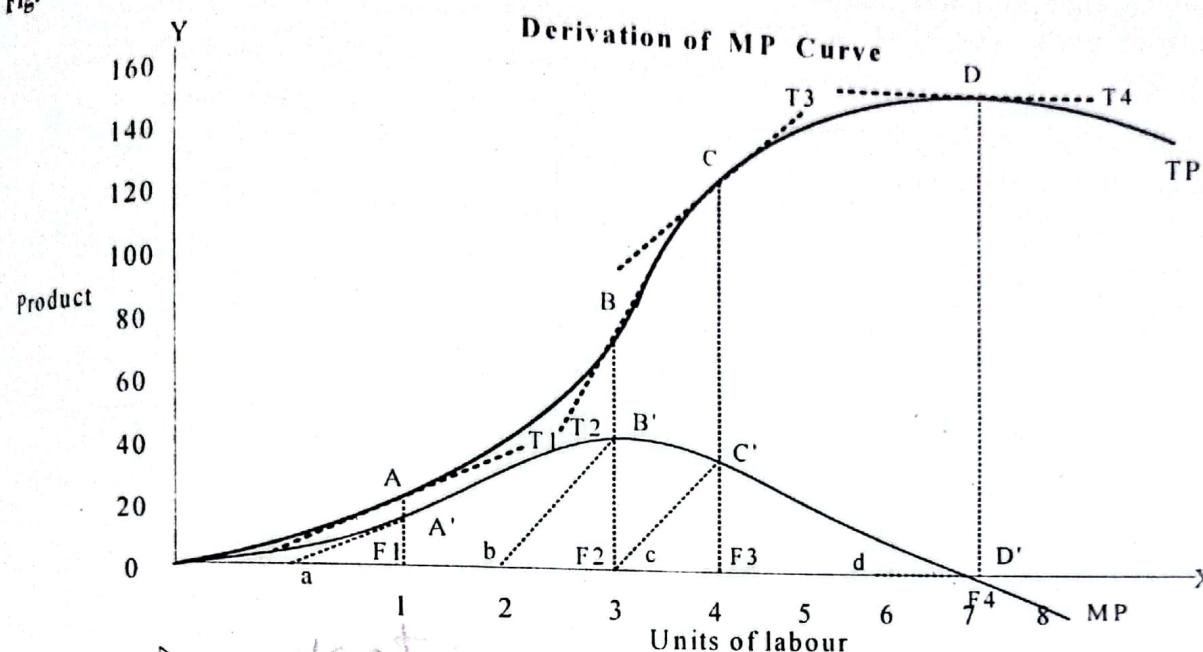
When total quantity is increasing, marginal is positive.
When total quantity is decreasing, marginal is negative
When total quantity is constant, marginal is zero.

Average and marginal quantities

When average quantity is increasing, marginal > average
When average quantity is decreasing marginal < average
When average quantity is constant, marginal = average

we have found $B'F_2$ and $C'F_3$ as marginal products against B and C. Since line dF_4 has coincided with x-axis (i.e. its slope is zero), so marginal product against total product DF_4 is zero. By joining points A' B' C' and D', we get marginal product curve.

Fig. 11.6 (b)

*Important*

PRODUCTION FUNCTION

Production function shows how the quantity of output changes as the quantity of factor inputs is changed. In the production function, both output and inputs are measured in physical units (like tons, meters etc.) and not in rupees. Production of a commodity requires the combined use of many factors. **The relationship between the quantity of factor inputs and the quantity of resulting output is called production function.** We can also define it as:

Production function is the technological relationship, which shows the maximum amount of output attainable from various combinations of factor inputs. Or

Production function is a schedule or table showing the maximum possible amount of physical output obtained from various combinations of inputs, given the state of technology.

The purpose of a production function is to tell us just how much output we can produce with varying amounts of factor inputs. The following table shows a simple production function about sewing of shirts using two inputs labour and capital.

