MODULE III PRODUCTION ECONOMICS AND THEORY OF FIRM 9

Production and Production function – Types, Factor Inputs – Input-Output Analysis**,** Undifferentiated Products - Cournot, Stackelberg, Dominant firm model, Bertrand-Heterogeneous products - Chamberlin's small and large number case - Kinked demand curve theory - Bain's limit pricing – Production Possibility Frontier.

Production

Production is a fundamental requirement for all economies and societies. It is the process of making goods and/or services that satisfy consumers' wants. Production is the process of making or manufacturing goods and products from raw materials or components. In other words, production takes inputs and uses them to create an output which is fit for consumption – a good or product which has value to an end-user or customer. In economics, a business which produces goods are known as "producers" and these companies are taking the inputs available to them (both material and immaterial) to produce products which the consumer will want to buy.

Production Function

Production function refers to the functional relationship between physical inputs and physical outputs of a commodity. As we know, for producing output, we need inputs. Generally, the land, labour and capital are well known and well-organized inputs used for the production of goods and services.

Hence, the producer is always keen to know the number of inputs needed to produce a given quantity of a commodity. *For instance*, the producer may find that 20 units of capital and 10 units of labour are required to produce 200 units of a commodity. Thus, it is the relationship between physical inputs which are 20 units of capital and 10 units of labour and physical output which is 200 units of a commodity. In economics, it is known as the Production Function.

In other words, production function refers to the technological relation between a firm's output/ production and the physical factors of production (inputs). It can be expressed as:

$Q_x = f(L, K)$

Here,

Q_x denotes Output/production of commodity

L denotes labour

K denotes capital

Therefore, production is a function of labour and capital. Using the values of the above example, we can write it as:

200_x= f (10L, 20K)

It implies that a maximum of 200 units of a commodity-X can be produced with the use of 10 units of labour and 20 units of capital.

In the words of Watson,

" Production function is the relation between a firm's production(output) and the material factors of production(input)."

According to Koutsoyiannis,

"The production function is purely a technical relation which connects factor inputs and output."

Factors of Production:

The factors of production refer to the inputs used to produce the output of a commodity.

Classification of Factors of production:

1. Fixed Factors
2. Variable Factors

1. Fixed Factors of Production:

It refers to those the application of which doesn't change with the change in output. Moreover, these factors are installed before the output actually starts. For Example, machinery is installed in production house even at zero production. Its quantity remains the same, whether the level of output is more or less or zero. Buildings, land, machinery, plants and top Management are some common examples of fixed factors.

2. Variable Factors of Production:

It refers to those the application of which varies with the change in the output such as labour. If other things remain constant, the more labour is needed to increase the output of a commodity.

Raw materials, ordinary labour, power, fuel, etc. are examples of variable factors. Such factors are required more, when output is more; less, when output is less and zero, when output is nil. For the sake of analytical simplicity, semi-variable factors are not considered here. Thus, at zero production, the use of variable factors is zero whereas its use increases with the rise in output.

Types of Production Function:

1. Short-run Production Function
2. Long-run Production Function

1. Short-Run Production Function:

Short-run is a period in which the output can be increased by increasing the input of some variable factor. In the short run, the fixed factor remains constant and variable factors change with change in output.

For this, when one factor is a fixed factor and other is variable, then the function can be expressed as:

$Q_x = f(L, \bar{K})$

Here,

Q_x = Output of commodity-X

L = Labour, a variable factor

K = Capital, a fixed factor

In short-run function, the output can only be increased by increasing the application of variable factors i.e. labour.

Illustration:

We can understand this with an illustration:

Suppose, a producer uses 10 units of capital as a fixed factor and 10 units of labour as a variable factor to produce 50 units of commodity as output.

$50_x = f(10L, 10\bar{K})$

And, if the output is increased from 50 units to 60 units by adding more labour to 15 units. It will be the production function for the short run.

$60_x = f(15L, 10\bar{K})$

Since Capital is constant and only labour changes, the ratio between capital and labour tends to change. This generates the law of variable proportion.

2. Long-Run Production Function:

Long Run is a period in which the output can be increased by increasing all the inputs. In the long run, all the factors are variable and change with change in output.

For this, when both factors are variable, then the production function can be expressed as:

$Q_x = f(L, K)$

Here,

Q_x = Output of commodity-X

L = Labour, a variable factor

K = Capital, a variable factor

In long-run function, the output can be increased by increasing the application of variable factors i.e. labour and capital.

