Micro Economics

I

COURSE CODE: B21EC01DC

BACHELOR OF ARTS ECONOMICS

SELF LEARNING MATERIAL

SREENARAYANAGURU OPEN UNIVERSITY

SREENARAYANAGURU OPEN UNIVERSITY

The State University for Education, Training and Research in Blended Format, Kerala

SREENARAYANAGURU OPEN UNIVERSITY

Vision

To increase access of potential learners of all categories to higher education, research and training, and ensure equity through delivery of high quality processes and outcomes fostering inclusive educational empowerment for social advancement.

Mission

To be benchmarked as a model for conservation and dissemination of knowledge and skill on blended and virtual mode in education, training and research for normal, continuing, and adult learners.

Pathway

Access and Quality define Equity.

Microeconomics 1

Course Code: B21EC01DC

Semester - I

Bachelor of Arts
Economics
Self Learning Material

SREENARAYANAGURU
OPEN UNIVERSITY

SREENARAYANAGURU OPEN UNIVERSITY

The State University for Education, Training and Research in Blended Format, Kerala

B21EC01DC
Microeconomics 1

SREENARAYANAGURU OPEN UNIVERSITY

Printed and published on behalf of Sreenarayanaguru Open University by Registrar, SGOU, Kollam.
www.sgou.ac.in

ISBN 978-81-963059-2-5

DOCUMENTATION

Production

March 2023

YouTube

MESSAGE FROM VICE CHANCELLOR

Dear
I greet all of you with deep delight and great excitement. I welcome you to the Sreenarayanaguru Open University.

Sreenarayanaguru Open University was established in September 2020 as a state initiative for fostering higher education in open and distance mode. We shaped our dreams through a pathway defined by a dictum 'access and quality define equity'. It provides all reasons to us for the celebration of quality in the process of education. I am overwhelmed to let you know that we have resolved not to become ourselves a reason or cause a reason for the dissemination of inferior education. It sets the pace as well as the destination. The name of the University centres around the aura of Sreenarayanaguru, the great renaissance thinker of modern India. His name is a reminder for us to ensure quality in the delivery of all academic endeavours.

Sreenarayanaguru Open University rests on the practical framework of the popularly known "blended format". Learner on distance mode obviously has limitations in getting exposed to the full potential of classroom learning experience. Our pedagogical basket has three entities viz Self Learning Material, Classroom Counselling and Virtual modes. This combination is expected to provide high voltage in learning as well as teaching experiences. Care has been taken to ensure quality endeavours across all the entities.

The university is committed to provide you stimulating learning experience. The UG programme in Economics is designed at par with that of the quality academic programme of the state universities in the country. The latest methodologies of exposition of economic ideas and concepts have been well embedded in to the curriculum. It creates interest among students for a deeper understanding of the discipline. The curriculum covers the theories and the historical evidences as well. Due emphasis is given to Indian experiences in the economic transformation. This would help learners in preparing for the competitive examinations, in case they opt for. We expect that the students on successful completion of the programme will be equipped to handle the key areas of the discipline. We assure you that the university student support services will closely stay with you for the redressal of your grievances during your studentship.

Feel free to write to us about anything that you feel relevant regarding the academic programme.

Wish you the best.

Regards,
Dr. P.M. Mubarak Pasha 01.03.2023

CONTENTS

Introduction to Microeconomics

UNIT

Definitions of Economics

Learning Outcomes

After reading this unit, the learner will:

- be introduced to different definitions of economics
- be familiarised with the concept of microeconomics
- be aware of the uses of microeconomics

Prerequisites

Economics, the only social science to be honoured with the Nobel Memorial Prize, is a dynamic subject. The word economics is derived from two Greek words 'oikos' and 'Nemein'. 'Oikonomia' means managing a house. Thus, Economics in its original sense means 'household management.' From 16th to 18th century, European countries and other trading nations seriously thought of ways for accumulating wealth in the form of gold, silver or other precious metals. The ideas of Political Economy as expounded by the Mercantilists dominated the way of thinking over the years. By the end of the 18th century, scholars such as Adam Smith and David Hume, began to evaluate and criticise the merits of mercantilist theory. Contrary to established beliefs, they realised that wealth was not finite, but could be created through the productive allocation of labour. That paved the way for the emergence of Economics as a new discipline. In economics, we study the decisions of individual households and firms.We also study the interaction of households and firms in markets dealing in specific goods and services .We can study the operation of the economy as a whole, which is the sum of the activities of all these decision makers in all these markets. Economics is typically divided into two types: microeconomics and macroeconomics. In every nation, certain fundamental problems must be addressed irrespective of the

form of its government or how rich or how poor the nation may be, or what type of economic system exists . That is, every economy has to solve certain basic or central problems. We know that economising of resources demands optimal and efficient use of resources because resources are scarce and capable of alternative uses. So, an economy has to decide how to allocate its available resources for the production of a multitude of commodities.

Keywords

Wealth, Welfare, Scarcity, Growth, Microeconomics

1.1.1 Definitions of Economics

Economics is a part of social science which studies the consumption, production, and distribution of goods and services. These forms the major subjec matters of economics. Microeconomics and macroeconimcs are the two important branches of economics. There are mainly four definitions of economics to summarise the subject matters of economics. Let us discuss the defintions in detail.

1.1.1.1 The Wealth Definition

The emergence and development of Economics as a subject is associated with the Scottish scholar, Adam Smith. In his book, 'An Enquiry into the Nature and Causes of Wealth of Nations', published in 1776, Adam Smith defined the subject for the first time. The title of the book itself is the definition. Adam Smith is considered as the father of Economics. His definition is known as the Classical definition or the Wealth definition. Economists like Jean Baptiste Say, John Stuart Mill, Thomas Robert Malthus, David Ricardo, and Karl Marx belonged to the Classical Tradition or School. It was criticised by Alfred Marshall and his followers. According to them the classical school gave more emphasis to wealth than human beings. Therefore, Marshall defined Economics in terms of welfare of human beings.

1.1.1.2 The Neoclassical or Welfare Definition

In his work 'Principles of Economics' published in 1890, Alfred Marshall defined Political Economy or Economics as "the study of mankind in the ordinary business of life, it examines that part of individual and social action which is most closely connected with the attainment and use of material requisites of wellbeing". Prof. A.C. Pigou and Edwin Cannan were the supporters of this definition. The Neoclassical economists believed that acquisition of wealth is important but more important is the general welfare of mankind. Thus, Marshall shifted the emphasis from wealth to welfare; wealth is only a means to human well being. Through this definition, the neoclassical school ascertained that welfare is more valuable than earning of wealth. The Welfare Definition was criticised by Prof.

Lionel Robbins on the ground that welfare is a subjective concept and it cannot be measured directly.

1.1.1.3 The Scarcity Definition

It is one of the modern definitions of economics. The twentieth century economist Prof. Lionel Robbins, through his famous work 'An Essay on the Nature and Significance of Economic Science' published in 1932 defined Economics as "a science which studies human behaviour as a relationship between ends and scarce means which have alternative uses." We can deduce the following conclusions from the scarcity definition.

- Human beings have unlimited wants (ends). Wants are insatiable, i.e., we have a chain of wants following another want.
- Means or Resources are scarce in their availability in relation to wants. Moreover, resources are capable of alternative uses. Since resources are scarce and can be put in for alternative uses, there arises the need for choice.
- Economics is a science (systematic body of knowledge) that studies human behaviour in relation to scarcity and choice.

The scarcity definition is criticised on the ground that it does not take into account of economic growth and development, which is an important means of overcoming scarcity of resources.

1.1.1.4 Growth Definition

The Nobel laureate in Economics (1970), Prof. Paul A. Samuelson presented a growth-oriented definition of economics in his book, 'Foundations of Economic Analysis'. According to him "Economics is the study of how men and society choose, with or without the use of money, to employ scarce productive resources, which have alternative uses, to produce various commodities over time and distribute them for consumption now and in future among various people and groups of society. It analyses the costs and benefits of improving the pattern of resource allocation". This definition introduced the dimension of growth under scarce situations.

New definitions of Economics are proliferating since Economics is a dynamic subject. As the focus of attention of the world economy is changing, we have to define economics differently.

Schema of Definitions of Economics

Name	Donor	Name of Book	Year
Wealth Definition (Classical)	Adam Smith	Wealth of Nations	1776
Welfare Definition (Neoclassical)	Alfred Marshall	Principles of Economics	1890
Scarcity Definition (Modern)	Lionel Robbins	Nature and Significance of Economics	1932
Growth Definition (Modern)	Paul A. Samuelson	Foundations of Economic Analysis	1947

1.1.2 Microeconomics

Microeconomics deals with economic behaviour of individual units of the economy such as a consumer, a firm, pricing of commodities, demand and supply of goods and services, factors of production. Since microeconomics splits up the entire economy into smaller parts for the purpose of intensive study, it is sometimes referred to as the Slicing Method. Microeconomic theory takes the total quantity of resources as given and seeks to explain how they are allocated to the production of various goods. The allocation of resources depends on the prices of various goods and the prices of various factors of production. Thus, the theory of product pricing and the theory of factor pricing are the branches of microeconomic theory. The theory of demand and the theory of production are two subdivisions of the theory of pricing.

Microeconomics also seeks to explain economic efficiency in the allocation of resources. The question of economic efficiency is the subject matter of Welfare Economics which is an important branch of microeconomics. The field covered by microeconomics may be summarised as follows:

a) Theory of Product Pricing with its two constituents, namely, the theory of consumer's behaviour and the theory of production and costs.

b) Theory of Factor Pricing with its four constituents, namely, the theories of wages, rent, interest, and profit.

c) Theory of Economic Welfare.

According to Prof. Gardner Ackley, "Microeconomics deals with the division of total output among industries, products and the firms and the allocation of resources among competing groups. It considers problems of income distribution. Its interest is in relative prices of particular goods and services"

Uses of Microeconomics

- It is useful in the determination of prices of commodities and factor services.
- It is helpful for the allocation of resources.
- It is suitable for deciding economic policies of the government like price policy, wage policy etc.
- Microeconomics is helpful for predicting economic trends.
- Microeconomics provides the technique of linear programming. This helps an entrepreneur to combine the factor services in an optimum way.
- Macroeconomic principles are built on the foundation of microeconomics.

Microeconomic analysis is not free from limitations. This analysis is not congenial for analysing the national economy e.g., the monetary policy, fiscal policy, taxation policies etc. which assume greater importance. But these policies do not come under the realm of microeconomics. In spite of the limitations, microeconomic analysis is widely used in macroeconomic analysis.