In functional notation, we can write a general production function as,

$$Q = f(A, B, C, D)$$

Where Q is the quantity of output, while A, B, C and D are different productive factors such as land, labour etc. If we assume that technology as well as organization and land do not change, while labour L and capital K are variable, then the production function can be written as

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

If we put different values of K and L we get a table as

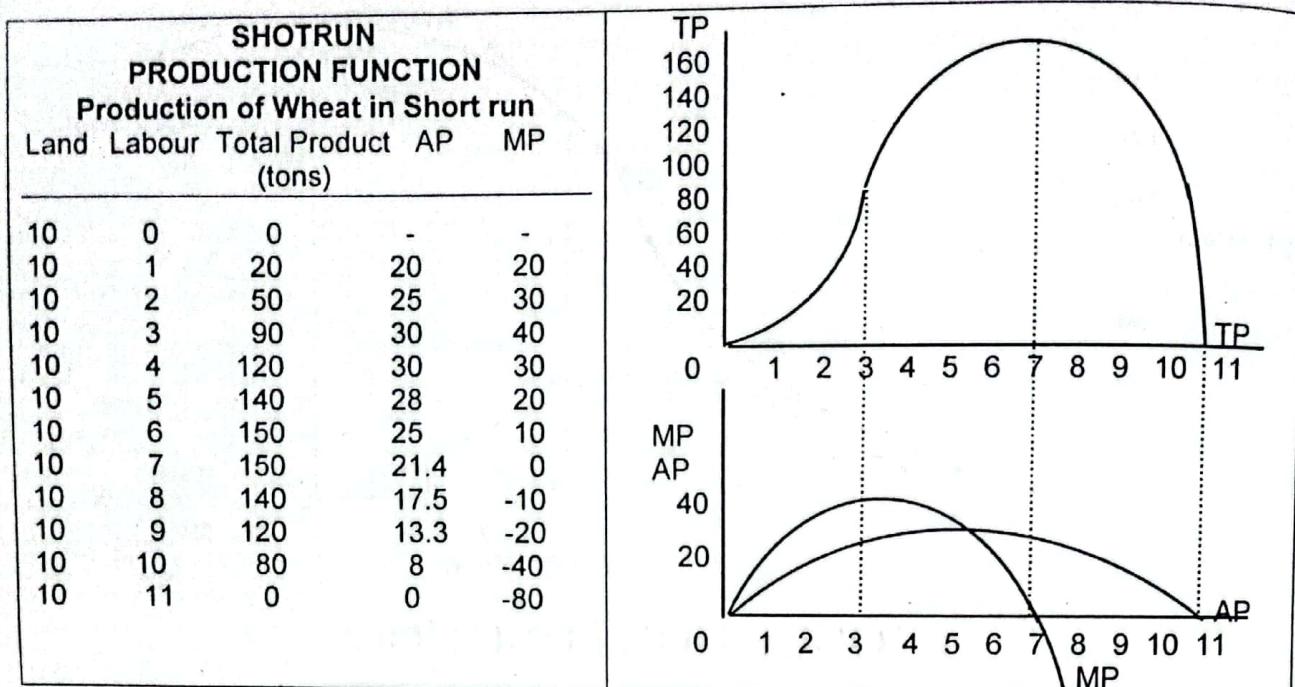
Capital input (Sewing machines)	Labour input (workers per day)			
	0	1	2	3
0	0	0	0	0
1	0	2	4	6
2	0	4	8	12
3	0	6	12	18

given opposite

Any change in the amount of labour or capital will affect the quantity of output.

Short run production function (Returns to a single variable input)

In the short run, some inputs (e.g., land, capital) are fixed in quantity. Output then depends on the quantity of variable input only. Short-run production function explains the relationship between output and the quantity of one variable input while quantity of other factors remains constant. The following table shows how output changes when more of labour is used.¹³



We make a few tables below to show how changes in labour and capital can affect output.