Illustration:

We can understand this with an illustration:

Suppose, a producer uses 5 units of capital as a fixed factor and 10 units of labour as a variable factor to produce 50 units of commodity as output.

$50_x = f(10L, 5K)$

And, If the output is increased from 50 units to 100 units by adding more labour and capital to 20 and 10 units respectively. Then, it will be the production function for the short run. It can be written as:

$100_x = f(20L, 10K)$

Since capital and labour, both changes to increase productivity, the ratio between capital and labour doesn't change. This generates the law of constant proportion.

Production function can be used to determine the most economical (cheapest) combination of factors of production that can be utilized to make something. It can answer a range of questions that management needs to answer when planning production and prices. It can measure marginal productivity of a specific factor of production – how output changes from one extra unit of that factor. Production function reflects how much output we should expect if we have so much of one factor of production, say labor, and so much of another factor, such a capital, and so much of another, etc. It is the indicator of the physical relationship between inputs and output of a producer.

Input-Output Analysis

Input-output analysis is a technique for studying inter-industry connections and interdependencies in the entire economy**,** where one industry's input equals another industry's output. Production is the most important aspect of economic activity. Intermediate goods, often known as inputs, are products that are produced by one industry but are used as an investment in the creation of another.

Input-output analysis is a type of economic model that describes the interdependent relationships between industrial sectors within an economy. It shows how the outputs of one sector flow into another sector as inputs. Wassily Leontief, who was a Soviet-American economist, developed the input-output analysis method, earning him the Nobel Prize in Economics in 1973.

Assumptions of the Input-output Analysis

1. The economy is in perfect equilibrium
2. The whole economy can be divided into two sectors. The inter-industry sector and the final demand sector. Each section can be subdivided further.
3. Each industry produces only one product, and no two products are produced together.

4. A company's total production is used as input by another company or the final demand section.
5. Production is followed according to the law of constant returns to scale.
6. In the economic area, the level of technological progress remains constant, so the input coefficients remain constant.
7. There are no external economies or production diseconomies.

Input-Output Analysis Table

An industrial sector can be both a consumer of the outputs and a supplier of the inputs of other sectors in an economy. The input-output analysis model describes such an interdependent relationship. The analysis is typically presented in a matrix or table. The outputs of each sector are shown in rows and turn into the inputs of the other sectors listed in columns.

Below is an example of an input-output table for an economy with two sectors. As the first row shows, the agriculture sector produces 500 units of outputs in total, of which the majority – 320 units flow into the manufacturing sector as inputs for its production. 100 units are delivered to households directly as final demand, and the remaining 80 units are consumed by the agriculture sector itself as fodder and seeds, for example.

Sectors	Inputs to Agriculture	Inputs to Manufacturing	Final Household Demand	Total Outputs
From Agriculture	80	320	100	500
From Manufacturing	60	40	160	260

The second row shows where the outputs from the manufacturing sector flow to. Out of the total 260 units of output, 60 units flow to the agriculture sector as inputs or factors of production, such as reaping machines. 40 units flow back to the manufacturing sector to support further production processes. The remaining 160 units are consumed directly by households.

Through I-O analysis, economists study the impact of input changes in a particular sector of an economy and how it affects the entire economy. I-O analysis can be conducted by economists and analysts in any given sector or industry in an economy. For example, a local government or a municipal wants to construct a bridge for its region. This project requires much capital, both human and resource capital. If an economist is to conduct an I-O analysis on the cost of the projects and the ripple impacts changes in input can cause, the following factors will be considered;

- The cost of constructing the bridge.
- The number of supplies needed.
- The number of laborers and contractors needed to be hired.

The economist will calculate the above in dollar amounts and use the I-O model to determine the direct, indirect and induced impacts that are likely to occur as a result of the project.

Undifferentiated Products - Cournot, Stackelberg, Dominant firm model, Bertrand-Heterogeneous products

Oligopoly markets are markets in which only a few firms compete, where firms produce homogeneous or differentiated products and where barriers to entry exist that may be natural or constructed. There are three main models of oligopoly markets, each consider a slightly different competitive environment. The Cournot model considers firms that make an identical product and make output decisions simultaneously. The Bertrand model considers firms that make identical product but compete on price and make their pricing decisions simultaneously. The Stackelberg model considers quantity setting firms with an identical product that make output decisions simultaneously.