Recap

- Human wants are unlimited
- The economic problem refers to unlimited wants with limited resources
- Problem of choice occurs because of scarcity in any economy
- The Classical definition (Wealth definition) given by Adam Smith in 1776
- The Neoclassical or Welfare definition introduced by Alfred Marshall in 1890
- The modern definitions are based on Scarcity and Growth
- The Scarcity Definition given by Prof. Lionel Robbins
- Prof. Paul A Samuelson introduced growth-oriented definition of economics
- Microeconomics deals with economic behaviour of individual units
- Microeconomics is called Price Theory
- Partial equilibrium analysis is adopted in microeconomics

Objective Questions

1. Who is associated with the wealth definition of economics?
2. Which is the book associated with the welfare definition?
3. Who is associated with the growth-oriented definition of economics?
4. Why do we consider Samuelson's definition superior to all previous definitions of economics?
5. Which is the branch of economics that deals with economic behaviour of individuals?
6. What are the major fields covered under microeconomics?
7. What are the two constituents of Theory of Factor Pricing?
8. Identify the branch of economics that deals with pricing of goods and services.

Answers

1. Adam Smith
2. Principles of Economics
3. Paul A. Samuelson
4. Because of its universal applicability
5. Microeconomics
6. Theory of Product Pricing, Theory of Factor Pricing, and Theory of Economic Welfare
7. Theory of Consumer's Behaviour and Theory of Production
8. Microeconomics

Assignments

1. Explain the scope of Microeconomics.
2. Illustrate the principles that are the basis for economics of individual choice.
3. Economists often assume that individuals are motivated only by their own self-interest. Is this assumption always a good one? Give examples to justify your answer.
4. If you want to understand the pricing dynamics of essential commodities. What branch of economics would you study?

Suggested Reading

1. Hall, Robert, E., & Liberman, Marc(2006). *Economics- Principles and Applications*(Third edition),South-western Educational Publishers.
2. Pindyck, R.S., Rubinfeld, D.L., & Mehta, P. L. (2017). *Microeconomics* (Eighth edition). Pearson Education Prentice Hall.

References

1. Agarwal, H.S. (2008). *Microeconomic Theory* (seventh edition). Ane Books Pvt.

2. Dwivedi, D.N. (2012). *Microeconomics: Theory and Applications* (Second Edition). Vikas Publishing House Pvt. Ltd.

3. Samuelson, P.A., & W. D. Nordhaus (special edition 2020). *Economics*. New Delhi: Tata McGraw Hill.

UNIT 2

Approaches to Microeconomic Analysis

Learning Outcomes

After reading this unit, the learner will be :

- introduced to various approaches in microeconomic analysis
- exposed to general and partial equilibrium concepts
- able to distinguish between short-run and long-run analysis

Prerequisites

Economics is a social science which does not exhibit all the characteristics of exact sciences like physical sciences or natural sciences. We know that economic theories or laws cannot be formulated under laboratory conditions. But we can make use of generalisations, logical reasoning, cause-effect relations, assumptions, universal truths etc. for economic analysis. Approaches like partial and general equilibrium; comparative and dynamic analysis; positive and normative are introduced here.

Keywords

Positive and normative, Short-run and long-run, Partial and general equilibrium

1.2.1 Approaches to Microeconomic Analysis

Micro economic analysis is based on certain crucial concepts. This includes diverse ways to understand microeconomics.

1.2.1.1 Positive and Normative Approaches

In economic analysis, positive and normative approaches are used. Positive economic analysis is based on observations, data, or facts. It can be proved or refuted by empirical studies. Positive analysis is based on evidence and focuses on the cause-effect relation among different variables. An objective investigation of economic issues is possible in positive economic analysis. Positive economic analysis says 'what is' or 'what will be'. The Law of Demand states that, other things remaining constant, consumer's demand for a normal good must be inversely related to its price. It is a positive economic theory. It can be described, tested, and proved.

Normative economic analysis is based on value judgement about what is good or bad for the economy. It is concerned with 'what ought to be'. It is a matter of opinion. It can't be proved or refuted by investigation based on data and facts. Normative opinion often expresses what is desirable or undesirable for the economy. It checks whether a mechanism is good or bad for the interests of the nation and makes value conclusions. It is a subjective approach. 'The pension given to unemployed youth is totally unproductive and wastage of resources' is a normative statement.

Inductive and Deductive methods are used for formulation of economic theories. In inductive method, generalisations are made by moving from the particular to the general. Under this method, economic theories and laws are formulated based on observations and experiments. Inductive methods make use of both experimental and statistical methods for formation of theories. Since the application of experimental methods in economics is limited, economists use the statistical method.

Generalisations are reached based on observation of economic behaviour from individual elements. Collection, classification, and analysis of data by using appropriate statistical techniques are executed after the perception of a study or enquiry. By adopting an inductive method, economic laws are moulded from observed facts. Observation of facts and further experiments are the chief instruments of this method. Inductive method is also known as historical, empirical or 'posteriori' method.

In the deductive method, economic theories are formulated by accepting certain universal truths and assumptions. It is followed by a general statement on the relation between the variables involved in it. Logical reasoning is applied to it and reaches certain conclusions about the behaviour of the variables.These conclusions and predictions are then tested based on facts. The theory is valid if the facts or observations support the prediction of the theory. If the facts or observations are not in tune with the predictions, the theory is rejected or asked for modification.

Consumers are rational, it is a self-evident truth and universally acceptable fact. Rational consumers know what is

good or bad for themselves. Based on this it can be said that an individual Y is rational if she will purchase more of a commodity at a lower price. As the actual behaviour supports this prediction, the law of demand is valid. Thus, deductive is a method of reasoning where the investigator proceeds from the general to the particular or from the universal to the individual. Deductive method may be described as abstract method, analytical or hypothetical method. Modern economists call it the method of intellectual experiment.

These two different methods are appropriate to different branches of economics.

1.2.1.2 Short-Run and Long-Run Analysis

Time period is very crucial in economic analysis. We can make necessary changes in factors of production as the time changes. In life too, most of our choices can be modified more easily in the long period than in the short period of time.

Short-run Analysis

Short-run refers to a time period where atleast one of the factors of production is fixed. If you are running a pharmaceutical company, it is easier to change the labour employed and raw materials used in the short-run than to introduce new technology. Here, labour and raw materials are variable, whereas capital is fixed. Due to the presence of fixed factors and lesser options of altering the variable factor in the short-run, diminishing marginal returns may occur and marginal costs may start to rise. During the COVID19 pandemic there was a sudden increase in demand for masks and sanitisers. Even at higher prices, its supply could not be increased in the short-run even when there is a rise in demand. The suppliers have constraints because only some factors of production are variable in the short-run.

Long-run Analysis

In the long -run, all factors of production are variable. The firms can easily adjust their supply according to demand, make new investment, expand production, and purchase machinery. The features of long-run are follows:

- We can expand our factory.
- Firms can easily enter or exit the market.
- Prices also adjust in the long-run.
- More demand can be easily met in the long-run than in the short-run.

Now let us look at what equilibrium means in economics.

1.2.1.3 Equilibrium

The word equilibrium means a state of balance or rest. It is a position from which there is no tendency to move. In economics, the term is used for theorising. We have to keep in mind that perfect balance does not exist in real economic behaviour. A consumer reaches equilibrium when she or he enjoys maximum satisfaction from the income spent on different commodities. Consumers' equilibrium shows the optimal choice of the consumer. For a firm, equilibrium is reached when the producer gets maximum profit. An industry (collection of firms dealing a product) will be in equilibrium when there is no tendency for the size of the industry to change. That is, it is a situation where existing firms are not interested to leave and no new firms like to enter into the industry.

1.2.1.4 Partial Equilibrium Vs General Equilibrium

A partial equilibrium is one that is based on only a restricted range of data. Suppose, we are considering the price of a single product for analysis. We take the general assumption of 'ceteris paribus' which means all others being unchanged or constant. In short, equilibrium price of the product is fixed in the market by interaction of demand and supply of the product independent of other markets. In doing so, we are not considering the inter connection that exists between the market under study and the rest of the economy. Thus, an equilibrium relating a single variable may be termed as partial equilibrium. The single variable may be the price of a product, behaviour of a consumer, a firm or an industry.

The method of partial equilibrium is associated with Marshall and the Cambridge School. All microeconomic studies are concerned with partial or particular equilibrium analysis. 'Other things remaining the same'(ceteris paribus) assumption is kept in microeconomic analysis.

Major drawback of partial analysis is that it doesn't consider the macro view of the economy. The assumption 'other things remaining the same' provides a conditional background. Thus, it cannot be practised in policy making. The general equilibrium analysis considers the simultaneous working of all sectors of the economy such as primary, secondary and tertiary, households, firms, the government etc. General equilibrium holds that all economic units are assumed to be interdependent. 'Everything depends on everything else'. General equilibrium for the entire economy exists only if all economic units were to achieve simultaneous partial equilibrium adjustments.

According to George J Stigler, the main advantages of general equilibrium analysis are the following:

- We get an idea about the general structure and interrelation between different sectors.
- We get assistance in discovering relevant data related to a specific problem.

There are two versions of general equilibrium analysis. They are Walrasian General Equilibrium and Leontief's Input output Analysis. The French economist Leon Walras developed the general equilibrium in mathematical terms through a system of simultaneous equations relating to many economic variables. Leontief's input-output analysis is the successor of the Walrasian model. It divides the economy into several sectors or industries. Inter-dependence between sectors is established in this model.

Partial equilibrium analysis is thus the study of the behaviour of individual decision-making units separately and in isolation. On the other hand, General equilibrium analysis studies the behaviour of all individual decision-making units together and simultaneously.

Recap

- Positive analysis is objective method of investigation
- Positive analysis tells what it is or what will be
- Normative analysis is subjective and makes value-based conclusions
- Inductive method moves from particular to general
- Deductive method moves from general to particular
- In short-run, only some factors variable
- In long-run, all factors variable
- Equilibrium is state of balance or no tendency to change
- In partial equilibrium analysis, behaviour of single variable is taken separately
- General equilibrium analysis considers interaction of all sectors
- Comparative equilibrium compares one equilibrium with another equilibrium

Objective Questions

1. Which is the equilibrium analysis that does not consider the macro view of the economy?
2. Which is the equilibrium analysis that considers the 'ceteris paribus' assumption?
3. Which is the equilibrium analysis that considers the behaviour of a single variable?
4. Which is the equilibrium analysis that considers the simultaneous working of all sectors of economy?
5. Name the economic analysis that goes from universal to individual.
6. In which analysis the investigator moves from particular to general?
7. Which is the method of analysis that is related to value judgement?

8. Identify the objective method of investigation that is related to 'what is'.

9. Even when there is an increase in demand in the short-run, supply cannot be increased. Why?

Answers

1. Partial
2. Partial
3. Partial
4. General
5. Deductive
6. Inductive
7. Normative
8. Positive
9. In the short-run only very few factors are variable.

Assignments

1. What are the different approaches to microeconomics?
2. Do you think economics is a positive science or normative science? Why?
3. Why is microeconomics always partial equilibrium analysis?
4. Identify whether the following statements are positive or normative
    a) The poverty rates should be reduced in India.
    b) The fiscal deficit is 3% of the total deficit this year.