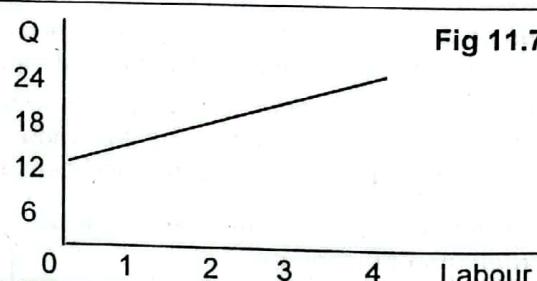
Short run Production Function

Situation I (change in proportion of labour and capital) suppose labour is variable (as weeks of one worker) while capital is constant at 5 units (e.g. 5 millions rupees). And output (in physical quantity) is number of bulbs in thousands.

Table 11.5

L	K	Q (Constant)
1	5	13
2	5	16
3	5	19
4	5	22

Fig 11.7



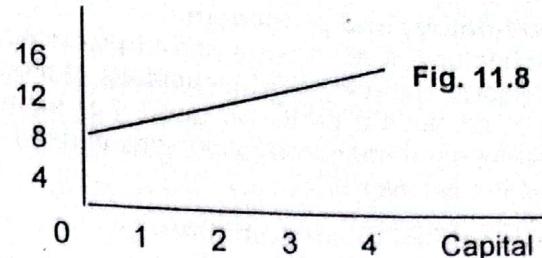
When we show the relation between labour and output in a graph it gives us a straight line as shown in figure 11.7. Since the output is increasing at a constant rate along with labour, it is called law of constant marginal returns.

Situation II (Again there is change in proportion of factors) Suppose, now labour is constant at 2 units while capital varies.

¹³ (Short run production function is explained through law of variable proportions. (The law is explained in the next chapters)

Table 11.6

L	K	Q
(Constant)		
2	1	8
2	2	10
2	3	12
2	4	14



Long Run Production Function (Returns to scale)

In the long run, it is possible for a firm to change all inputs i.e. it can change the scale of production. The effect of change in scale is called laws of returns to scale.

Situation III (Change in the scale of production) Suppose the scale is doubled i.e. the amount of both labour and capital are doubled.

Since by doubling the quantities of inputs, (i.e. doubling of scale of production), the output is doubled, this function shows constant returns to scale.¹⁴ (If a change in scale of inputs does not change output in the same ratio, the production function shows increasing or decreasing returns to scale)¹⁵

	L	K	Q
Scale I	1	1	5
Scale II (Double of Scale I)	2	2	10

There are many kinds of production functions. Some are *linear*. Others are *non-linear*. We take a simple example of a linear production function where both labour and capital are variable inputs

$$Q = 3L + 2K$$

The function is linear¹⁶ since power of each variable is one.

SUPPLEMENTARY NOTES

➤ Return to one factor vs. Returns to Scale

There is a difference between returns to a factor and returns to scale:

- (i) The law of return to a single factor operates in the short run, whereas the law of returns to scale operates in the long run
- (ii) The law of returns to a factor explains the behaviour of production with one variable factor, whereas the law of returns to scale explains the behaviour with all factors variable
- (iii) The law of return has three phases — increasing returns, diminishing returns and negative returns, whereas the law of returns to scale exhibits increasing returns to scale, constant returns to scale and diminishing returns to scale

¹⁴ It is also homogeneous of degree one

¹⁵ Graph of long run production function. To show long run production function graphically when both labour and capital are variable, we draw Iso-product curves. But those are outside the scope of present study.

¹⁶ This function is just a simple example to introduce the nature of production function. This shows that even without labour, some output can be produced. In actual practice, this is not possible. Capital without labour can produce nothing. If we want to consider only realistic production function, we can use many other forms.

Suppose we use $Q = 2KL + L$. In this production function Q is affected by changes in K and L as follows.

When labour applied is zero, output is zero.

Situation I			Situation II			Situation III — Both Labour and capital variable		
L	K (constant)	Q	L (constant)	K	Q	L	K	Q
0	1	0	1	0	1	0	0	0
1	1	3	1	1	3	1	1	3
2	1	6	1	2	5	2	2	10
3	1	9	1	3	7	3	3	21