Undifferentiated Products

Undifferentiated products can be defined as the intrinsically identical products (like milk, gasoline and packaged ice) which are easily substitutable by products from competitors or other suppliers. The Threat from substitution is very high. These kinds of products can compete on the

basis of only price and availability. In order to achieve differentiation they have to highlight the perceived difference or the difference in customer delivered value.

These products are also known as fungible products. Price is never a good differentiating factor as it only benefits the customer and not the business because it erodes away the profit. So companies/brands with undifferentiated products position their products differently from their competitors by highlighting different qualities/features of their products or brands. Let us consider the example of salt. Salt is an undifferentiated product. One can easily substitute one salt brand with another.

There is nearly no point of differentiation on basis of product. So different brands highlight different features/qualities of the product or brand itself to attract customers.

Captain Cook – Free flow refined Iodized Salt. (Product Quality/Feature)

Tata Salt – Desh ka Namak. (Brand Equity of Tata as an Indian Brand)

I-shakti – Iodine Sahi toh Dimaag Tez (power of Iodine – Product feature/quality)

Aashirwaad – Brand Equity of Aashirwaad brand from ITC

Undifferentiated Product Examples

Whenever consumers have similar needs for a product, it's a good candidate for undifferentiated marketing. Staples like sugar, flour, toothpaste, dish soap, and fruits and vegetables are just a few of the many undifferentiated product examples that just about everyone buys, regardless of demographics.

Brands like Coca-Cola and Colgate have successfully generated billions in revenue using undifferentiated marketing, including mass-market advertising campaigns. Store brands you see in the grocery aisles are usually undifferentiated products, which can include anything from chocolate chip cookies and frozen dinners to paper plates and aluminum foil.

Companies are certainly not limited to undifferentiated marketing for any products they sell, including undifferentiated products. Soap, for example, can be marketed to men and women individually, with different pricing, different packaging and different ads. Even if the soap inside the packaging maybe the same, the right marketing can turn a low-margin staple item into a premium brand for the right target audience.

Advantages of Undifferentiated Marketing

Perhaps the biggest advantage of undifferentiated marketing is that it can generate tons of sales. All other factors being equal, if you're targeting everyone under the sun for your product while your competitor is only targeting one segment of the market, your sales volume should be significantly higher.

Undifferentiated marketing is the most cost-effective approach when its results are measured in the long run. This approach also benefits from improved brand awareness and fewer changes needed to advertising content, as well as little need for in-depth market research.

Disadvantages of Undifferentiated Marketing

Undifferentiated marketing was particularly effective in the 20th century, when mass production and mass media were both cost effective, especially for national and international companies. This is still the case today for many products and brands.

For small businesses, an undifferentiated approach can be very difficult to compete with, since they can't get the same bulk discounts in supplies, distribution or advertising bundles that large corporations can.

Another disadvantage for undifferentiated marketing is that it doesn't foster much loyalty in its customers. This can be particularly difficult to overcome if a competitor is focused on a smaller segment of your market. Consider, for example, the often-intense loyalty of Tesla car owners or Apple computer owners, compared to those who buy Ford or Samsung products.

Cournot Model

The model of pricing put forward by Augustin Cournot in 1838 is a duopoly model (existence of only two firms in the market). Cournot's model assumes that there are only two firms in the market – A and B – each one producing mineral water at zero cost (This is because each of the firms is assumed to own a spring of mineral water). In other words, the model is based on following assumptions.

1) There are two firms – A and B.
2) They are operating with zero cost.
3) They are producing identical product.
4) They decide their own output on the assumption that the competition will not change his output level.
5) Firm A starts producing first.

Based on these assumption, the duopoly firms will operate

Important observations from the Cournot Model

1) Cournot solution is stable.
2) More the number of firms in the market, more will be the quantity supplied and less will be the price. (It can be shown that if 3 firms exist in the market, 3/4 the of the market demand will be supplied).
3) Since the firms do not recognize the interdependence, they cannot act as monopolist.
4) Each firm maximizes its profit in each period but industry's profits are not maximized.