Suggested Reading

1. Koutsoyiannis, A. (1990). *Modern Microeconomics*. Macmillan

2. Samuelson, P.A., & W. D. Nordhaus (special edition 2020). *Economics*. New Delhi: Tata McGraw Hill

3. Pindyck, R.S., Rubinfeld, D.L., & Mehta, P. L. (2017). *Microeconomics* (Eighth edition). Pearson Education Prentice Hall.

Reference

1. Agarwal, H.S. (2008). *Microeconomic Theory* (seventh edition). Ane Books Pvt Ltd.

1. Dwivedi, D.N. (2012). *Microeconomics: Theory and Applications* (Second Edition). Vikas Publishing House Pvt. Ltd.

2. Hall, Robert, E., & Liberman, Marc(2006). *Economics- Principles and Applications*(Third edition),South-western Educational Publishers

UNIT 3

Basic Economic Problems

Learning Outcomes

After reading this unit, the learner will be able to:

- get familiarised with basic economic problems
- illustrate a Production Possibility Curve
- get aware of the uses of Production Possibility Curve

Prerequisites

Every economy has to find solutions to the basic economic problems irrespective of its level of development. Basic economic problems are what to produce, how to produce, and for whom to produce. These are sub-problems of allocation of resources. The production possibility frontier illustrates the resource utilisation in an economy given the resources and technology. The production possibility curve actually decides that fuller and efficient use of resources and growth of resources are related problems of resource allocation. The ways of solving these problems are different in various economic systems or economic organisations.

Keywords

What to produce, How to produce, For whom to produce, Opportunity cost, Production possibility curve

1.3.1 Basic Economic Problems

Human wants are unlimited but the means to satisfy them are scare. The fundamental economic problem is thus the problem of making choices due to the scarcity of resources.

Prof. Samuelson's well-known quotation, 'What, how and for whom to produce' reveals the central problems. The following are the central problems to be solved in an economy.

1.3.1.1 What to Produce and in What Quantity

An economy needs multitudes of commodities in the form of consumer goods, capital goods, intermediate goods, necessities, luxuries, and defence goods. The economy cannot produce these goods abundantly in view of scarcity of resources. This problem calls for the choice in types of goods and services to be produced. 'How much' quantity needed is also to be considered. Because neither overproduction or underproduction of commodities is desirable for the economy. Therefore, an economy has to set choices for the production of commodities. Allocation of resources is essential for ensuring maximum aggregate utility of resources. Thus what goods are produced and in what quantities is a question about the allocation of scarce resources between the alternative uses.

1.3.1.2 How to Produce

This problem deals with choice in the use of appropriate technique of production. We know that a commodity can be produced by using different methods of production. For example, if we want to construct a highway, it can be constructed by supplying more labour and less capital (labour intensive method). It can also be constructed by using more machinery and less amount of labour (capital intensive method). Selection of a suitable method of production depends on availability of labour, capital, sustainability of resources, price of labour, and capital. High cost of production with low per unit output is not desirable to the economy.

1.3.1.3 For Whom to Produce

This problem deals with the functional distribution of income among the four factors of production (land, labour, capital, and entrepreneur). The remuneration or factor income earned by the owners of factors of production (rent, wage, interest, and profit) becomes the incomes of households (consumers). It is related to distribution of production (output). In other words, this problem is concerned with how the national income is allocated among the four factors of production. The above mentioned 'What, how and for whom to produce' are part of allocation of resources.

1.3.2 Scarcity and Choice

When we go to buy some things in a shop, we can only buy things that fit in our budget. But as human beings we would like to purchase a lot more goods if we are given a choice. In the world we live in, we have many resources for our use. This includes fresh air, land, forests, oil, and minerals. Some regions have more

resources and people have easier access to these resources. Some other regions have lesser resources, which lead to scarcity. When we use scarce resources that are limited, we must make the best possible choices. Ram goes to a shop with Rs.10. He wants to buy a pencil. The pencil costs Rs.10. But then he sees a toy for ten rupees. What will his choice be? He might need the pencil for his homework, but the toy will make him happier. His rational choice would be to buy the pencil with his limited money. Thus even though he wants the toy and the pencil, he makes a choice. This is exactly the problem of scarcity and choice in economics.

Step into a big store like a Reliance Mart or Lulu Hypermarket. There are numerous choices available for us and it is extremely difficult for any individual to buy everything that he or she wants. Given the limitations on your budget and the size of your house, you must choose which products to buy and which to leave in the market.

You can't always get what you want. Most of the people want a big house in an ideal location, want a car or two, and also want to live a luxurious life. Limited income is not the only thing that keeps people from having everything they want. There is also a time constraint for every individual. There are only 24 hours in a day. And because the time we have is limited, choosing to spend time on one activity also means choosing not to spend time on a different activity. For example, spending time studying for an exam means giving up leisure time.

Why are individuals forced to make choices? The prime reason is that resources are scarce. A resource is something that can be used to produce something else. An economy's resources included land, labour, capital (machinery, buildings, and other man-made productive assets), and human capital (the educational achievements and skills of workers). A resource becomes scarce when there is not enough of the resource available to satisfy all the various ways a society wants to use it. There are many scarce resources. These include natural resources like resources that come from the physical environment, minerals, oil, etc. There is also a restricted quantity of human resources like labour, skill, and intelligence.

We as individuals must make choices everyday. The same way, the scarcity of resources means that society as a whole must make choices. One way for a society to make choices is simply to allow the addition of individual choices as individual decisions are regarded best for a market economy.

As human wants are unlimited and resources are scarce, we face the problem of choice. The economy has to decide on the best allocation of resources to give the maximum satisfaction to the entire society. The economic problem thus refers to unlimited wants with scarce resources. Even when an individual's income increases and she/he can afford to buy more, her/his list of wants will keep on increasing. As we cannot satisfy all our wants because of resource constraint, we always economise.

1.3.3 Opportunity Cost

Suppose you are waiting for your summer holidays in school to begin. Suddenly the school announces Karate classes for the next two months. You do not want to miss your favourite karate classes. Here comes the concept of opportunity costs. If you go for vacation, your opportunity cost will be missing Karate and if you go for Karate, your opportunity cost will be missing your holidays.

Imagine the night before the exam. Your friend calls you for a new movie. If you go to the theatre you will lose three hours of study and also have to pay Rs. 100 for the ticket. Here if you go for the movie, your opportunity cost will be giving up your study time.

The benefit that an individual is losing by choosing one option over the other one is called opportunity cost. It is the cost of the next best alternative forgone.

The production possibility curve in economics is explained by using the concept of opportunity cost.

1.3.4 Production Possibility Set

We can represent the central problems graphically with the help of the Production Possibility Curve. For the sake of simplicity and convenience, let us assume that an economy produces two goods only. Let them be good X and good Y. We can have a Production Possibility Set of good X and good Y.

Production possibility set is a collection of all possible combinations of goods and services produced with the available resources and a given level of technology. The economy works on the following assumptions:

- The economy is functioning at full employment level.
- Availability of factors of production is fixed.
- The economy produces two goods only in different proportions.
- There is no change in technology of production.
- The economy can produce either of two goods or both the goods.

The following table shows the Production Possibility Set of the two goods.

Table 1.3.1 Production Possibility Set

Production Alternatives	Production of Good X (In units)	Production of Good Y (In units)	Marginal Opportunity Cost
A	0	30	-
B	1	28	2

C	2	24	4
D	3	18	6
E	4	10	8
F	5	0	10

Each combination in the production possibility set shows efficient use of resources because the entire resources are set apart for the production of the two goods under a specified technology. If the entire resources are used for the production of Good Y alone, it can produce 30 units of Good Y and zero unit of good X (production alternative A). If the economy selects alternative C, it can produce 24 units of good Y and 2 units of good X. Production Alternatives A to F constitute the Production Possibility Set of the economy.

From table 1.3.1, it is clear that when we want to produce more quantity of good X, the economy has to produce less quantity of good Y. While moving from alternative A to B, the quantity of good X increases and quantity of good Y decreases. Movement from alternative D to E reveals that the economy has to sacrifice 4 units of good Y to produce one more unit of good X. The simple meaning of the shift over indicates that the economy can produce more of a good at the cost of or sacrifice of the other good. The number of units of a good sacrificed to produce an additional unit of the other good can be termed as Marginal Opportunity Cost (MOC) or simply opportunity cost. In Table 1.3.1 the marginal opportunity cost is seen as increasing.

Production Possibility Curve or Production Possibility Frontier is the graphical representation of a production possibility set. Units of good X are measured along the X axis and good Y along the Y axis. Mark the points A, B, C, D, E and F. The curve AF will be the Production Possibility Curve or Transformation Curve.

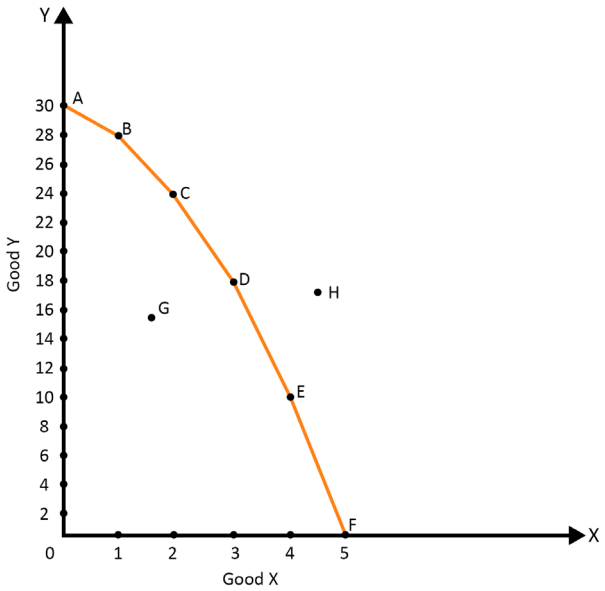


Fig 1.3.1 Production Possibility Curve

When we move from A to B or B to C, we will be transforming resources from the production of Good Y to the production of Good X. Any point below the PPC (point 'G') in figure 1.3.1 shows under-utilisation or inefficient use of resources. Considering the point H in the figure, the economy cannot opt for the production of H because the available resources and present technology do not permit it to operate at H. This is the rationale behind the concept, Production Possibility Frontier.

1.3.4.1. Shift in the PPC

The economy can operate at any point above the PPC when there is growth of resources or improvement in technology. Then the Production Possibility Curve will shift upwards.

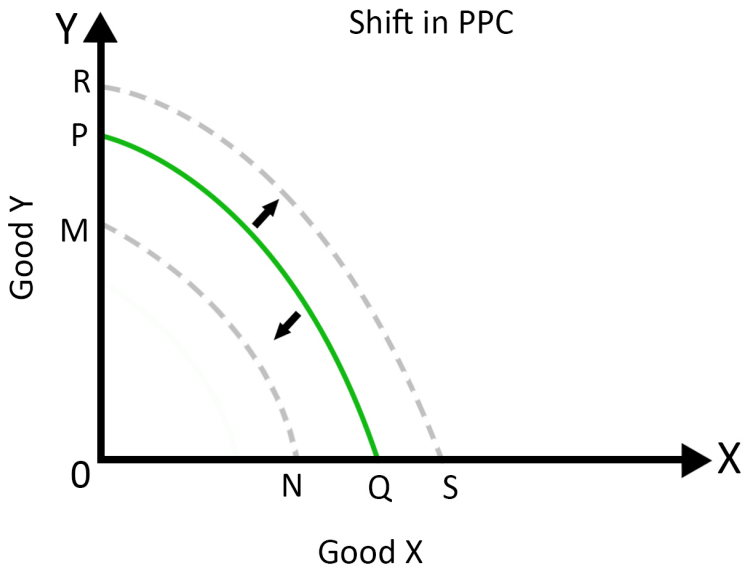


Fig 1.3.2 Shift in Production Possibility Curve

Figure 1.3.2 shows shift in Production Possibility Curve. Suppose the PPC of the economy is PQ. When there is either expansion of resources or advancement of technology, there will be rightward shifting of PPC. This is shown by the new PPC 'RS'. There may be a decrease in output due to unforeseen risk, depletion of natural resources, outdated technology etc., then the production possibility curve shifts leftward. The dotted curve MN in fig.1.3.2 shows leftward shifting of production possibility curve.

1.3.4.2 Marginal Opportunity Cost and the shape of PPC

Consider table 1.3.1. To increase the production of good X, the economy has to sacrifice some units of good Y. Normally, the shape of the transformation curve is concave to the origin. As the economy produces every additional unit of good X, the value of Marginal Opportunity Cost is increasing. This is the reason behind the concave shape of production possibility curve towards its origin.

If the values of marginal opportunity cost remain constant, the transformation curve is a downward sloping straight line. If marginal opportunity cost shows a decreasing trend, the production possibility curve is convex to the origin.

1.3.4.3 Uses of Production Possibility Curve

With the help of the production possibility frontier, we can explain issues like unemployment, economic growth, efficiency in production, technological progress etc. According to Lipsey, "the higher the proportion of resources unemployed, the closer the production possibility curve to the origin". If an economy allocates more resources for the production of capital goods than consumer goods, it will reap more of both goods in the future. So, the economy can acquire higher growth in future.

Recap

- What to produce, how to produce, and for whom to produce are central problems of economy
- What to produce choose types of commodities to produced
- How to produce deals choice of suitable technique of production
- For whom to produce deals distribution of national output
- Opportunity cost is cost of the next best alternative
- Central problems of an economy represented with help of PPC
- PPC is called production possibility frontier
- Economy cannot function beyond curve with existing resources and technology
- Rightward shifting of PPC shows growth of resources of economy
- Concavity of PPC attributed to increasing trend of marginal opportunity cost
- Production of one good be increased by sacrificing quantity of other good in PPC
- Sacrifice of one good for other termed as marginal opportunity cost
- Any point along the PPC shows fuller and efficient utilisation of resources

Objective Questions

1. A firm used capital intensive technique for production. Which central problem is dealt here?
2. Suggest a suitable technique of production for a country which has surplus labour but deficiency in capital.
3. Which is the central problem that solves the 'functional distribution'?
4. Why do we say that each production alternative in the production possibility set shows efficient use of resources?
5. What is the reason behind the concavity of Production possibility curve?
6. Which is the device used to represent the central problems of an economy graphically?
7. What will happen to the PPC if there is advancement of technology?

Answers

1. How to produce
2. Labour Intensive
3. For whom to produce
4. It is assumed that entire resources are used for production of two goods with no change in technology.
5. Increasing trend of marginal opportunity cost
6. Production possibility curve
7. It will shift rightward or upward

Assignments

1. Discuss the basic economic problem.
2. Explain PPC. Graphically illustrate PPC and it's shift.

Suggested Readings

1. Hall, Robert, E., & Liberman, Marc(2006). *Economics- Principles and Applications*(Third edition),South-western Educational Publishers.

2. Pindyck, R.S., Rubinfeld, D.L., & Mehta, P. L. (2017). *Microeconomics* (Eighth edition). Pearson Education Prentice Hall.

References

1. Dwivedi, D.N. (2012). *Microeconomics: Theory and Applications* (Second Edition). Vikas Publishing House Pvt. Ltd.

2. Agarwal, H.S. (2008). *Microeconomic Theory* (seventh edition). Ane Books Pvt Ltd.

3. Samuelson, P. A., & W. D. Nordus (1998) *Economics*, Tata McGraw Hill :New Delhi.

Demand, Supply, and Equilibrium

UNIT

Demand

Learning Outcomes

After learning this unit, the learner will be able to:

- familiarise with the concept of demand
- explain the shifts in demand
- narrate the different types of elasticities of demand

Prerequisites

Demand is a fundamental concept in microeconomics. It explains the consumption behaviour of individuals. Demand for commodities by a consumer shows the purchasing pattern of the consumer. Usually, we purchase goods on the basis of the price of that good and our income. Suppose, you are planning to buy apples. If the price of the apples is high, then, you may purchase only half a kilo of apples instead of one kilo. Similarly, the income of the consumer also affects our demand for a commodity. You won't purchase luxurious goods when your income is low. However, when your income increases, you may buy those luxurious goods which you haven't purchased earlier. Demand for a commodity is determined by many factors which are economic and non-economic in nature.

This unit discusses the demand for a commodity, the factors affecting the demand for a commodity, shift in demand, and elasticities of demand. Let us explain these in detail.

Keywords

Demand, Law of demand, Demand curve, Expansion and contraction of demand curve, Shift in demand, Elasticity of demand

2.1.1 Demand

In the ordinary language, the word 'demand' means desire. But mere desire does not constitute demand in Economics. Demand in economics implies both the desire to purchase, and ability and willingness to pay for a good. By demand, we mean the various quantities of a given commodity or service which a consumer would buy in one market in a given period of time at various prices. Market demand, as distinct from individual demand, is the total sum of the demand of all individual consumers who purchase the commodity at various prices in the market.

2.1.1.1 Demand Function

Demand function expresses the relation between quantity demanded and factors affecting demand. It can be mathematically written as

$D = f(P, Y, T, P_1, P_2 \ldots\ldots)$

Where

D - demand

f - function of

P - price of the commodity

Y - income of the consumer

T - taste and preference of the consumer

$P_1, P_2 \ldots\ldots$price of related goods

The predominant factor that influences the demand is the price of the commodity (P). If all other factors (Y, T, $P_1, P_2 \ldots$) remain constant, demand for a commodity depends on the price of the commodity only. The Latin phrase 'ceteris paribus' is used to rule out the possibility of other factors changing. The phrase, 'ceteris paribus' stands for 'all other things being unchanged or constant'.

2.1.1.2 Law of Demand

We can illustrate the law of demand in the case of personal computers and android phones. They were used by business executives and elite teams during the initial stages of their introduction. But the prices of these devices fell sharply over the few years. Personal computers and smartphones came to be widely used for work, education, and even for fun. Falling prices along with higher incomes and a growing variety of uses brought tremendous demand for computers and smartphones.

The law of demand expresses the demand function, that is, the relation between demand and price. The law of demand states that, other things being constant, a consumer's demand for a normal good must be inversely related to the price of the good. When the price of a normal good increases, its demand decreases and vice versa. Normal goods are those goods whose demand increases as the consumer's income increases and demand decreases as the consumer's income decreases. Thus, the consumer's demand for a normal good and income of the consumer move in the same direction. There exists a positive functional relation between demand for a normal good and the income of the consumer.

The relationship between demand for a commodity and its price can be represented in the form of demand schedule.

2.1.1.3 Demand Schedule

Demand schedule is a table that shows what amount of good consumers are willing to buy as the price per unit changes. Let us take the case of a household, whose weekly demand for apples at different prices is given below. It is assumed that change in quantity demanded is purely due to change in price, while other non-price variables like price of related goods, income of the consumer, taste and preference of the consumer remain constant.

Table 2.1.1 Demand Schedule

Price of Apple (in rupees)	Quantity Demanded (in Kg)
50	10
100	8
150	6
200	4
250	2

The higher the price of apple, other things held constant, the fewer unit consumers are willing to buy. The lower its price, the more units of it are bought.

We can represent the above schedule as a graph in the form of a demand curve. It shows the inverse functional relationship between the price and quantity demanded. Price of the good, the independent variable is measured on the vertical axis and quantity demanded, the dependent variable along the horizontal axis. After plotting the points as per table 2.1.1, we get the demand curve (DD).

2.1.1.4 Demand Curve

The following demand curve is a graphical representation of the demand schedule.

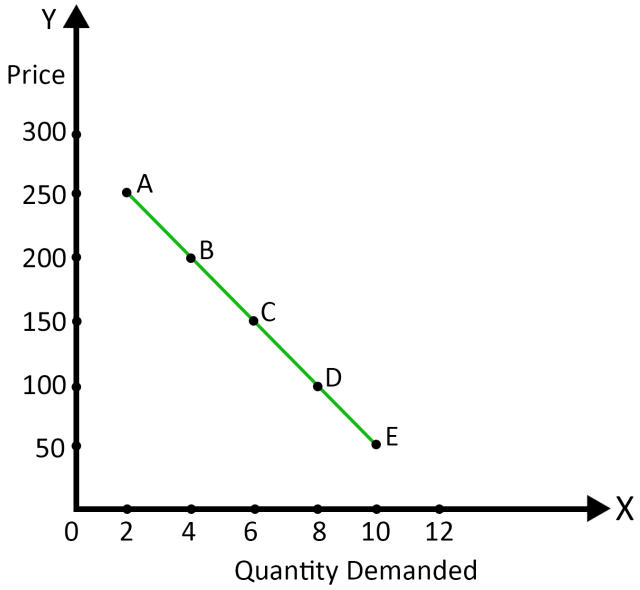


Fig 2.1.1 Demand Curve

Every point on the DD curve shows the quantity demanded at a particular price. At point 'e', the household demands 10 Kg of apple at price Rs. 50 per kg whereas at point 'c', the household demands only 6 kg of apple as price is higher, that is, Rs. 150 per kg. This shows that the quantity demanded and price are inversely related. Demand goes up when price goes down. Demand curve generally slopes downward from left to right.

2.1.1.5 Reasons for the Downward Slope of Demand Curve

Modern economists point out two reasons for the downward sloping of the demand curve. They are the income effect and substitution effect. When the price of a commodity falls, there will be an increase in purchasing power (real income) of the consumer. When real income rises the consumer can buy more. Likewise, when the price rises, the real income falls and the consumer will reduce consumption. So, the consumer can demand more when price falls and less when price rises. A change in quantity demanded as a result of change in real income caused by price change of the good is called income effect. Income effect is related to change in real income due to change in price and not due to change in money income.