Criticism of Cournot's Model:

Cournot's duopoly model, expressing the limiting case of Oligopoly, is criticized on many grounds. Following are some of the important ones: -
a) Assumption of costless production is highly unrealistic.
b) It is a 'closed' model where there is no entry for new firms.
c) In each successive period, price is brought down by the action-reaction pattern of two firms in the market.

Stackelberg Model

This model was developed by a German economist Stackelberg. In the Cournot's model it was assumed that both the competitions make their output and price decisions at the same time. Situation will be different if one of them moves first. Stackelberg presented a duopoly model in which one of the two firms sets its output before the other firm.

Important implications of Stackelberg's model

1) The first mover will announce higher output and to maximize the profit, the other producer has to acknowledge it and produce a lower level of output. Otherwise price will come down and both the firms will suffer.

2) Stackelberg model brings about the need for collusive agreement between the duopolists as they are mutually interdependent.

Cournot and Stackelberg models are two different approaches to oligopolistic market. For those industries where all the firms have more or less similar market share and none of them has leadership position, Cournot's model may be applicable. Whereas, for those industries like mainframe computers (where IBM is the leading firm) Stackelberg's model may be more appropriate.

Bertrand Model

Bertrand developed the model in 1883. The model is applicable for the firms which produce homogenous product and make their pricing & output decisions at the same time. The model differs from that by Cournot on the ground that the firms compete on the basis of price and not on the basis of quantities (as was the case in Cournot model). Another important assumption on which the model is based is that there are only two firms competing in the market. As per Bertrand, the firms will compete on the basis of price. Since they produce homogeneous products, the consumer will buy from the firm selling the product at the lowest price. So there will be 3 possibilities in the market.

1) A firm which charges higher price than its competition will have no market share.
2) A Lower-price firm will capture entire market.
3) If both the firms charge same price, the consumers will be indifferent. That means both the firms will supply half of the market each.

Dominant Firm Model

In same oligopolistic markets, one large firm has a major share of market while the remaining market is supplied by the remaining smaller sized firms. Such a large sized firm is called a dominant firm. It sets the price that maximizes its own profit and the other smaller firms accept

that price as given and produce accordingly. The dominant firm maximizes profit and other smaller firms take that price as given.

Chamberlin's small and large number case

The "Small group" model by Chamberlin indicates that if the firms in a small group realize their interdependence, they can attain stable equilibrium with profit maximization and in fact all can enjoy monopoly profit. According to him if the firms do not recognize their interdependence, they may have either Cournot equilibrium (where a firm assumes that its competitors will keep quantity of output constant) or Bertrand Equilibrium (where firm assumes that its competitors will keep price constant). But according to Chamberlin, firms are well aware of the fact that the competitor's price and quantity decisions are going to have direct and indirect effect on the firms' equilibrium position. With the understanding of such effects, oligopolistic firms can achieve stable equilibrium with monopoly profit for all the firms in a group.

However, Chamberlin's theory differs with the assumption of independent action by competitors. According to him, in contrast to the Bertrand and Cournot assumption, the firms do in fact recognize their interdependence. When changing their price and output, the firms do recognize the direct and indirect effects of their decisions. The direct effects are those which would occur if competitors were assumed to remain passive. The indirect effects are those which result from the fact that rivals do not in fact remain passive but react to the decisions of the firm which changes its prices or output. The recognition of the full effects (direct and indirect) of a change in the firm's output (or price), results in a stable industry equilibrium with the monopoly price and monopoly output.

Kinked Demand Curve Theory

The kinked demand curve of oligopoly was developed by Paul M. Sweezy in 1939. Instead of laying emphasis on price-output determination, the model explains the behavior of oligopolistic organizations. The model advocates that the behavior of oligopolistic organizations remain stable when the price and output are determined. This implies that an oligopolistic market is characterized by a certain degree of price rigidity or stability, especially when there is a change in prices in downward direction.

The kinked demand model postulates that when a firm increases it price, its competitors do not change their prices. This causes the demand for goods produced by the firm attempting the price increase to fall. In other words, the firm faces a very flat demand curve above the market price. On the other hand, when the firm decreases its price, its competitors follow suit. Since all firms reduce their prices, there is no gain in market share for any firm. The increase in sales is restricted only to the increase in quantity demanded due to lower market price. This is illustrated by a steeper demand curve below the market price.