Substitution effect is when the price of a good falls, it becomes cheaper than other goods, that is, its price attraction improves. It prompts a consumer to buy more of the goods whose price has fallen. Hence the consumer will replace cheaper goods in place of relatively costlier. When the price of palm oil falls, people demand more units of palm oil than cocunut oil. Substituting a cheaper commodity for a relatively expensive commodity is a substitution effect. Thus, the substitution effect refers to the change in demand caused by a change in relative prices.

The combined operation of income effect and substitution effect is called price effect, which causes an increase in demand with a fall in price.

Demand function can be linear or nonlinear. If the graph of the demand function is a straight line, it is a linear demand function. A linear demand function can be written as

$Q = a - bp; 0 \leq P \leq a/b$

$= 0$ if $P = a/b$

Where, 'a' is the vertical intercept and '-b' is the slope of the demand curve.

At price 0, demand is 'a' and at price equal to a/b, the demand is 0.

Illustration of linear demand function is given below.

Consider the demand function

$Q = 10 - 2p \quad 0 \leq p \leq 5$

$= 0$ if $p = 5$

From the function, price can take values between 0 and 5. When price is 5, quantity demanded is 0. When price is greater than 5, demand will be a negative quantity.

Demand never becomes negative, because negative demand makes no sense. Either the consumer will choose to buy the good or choose not to buy it (demand is zero). Negative buying does not happen in the real world. Here the slope is -2. It means when price increases by Re.1, the demand will fall by two units. We can prepare a demand schedule using the above demand function. This is shown in Table 2.1.2.

Table 2.1.2 Schedule for Linear Demand Function

Price	Quantity Demanded (Q = 10 – 2p)
0	10 – 2 x 0 = 10
1	10 – 2 x 1 = 8
2	10 – 2 x 2 = 6
3	10 – 2 x 3 = 4
4	10 – 2 x 4 = 2
5	10 – 2 x 5 = 0

We can draw demand curve using the above demand schedule based on the function Q = 10 – 2p.

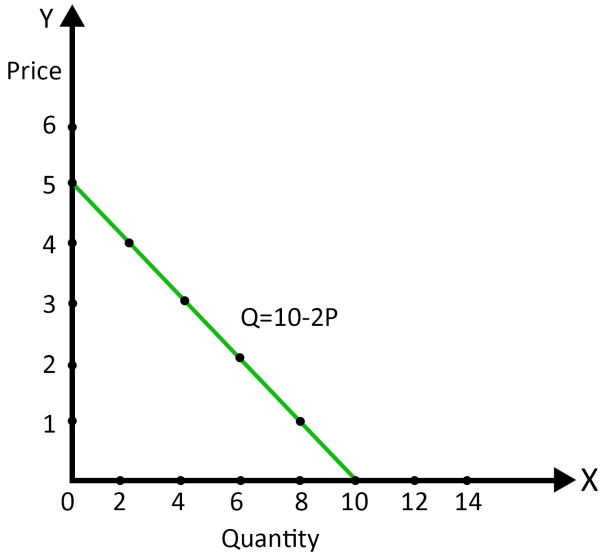


Fig 2.1.2 Linear Demand Curve

Market Demand

Market demand for a good at a particular price is the total demand of all the consumers. Suppose there are three consumers in the market for a good. At P_1 price, the demand for consumer 1 is q_1, demand of consumer 2 is q_2 and that of consumer 3 is q_3. The market demand of the good at P_1 is $q_1 + q_2 + q_3$. The market demand is found by adding together the quantities demanded by all buyers at each price. The Market demand curve of a good can also be derived from individual demand curves by horizontal summation as shown in figure 2.1.3. Thus, the market demand at $p^{l} = q^{l}_{1}+q^{l}_{2}$ and at $p\hat{} = q\hat{}_{1}+q\hat{}_{2}$. This method of adding two curves is called horizontal summation.

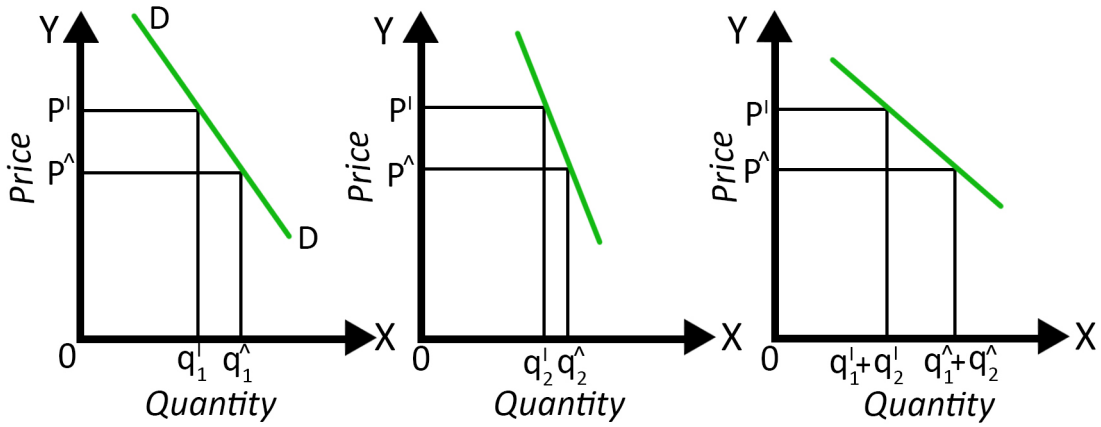


Fig 2.1.3 Derivation of Market Demand Curve

2.1.1.6 Expansion and Contraction of Demand

Movements along demand occur because of the change in the price of the commodity. Here, factors other than price have no role in making movements in demand. Movements in demand can be of two types. They are expansion and contraction of demand. We can see the movements along the demand curve with the help of figure 2.1.4.

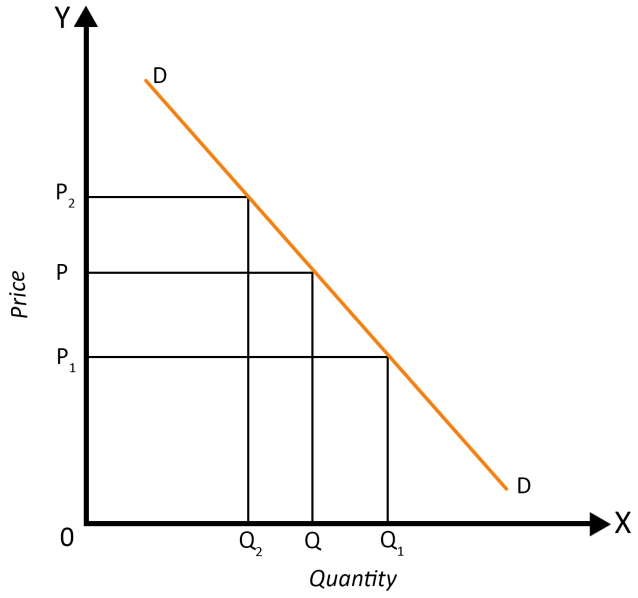


Fig 2.1.4 Expansion & Contraction of Demand

DD is the demand curve. At OP price, OQ is the demand. When price falls to OP_1, demand rises to OQ_1. The fall in price of the good results in the rise in demand for the good. This is called expansion of demand. Rise in demand due to fall in price brings downward movement along the same demand curve.

When price rises to OP_2, the quantity demanded contracted to OQ_2. Fall in demand due to rise in price is termed as contraction of demand. This makes an upward movement along the demand curve.

2.1.1.7 Shifts in Demand Curve – Increase and Decrease in Demand Curve

While movements along demand occur because of change in price alone, shift in demand is caused due to change in factors other than price.

Rightward shifting of demand curve occurs when there is favourable change in factors other than price viz. changes in price of substitutes and complementary goods, income of the consumer, taste and preferences of the consumers, demonstration effect etc.

Figure 2.1.5 depicts rightward and leftward shifting of the demand curve.

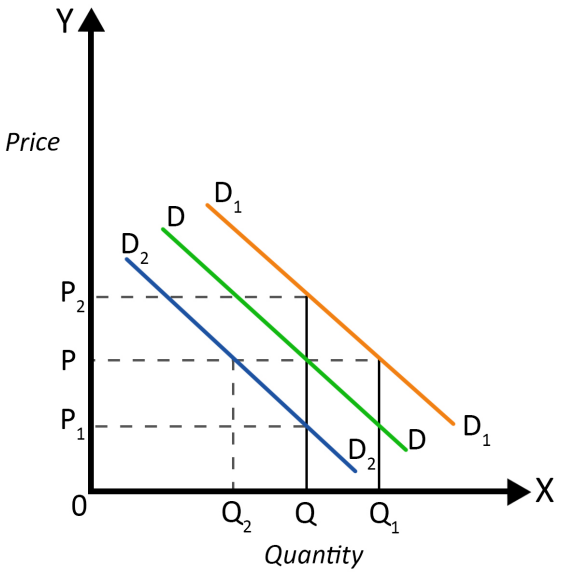


Fig 2.1.5 Rightward and leftward Shift in demand curve

DD is the initial demand curve. At OP price, OQ is the demand. Suppose there is a rise in income of the consumer, then, the quantity demanded also increases. The consumer has a new demand curve D_1D_1. The original demand curve, DD shifts rightwards to D_1D_1. The consumer can demand more quantity (OQ_1) at the same price (OP) or the same quantity (OQ) at a higher price (OP_2). The following are some of the instances of rightward shifting of demand curve.

- Increase in income of the consumer in the case of normal goods and decrease in income for inferior goods.
- Rise in price of one of the substitute goods. (Rise in the price of coffee causes an increase in demand for tea).
- Fall in price of one of the complementary goods. (Fall in price of river sand causes increase in demand for cement).

- Migration of people from rural areas to cities causes a rise in demand for goods in cities.
- Favourable change in taste, preference, and climatic conditions.
- Influence of media and advertisement.

Leftward shifting of the demand curve occurs when there are unfavourable changes in factors other than price. In figure 2.1.5, D_2D_2 is the leftward shift in demand curve. As a result of leftward shifting, the consumer demands the same quantity (OQ) at a lower price (OP_1) or lower quantity (OQ_2) at the same price (OP).The following instances make a leftward shifting of demand curve.

- Decrease in income of the consumer for normal goods.
- Increase in income of the consumer for inferior goods.
- Fall in the price of one of the goods in the case of substitutes.
- Rise in price of one of the complementary goods.
- Unfavourable change in taste and preference and climatic condition.

When there is a favourable or unfavourable change in factors other than price, demand curve shifts to rightward (upward) or leftward (downward) direction. We have new demand curves as a result of shifting.

2.1.1.8 Elasticities of Demand

Elasticity of demand is a ratio of the proportionate change or percentage change in the dependent variable (change in demand) to the change in the independent variable (change in price). In the case of demand for a commodity, we assume that it depends mainly on its own price, income of the consumer, and price of related commodities. Accordingly, we have three types of elasticities with respect to demand. They are price elasticity of demand, income elasticity of demand, and cross elasticity of demand. Among these, the price elasticity of demand is more significant due to its theoretical and practical value.

Price Elasticity of Demand

The price elasticity of demand is defined as the degree of responsiveness of a commodity to the change in its price. Price elasticity of demand is measured as the percentage change in quantity demanded divided by the percentage change in price. This is the percentage method (proportionate method) of measuring the elasticity of demand. There are two other methods of measuring price elasticity. They are the geometric measure of elasticity along a linear demand curve and the expenditure method of measuring elasticity.

Let Po be the initial price of a good and Q_0 be the quantity demanded at Po. When its price rises to P_1, the quantity demanded is Q_1.

Then, change in price $\Delta P = P_1 - Po$.

Change in quantity $\Delta Q = Q_1 - Q_0$.

The price elasticity of demand,

$ep = (\Delta Q/ Q_0)\times 100 \div (\Delta P/ Po)\times 100$.

Rearranging this equation,

$ep = \Delta Q/\Delta P \times Po/Qo$

It is important to note that the elasticity of demand is a number and it does not depend on the units in which price of the good and the quantity of the good are

measured. Price elasticity of demand is a negative number since the demand for a good is negatively related to the price of a good. However, we take the absolute value of elasticity. In absolute value, sign is not considered. It is better to avoid negative signs of change in price or change in demand.

Illustration – Calculation of price elasticity of Demand

Consider the demand for a good. At price Rs. 4, the demand for the good is 25 units. Suppose price increases to Rs. 5, the demand falls to 20. Calculate price elasticity of demand.

Price elasticity of demand, ep = $\Delta Q/\Delta P \times Po/Qo$

$$P_0 = 4 \ , \ Q_0 = 25$$
$$\Delta P = P_1 - P_0 = 5 - 4 = 1$$
$$\Delta Q = Q_1 - Q_0 = 20 - 25 = |5|$$
$$ep = 5/1 \times 4/25$$
$$= 0.8$$

Diagrams to show Price Elasticity of Demand

Value of the elasticity coefficient varies from zero to infinity. In some demand curves, elasticity remains the same throughout its length. In a perfectly inelastic demand curve, elasticity is zero throughout its length, and the shape of demand curve is vertical to X-axis. Elasticity is one in the unitary elastic demand curve. It is a rectangular hyperbola. In a perfectly elastic demand curve, elasticity is infinite, and shape of demand curve is horizontal to X-axis. These are shown in the figure 2.1.6, a, b and c.

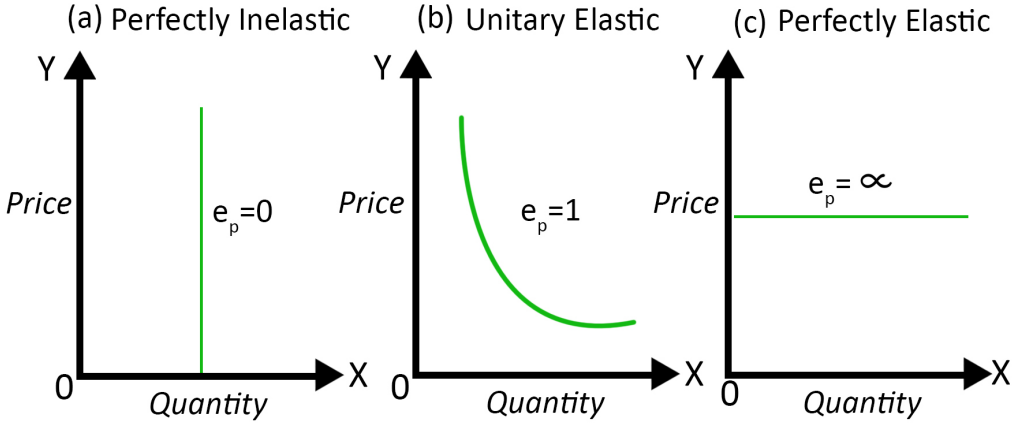


Fig 2.1.6 Price Elasticity of Demand

Illustration - Rectangular Hyperbola

If the equation of a demand curve takes the form pq = c, where p and q are two variables and c is a constant, it will be a rectangular hyperbola, where price (p) times quantity (q) is a constant. It is downward sloping as shown in the following diagram 2.1.7. Consider points

A and B on the curve, the areas of the two rectangles OP_1AQ_1 and OP_2BQ_2 are the same and equal to c. In such a demand curve, at whatever point the consumer consumes, the expenditures remain the same and equal to c.

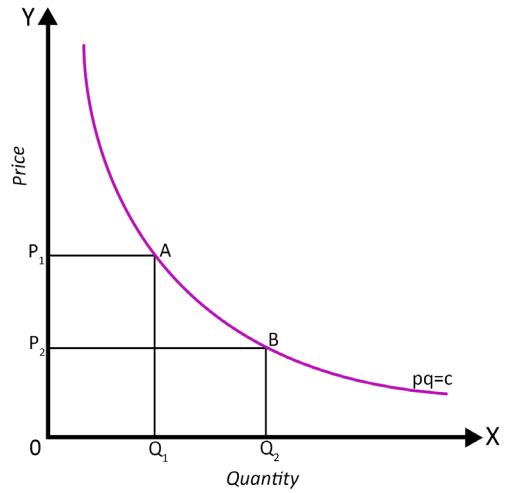


Fig 2.1.7 Rectangular Hyperbola

Elastic, Inelastic, and Unit Elastic Demand Curves

In addition to constant elastic demand curves, there are three other degrees of elasticity. Figure 2.1.8 shows the three cases of elasticities. In each case, there is a 50 percent fall in price and consumers change the quantity from A to B. In figure 2.1.8 (a), 50 percent fall in price makes triple the increase in demand. It is a situation of elastic demand (ep > 1). Figure (b) is a case of unit elastic demand (ep = 1). Demand doubled as a result of the fall in price. Figure (c) shows inelastic demand, cutting price in half led only to less than 50 per cent increase in quantity demanded.

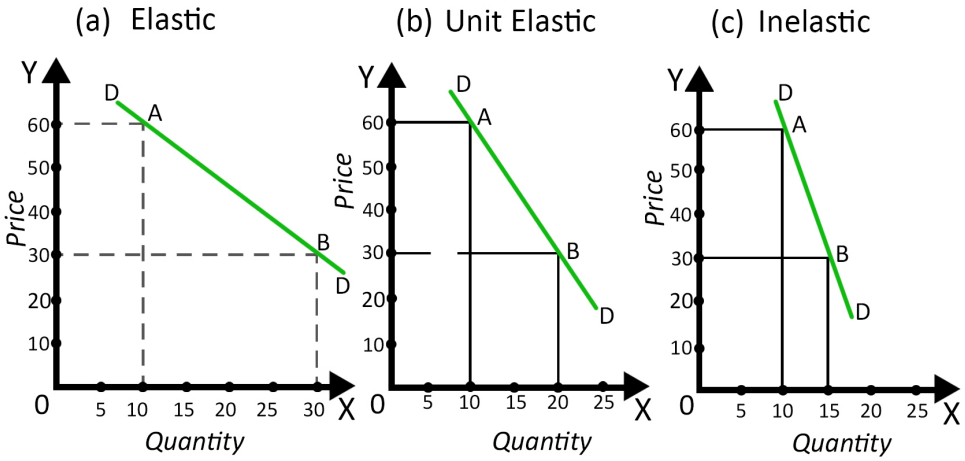


Fig 2.1.8 Elastic, Unit elastic, Inelastic demand Curves

Determinants of Price Elasticity of Demand

While demand for some commodities is highly elastic, for some others it is highly inelastic. There are several factors which influence the price elasticity of demand for a commodity. They are the following.

I. Availability of close substitutes:

Tea and coffee, coconut oil and palm oil etc. are substitutes. The closer the substitute, the greater the price elasticity of demand. Many products are available in different brand names and each brand stands a close substitute for the other. Elasticity of demand for each brand will be more than the generic commodity. Salt has no substitute hence its elasticity is lower.

II. Nature of commodity:

Necessities like food are essential for life and are more inelastic than demand for comforts and luxury goods. Though demand for food is inelastic, demand for specific food items are likely to be more elastic. Demand for luxury goods and comforts are elastic because of their less urgency. They can be postponed when their price rises. Generally, demand for durable goods is more elastic than demand for non-durable necessities.

III. Alternate uses of commodity:

Goods capable of alternative uses are highly elastic for a fall in price. Price cut of a multi-use commodity encourages the extension of its use. For example, electricity is used for cooking, lighting, heating, cooling etc in a home. Therefore, demand for electricity is highly elastic for a fall in price and inelastic for rise in price.

IV. Expectation of change in price:

The direction of change in price affects elasticity. Between any two points on the demand curve, elasticity coefficient is higher for the fall in price and lower for rise in price.

V. Proportion of income spent:

If the proportion of income spent on a commodity is very small, its demand will be inelastic. Rise in the price of such goods won't affect the budget of the consumer.

Income Elasticity of Demand

We know that there exists a positive relation between demand for a normal good and income of the consumer. The demand for normal goods increases with increase in consumer's income. Income elasticity of demand is defined as the responsiveness of demand to the change in consumer's income.

Income Elasticity of Demand,

e_y = Proportionate change in demand ÷ Proportionate change in income

Let Q be the initial quantity demanded and Y be the initial income of the consumer and let ΔQ be the change in quantity and ΔY be the change in income, then

$$e_y = (\Delta Q/Q)\times 100 \div (\Delta Y/Y)\times 100$$

Rearranging, $e_y = \Delta Q/\Delta Y \times Y/Q$

It is to be noted that while price elasticity of demand for normal goods is negative, income elasticity of demand for normal goods is positive. But income elasticity of demand for inferior goods is negative. This is because the demand for inferior goods decreases with increase in income. Value of income elasticity for normal goods varies depending on the nature of commodities. Income elasticity of necessities is less than one for increase in income. In the case of comforts and luxuries, it is equal to one and greater than one respectively for an increase in

consumer's income. Income elasticity of demand is used to forecast the trend of demand when a change in income is expected.

The concept of income elasticity is widely applied by the business community like airlines, software companies, and mobile network providers to classify customers into groups with different income elasticities. Airlines charge relatively high charges for executive travellers, while charging less for economy class. They charge subsidised prices to leisure passengers to fill up all their empty seats as a strategy for raising revenue and maximising profit.

Cross Elasticity of Demand

Cross elasticity of demand is the measure of responsiveness of demand for a commodity to the change in the price of its related commodity (substitutes and complementary goods). Consider the substitutes tea and coffee, the cross elasticity of demand for tea is the percentage change in quantity demanded of tea due to change in price of coffee. The cross elasticity of demand (e_c) for tea with respect to price of coffee can be expressed as,

Percentage change in demand for tea ÷ Percentage change in price of coffee

Let 'P' be the initial price of coffee and ΔP be the change in price of coffee and let Q be the initial quantity of tea demanded and ΔQ be the change in quantity demanded of tea.