The kinked demand curve model seeks to explain the reason of price rigidity under oligopolistic market situations. Therefore, to understand the kinked demand curve model, it is important to note the reactions of rival organizations on the price changes made by respective oligopolistic organizations.

There can be two possible reactions of rival organizations when there are changes in the price of a particular oligopolistic organization. The rival organizations would either follow price cuts, but not price hikes or they may not follow changes in prices at all.

Bain's Limit Pricing

J.Bain, in his article 'Oligopoly and Entry Prevention' has touched upon one more aspect influencing the price and quantity decisions of oligopolistic firm's threat of entry of new firms. Bain maintained that the firms fix the price above the competitive price (where there are only normal profits) and below monopoly price (where profits are maximized). Such a price level is called by him as 'limit price' which according to him is the highest price that a firm can charge without the entry of new firms.

Production Possibility Frontier

Production possibilities of an economy imply those numerous alternative combinations of goods and services, which a particular economy can produce, with the given technology and employing the available resources fully and efficiently. In other words, it refers to various feasible bundles of goods and services that can be produced together by efficiently utilizing the given technology and available resources.

Production Possibility Frontier (PPF) is a macroeconomics concept that shows various combinations of two products or services using almost the same and finite raw materials for production. It is a graphical representation of two products or services which are dependent on the same finite inputs for the production process. Here both the combination of the goods and services takes place in such a way that the resources are used most efficiently and optimally. Thus PPF makes allocation of resources in the best possible manner that benefits both the organization and the country. It is popularly also known as Transformation Curve or Production Possibility Curve. An expansion in the production of one product lowers the production of another product. In other words, we would like to get the best possible curve to give us the optimum utilization of the limited resources between the two competing products dependent upon the same resources. The production possibility curve represents graphically alternative production possibilities open to an economy.

Assumptions of Production Possibility Frontier

- The first assumption of PPF is that it assumes the technological infrastructure or setup remains unchanged.
- The second assumption is that it takes into consideration only two products or services using the same resources. The companies having three or more such products cannot use the PPF curve.
- The third assumption of PPF is that both the products under the study have an opposite relationship with each other. According to this principle, the production of one product can only be increased with a decrease in the production of others. This is because of limited input resources.

The productive resources of the community can be used for the production of various alternative goods. But since they are scarce, a choice has to be made between the alternative goods that can be produced. In other words, the economy has to choose which goods to produce and in what quantities. If it is decided to produce more of certain goods, the production of certain other goods has to be curtailed.

Let us suppose that the economy can produce two commodities, cotton and wheat. We suppose that the productive resources are being fully utilized and there is no change in technology. The following table gives the various production possibilities.

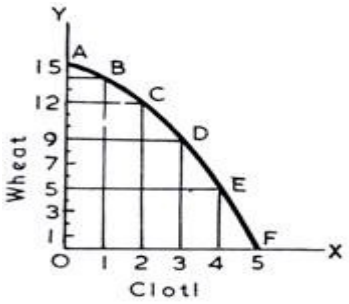
Alternative Production Possibilities

Production Possi bilities	*Cotton (in '000 quintals)*	*Wheat (in 000 quintals)*
A	0	15
B	1	14
C	2	12
D	3	9
E	4	5
F	5	0

If all available resources are employed for the production of wheat, 15,000 quintals of it can be produced. If, on the other hand, all available resources are utilized for the production of cotton, 5000 quintals are produced. These are the two extremes represented by A and F and in between them are the situations represented by B, C, D and E. At B, the economy can produce 14,000 quintals of wheat and 1000 quintals of cotton.

At C the production possibilities are 12,000 quintals of wheat and 200 quintals of cotton, as we move from A to F, we give up some units of wheat for some units of cotton For instance, moving from A to B, we sacrifice 1000 quintals of wheat to produce 1000 quintals of cotton, and so on. As we move from A to F, we sacrifice increasing amounts of cotton.

This means that, in a full-employment economy, more and more of one good can be obtained only by reducing the production of another good. This is due to the basic fact that the economy's resources are limited.



Production Possibility Curve
Fig. 21.2

The following diagram (21.2) illustrates the production possibilities set out in the above table.

In this diagram AF is the production possibility curve, also called or the production possibility frontier, which shows the various combinations of the two goods which the economy can produce with a given amount of resources. The production possibility curve is also called transformation curve, because when we move from one position to another, we are really transforming one good into another by shifting resources from one use to another.

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