Cross elasticity of demand for tea (e_c) is

$$\left(\frac{P}{Q}\right) \times \frac{\Delta Q}{\Delta P}$$

Cross elasticity of demand for complementary goods like vehicle and fuel, milk and tea, electricity and appliances can also be calculated in the same way as shown in the illustration. We must keep in mind that when one of the two goods are substitutes for each other, its demand has a positive cross elasticity because an increase in price of one makes an increase in demand for the other.

But the demand for complementary goods has negative cross elasticity because an increase in the price of one of the complementary goods leads to a decrease in the demand for the other.

Let's conclude that if the cross elasticity of two related goods is positive, the goods are substitutes for each other. If cross elasticity of demand for two related goods is negative, the two goods are complements.

Illustration – Calculation of Cross Elasticity of Demand

Consider the substitutes tea and coffee. When the price of coffee powder increases from Rs. 100 to Rs. 140 per Kg, the demand for tea dust increases from 2 Kg to 3 Kg per week. There is no change in the price of tea dust. Find the cross elasticity of demand for tea with respect to the price of coffee.

Cross elasticity of demand $\left(\frac{P}{Q}\right) \times \frac{\Delta Q}{\Delta P}$

Initial price of coffee (P) = 100
Change in price of coffee (ΔP) = 40
Initial quantity of tea (Q) = 2
Change in quantity of tea (ΔQ) = 1

$$\left(\frac{100}{2}\right) \times \frac{1}{40} = 1.25$$

Recap

- Demand schedule exhibits relation between quantity demanded of commodity at different prices
- Demand curve is graphical representation of demand schedule
- Demand curve slopes downward
- Law of demand establishes inverse relation between demand and price
- Under normal goods, demand moves in same direction of change in income
- Market demand shows total demand by all consumers in the market
- Demand is influenced by multiple factors
- Movements in demand curve reflect changes in quantity demanded
- Shifts in demand reflect changes in demand
- Movements in demand curve are result of change in price of good
- Shifts in demand curve are result of change in factors other than price
- Price elasticity is responsiveness of demand to change in price
- Elasticity of demand is a negative number independent of units
- Value of elasticity varies from zero to infinity
- In perfectly elastic demand, elasticity is infinite
- In elastic demand, elasticity is more than one
- In unit elastic demand, elasticity of demand is equal to one
- In inelastic demand, elasticity is less than one
- In perfectly inelastic demand, elasticity is zero
- Income elasticity is responsiveness of change in demand to change in income
- Cross elasticity of demand, measures responsiveness of quantity demanded to change in price of related goods

Objective Questions

1. Which is the independent variable that is associated with demand for a good?
2. What is the name for representing demand schedule in a graph?
3. Name the curve that shows the inverse relation between price and demand.
4. Give two reasons behind the downward sloping of demand curve.
5. Palm oil and sunflower oil are substitutes. How the demand for palm oil get affected when the price of sunflower oil goes down?
6. What is the term used to refer to the goods that are consumed together?
7. What is the cause behind contraction of demand?
8. How does the demand curve change when there is an increase in the income of the consumer?
9. What is the reason behind expansion of demand?
10. Name the concept that measures responsiveness of demand to changes in its price.
11. Name the type of elasticity that measures responsiveness of demand to change the income of the consumer.

Answers

1. Price
2. Demand curve
3. Demand curve
4. Substitution effect and income effect
5. Decrease in demand of palm oil
6. Complementary goods
7. Rise in price
8. Rightward shifting
9. Fall in price
10. Price elasticity of demand
11. Income elasticity

Assignments

1. Explain the factors influencing demand for a commodity?
2. Explain the difference between movements in demand and shifts in demand.
3. Ellucidate the different elasticities of demand.
4. Explain the factors which determine price elasticity of demand?
5. What is cross elasticity of demand? How can you distinguish between substitute and complement goods using the concept of cross elasticity of demand?
6. Explain the concept of income elasticity of demand. How would you differentiate between necessities and luxuries on the basis of income elasticity of demand.

Suggested Readings

1. Hal R Varian(2010) *Intermediate Microeconomics: A Modern Approach*, 8th Edition, W.W Norton and Company/ Affiliated east- West Press (India).
2. Salvatore, D. (2003) *Microeconomics Theory and Applications* (Fourth Edition), Oxford University Press.
3. Snyder, Christopher and Walter, Nicholson (2017) *Microeconomic Theory-Basic Principles and Extensions*, Cengage Learning.

References

1. Agarwal, H.S. (2008). *Microeconomic Theory* (seventh edition). Ane Books Pvt Ltd
2. Dwivedi, D.N. (2012). *Microeconomics: Theory and Applications* (Second Edition). Vikas Publishing House Pvt. Ltd.
3. Koutsoyiannis, A. (1990). *Modern Microeconomics*. Macmillan.
4. Pindyck, R.S., Rubinfeld, D.L., & Mehta, P. L. (2017). *Microeconomics* (Eighth edition). Pearson Education Prentice Hall.
5. Samuelson, P.A., & W. D. Nordhaus (special edition 2020). *Economics*. New Delhi: Tata McGraw Hill

UNIT 2

Supply Analysis

Learning Outcomes

After learning the unit, the learner will be:

- familiarised with the concept of supply
- introduced to the factors affecting the supply of a commodity
- able to explain the supply schedule and supply curve of a commodity

Prerequisites

Mostly, the goods we use daily are purchased from shops especially, retail shops. The retail shops purchase these goods from wholesale shops which are directly operated or supplied by the producers of the goods. So, we are able to purchase the goods we want as a result of the supply of goods by the producers.

Just go through the materials that you use for learning. Books, pens, laptop, pencils etc. are available at stationery and retail shops near you since they are supplied by the producers through the chain of wholesale and retail shops. Similarly, all goods which we purchase from the market are supplied by the producers of those goods.

The supply of a good means the amount of the good a producer offers during a specific period of time. This unit deals with the supply in detail.

Keywords

Supply, Price of a commodity, Profit, Technology, Input prices, Supply curve

2.2.1 Supply Analysis

Supply represents various quantities of a good that a firm is willing and able to provide at different levels of prices during a period of time. This is similar to the demand which is referred to as the quantity of a good a consumer is willing and able to purchase at different levels of price during a period of time. While measuring the supply of a good, it is important to refer to the time period of supply. It may be a day, a week, a month, a year, or many years. Supply is a flow variable which is calculated in terms of the time dimension. We cannot measure the supply of a good without referring to the time period of supply.

The willingness and ability of the firm to provide different quantities of a commodity are very important to determine the level of supply of the firm. Willingness of a firm to supply various quantities at different levels of price depends on the amount of profit the firm calculates for the various quantities of the commodity it plans to supply. The profit at various quantities of supply of a good depends on the revenue received from selling goods and cost incurred during the production of goods. The revenue of the firm depends on the price at which the commodity is sold. Cost of producing goods depends on many factors such as input cost, transportation cost, and managerial cost. So, firms will be willing to supply various quantities of the good only after considering the profit it receives from supplying each quantity of the good.

Suppose, a firm is supplying rice. Then, the willingness of the firm to supply different quantities of rice depends on the profit the firm receives from supplying the rice. Higher the price for rice, higher will be the revenue from rice production. If input prices such as rent paid to land and wages for labour are lower, the cost of producing rice will also be lower. A higher revenue and a lower cost give higher profit. Then, the firm will be willing to supply more quantities of rice.

The ability of a firm to supply various quantities of a good depends on the available technology and availability of resources to produce the goods. You have learnt in the previous block that under production function, the output is a function of technology and other inputs. Technology is given in the short-run. The reason is, the development of technology requires research and innovation. Since research and innovation need time to get its result, a particular technology stays for some period of time. If a firm has the state-of-the-art technology, then the productivity of labour will be very high, leading to greater ability to produce goods. Conversely, if the firm has rudimentary technology, the level of manual labour will be high and productivity will be low, leading to low ability to produce goods. In terms of availability of resources, the greater the availability of resources, the greater will be the ability of the firm to produce and supply goods, and vice versa.

In the example of rice production, use of technology can be viewed in terms of using tractors to plough and sow the seed in the paddy field, and harvester machines to harvest the crop. In the agricultural field, the state-of-the-art technology is the tractor combine harvesters which can be used for all stages of cultivation of rice. This increases productivity and leads to higher rice cultivation.

Like the difference in demand and

quantity demanded, the supply analysis also has two concepts viz. supply and quantity supplied. As we have discussed, supply refers to various quantities of goods provided at different price levels during a period of time. The quantity supplied refers to a particular quantity of a good, a firm is willing and able to provide at a particular price. Therefore, the supply represents the quantities supplied at different price levels which are given as supply schedules whereas, the quantity supplied represents a single entry on the supply schedule showing a particular price and corresponding quantity of good supplied. Let us discuss the matter in detail.

2.2.1.1 Supply Function

Supply function shows the relation between the quantities of a commodity supplied by firms and various factors affecting the supply of the commodity. While discussing the willingness and ability of a firm to supply a good, we saw that the price of inputs and availability of technology do affect the supply of the good. The factors that determine the supply of goods are the following:

- The price of the good
- The price of factors or inputs used for the production of the good.
- Technology
- Price of complementary and substitute goods.
- Number of other firms producing the same good.
- Price expectations of the good.

Let us explain each of these factors.

You know that the supply of the good depends on the price of the good since price gives revenue which in turn measures the profit of the firm producing the good. As a firm's objective is to maximise the profit, the supply of goods is decided on the basis of price of the goods.

A good or a commodity is a result of a production process. A production process refers to the transformation of inputs into outputs. Inputs are necessary for producing output. So, the price of inputs or factors used for the production of the good plays a major role in determining the supply of the good.

You have already seen the importance of technology in determining the size of production. The particular state of the technology affects the productivity of labour, leading to changes in the level of production. A state-of-the-art technology improves production whereas a poor technology reduces the production.

Complementary goods are those goods which are used simultaneously while using the original good. Substitute goods are those goods which are used by replacing the original good. The supply of a good depends on the supply of its complementary and substitute goods. With respect to complementary goods, the supply of the original good increases with the increase in the supply of its complementary good and vice versa. In terms of substitute goods, the supply of the original good reduces with the increase in the supply of the substitute good and increases with the decrease in the supply of the substitute goods.

The number of firms producing the good determine the supply, in terms of the availability of resources, and equilibrium in the market.

Future price expectations affect the supply of the goods as price determines the profit of the firm. If the price is expected to fall in future, firms' supply of goods in the present time increases since low prices cause low profit in future, and firms try to take advantage of the current higher price. On the other hand, if the price is expected to increase in future, the firm's supply of good in the present time falls to increase the supply in future to reap higher profit from the higher price in future.

Considering the supply of rice, the factors affecting the rice supply are the price of rice, the price of inputs such as rent of land used in the cultivation and wages of agricultural labourers, the technological advancement of the tractors and harvesters used in the agricultural field, the total number of rice producers, price of wheat which is the substitute of rice, and the expected future price of rice.

Considering the factors affecting the supply of goods in general, the supply function can be represented as follows:

$$S = A (P_X, f_1, f_2, f_3,\ldots f_m, N, P_C, P_S, P_E)$$

S is Supply; P_X is the price of the good; f_1, f_2, f_3,.. f_m are the prices of factors or inputs used in the production of the commodity X. The subscript to 'f' measures the number of factors used for the production of X; N is the total number of firms producing the commodity, X; P_C is the price of complementary good; P_S is the price of substitute good; and P_E is the expected future price of X.

Among these factors affecting the supply, the most important factors are the price of the good X, the technology, and the price of factors of production. Then, the supply function is termed as

$$S = A (P_X, f_1, f_2, f_3,\ldots f_m)$$

Functionally, the supply of a commodity is most related to the price of the commodity. Supply shows the quantities offered by a firm at different prices. Let us discuss this in the next section.

2.2.1.2 Supply Schedule

A supply schedule gives an account of various quantities of a good supplied at each price of the good for a given time period. Since the supply schedule shows the relation between the price and the corresponding quantity supplied of a commodity, the other factors affecting supply are considered as constant. This is the ceteris paribus assumption.

A supply schedule is usually given in a table with the price of goods and the corresponding quantity supplied. Individual supply schedules show the account of the supply of each firm. Adding each firm's supply schedule gives the market supply schedule. Table 2.2.1 gives a hypothetical supply schedule for rice.

Table 2.2.1 Supply Schedule for Rice

Price per Quintal of Rice in Rupees	Quantity Supplied of Rice in Quintals
550	100
600	160
650	200
700	230
750	250

It is clear from the table that the quantity supplied of rice increases with increase in the price of rice, with other factors remaining the same. The quantity of rice supplied at Rs. 550 per quintal was 100 quintals and increased to 250 quintals when the price per quintal increased to Rs. 750.

In contrast to the demand schedule which shows a negative relationship between price and quantity demanded of a commodity, the supply schedule shows a positive relationship between the price and quantity supplied of a commodity. This relationship between the price of a commodity and the quantities supplied of the commodity is portrayed in the supply curve.

2.2.1.3 Supply Curve

The supply curve gives the diagrammatic representation of the relation between the price of goods and the respective quantities supplied by firms during a period of time, with other factors affecting supply remaining constant.

A supply curve of a commodity can be derived from the supply schedule of the commodity. We can derive the supply curve of rice from the supply schedule given in Table 2.2.1.

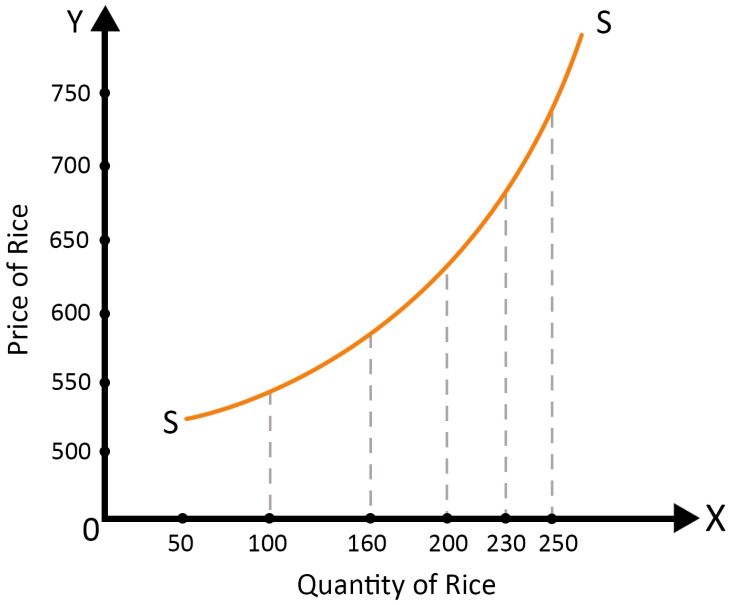


Figure 2.2.1 Supply Curve of Rice

In the figure, SS is the supply curve. The quantity of the commodity, rice, is measured on the X-axis and the corresponding price is measured on the Y-axis. Each point on the supply curve shows the combination of the price of the commodity and the quantities supplied.

The figure portrays that the supply curve of a commodity shows the positive relationship between the quantity supplied and the corresponding price of the commodity, given the other factors.

Therefore, the supply curve of a commodity is positively sloped or upward sloped showing a direct relationship between price and quantity supplied.

Reasons for Positive Slope of Supply Curve

The supply curve is positively sloped showing the direct relation between quantities supplied of a commodity and its price. That is, quantities supplied of a commodity increase with the increase in price, and decrease with the decrease in price.

In economics, we deal with rational individuals. A rational firm is a profit maximiser. When the price of a commodity increases, given the cost of production of each unit of output, a rational firm tries to increase its production so that it can sell the commodity at a higher price and reap a higher profit. When the firm increases the production to get a higher profit, the total cost of production increases. As an increase in production requires increase in the stock of factors, it leads to diminishing returns to the factors. With increase in the stock of factors and resultant diminishing returns to the factors, there will be an increase in the additional cost of production. So, a higher price is necessary to cover the additional cost when production is increased. Therefore, a higher price corresponds with a higher quantity supplied and vice-versa leading to the positive slope of the supply curve of a commodity.

2.2.1.4 Law of Supply

The law of supply states that under the 'ceteris paribus'(other factors remaining the same) condition, there exists a direct relationship between the quantity supplied of a commodity and its price. That is, quantities supplied increase with the increase in price and reduce with the reduction in price. Under the law of supply, the supply function is, $S = f(P_X)$.

2.2.1.5 Equilibrium of Demand and Supply

At equilibrium, demand and supply are equal. That is, at equilibrium price, the quantity that every consumer is willing to buy and every producer willing to sell are equal. The price at which quantity demanded equals quantity supplied is known as **equilibrium price** (P*). Equilibrium price is the market clearing price. At all other prices, market is in disequilibrium. The quantity demanded and supplied at equilibrium price is known as **equilibrium quantity** (Q*). It is the market clearing quantity. We can express the equilibrium state symbolically as,

$$Q_D (P^*) = Q_S (P^*)$$

where,

$Q_D (P^*)$ – quantity demanded at P*

$Q_S (P^*)$ – quantity supplied at P*

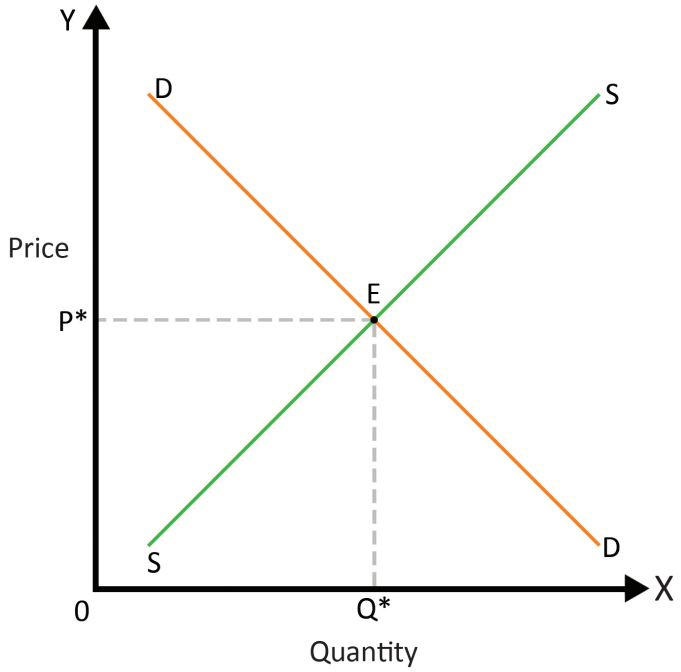


Figure 2.2.2 Equilibrium of Demand and Supply

In the figure 2.2.2, SS represents supply curve and DD represents demand curve. E is the equilibrium point, where demand and supply curves intersect each other and P* and Q* represent equilibrium price and Quantity.

Recap

- Supply refers various quantities of commodities at different price levels
- Level of supply determined by willingness and ability of firms to offer various quantities
- Willingness of firm to supply different quantities depends on profit received
- Ability to supply depends on availability of resources and technology
- Factors affecting supply - commodity price, input prices, technology
- Supply and quantity supplied are different concepts
- Supply schedule - various quantities supplied at respective price levels
- Quantity supplied - particular quantity offered by a firm at a particular price
- Supply curve is positively sloped
- Law of supply - direct relation between quantities supplied and the prices

Objective Questions

1. Define supply
2. Represent the supply in terms of time dimension.
3. What determines the willingness to supply for a firm?
4. What are the factors determining the ability to supply?
5. Write three factors affecting the supply of a commodity.
6. What is quantity supplied of a commodity?
7. What is the ceteris paribus condition in the law of supply?
8. What is supply curve?
9. What is the slope of a normal supply curve?
10. State the law of supply.
11. What is a supply schedule?
12. How does the supply of a substitute good affect the supply of the original good?

Answers

1. Supply is defined as the various quantities of a good offered by a firm at different price levels during a particular period of time.
2. Supply is a flow variable
3. The level of profit from the supply of a commodity determines the willingness to supply for a firm.
4. The ability to supply for a firm is determined by the availability of resources and technology.
5. Price of the commodity, price of inputs used in the production of the commodity, technology
6. Quantity supplied of a commodity refers to a particular quantity offered by a firm at a particular price of the commodity.
7. The factors affecting the supply of a commodity other than its price remain constant.
8. Supply curve shows the diagrammatic representation

of relation between price of goods and respective quantities supplied.

9. A normal supply curve is positively sloped.

10. Law of supply states that under the 'ceteris paribus' condition, there exists a direct relation between quantities supplied of a commodity and the prices of the commodity during a particular period of time.

11. Supply schedule gives the account of various quantities supplied of a commodity corresponding to respective price levels

12. In terms of substitute goods, the supply of the original good reduces with the increase in the supply of the substitute good and increases with the decrease in the supply of the substitute goods.

Assignments

1. Explain the factors affecting the supply.
2. Elucidate on the slope of the supply curve using the graphical representation of the supply curve.
3. Explain the supply schedule with an illustration.
4. Elucidate on supply function and law of supply.

Suggested Readings

1. Agarwal, H.S. (2008). *Microeconomic Theory* (seventh edition). Ane Books Pvt
2. Dwivedi, D.N. (2012). *Microeconomics: Theory and Applications* (Second Edition). Vikas Publishing House Pvt. Ltd.
3. Pindyck, R.S., Rubinfeld, D.L., & Mehta, P. L. (2017). *Microeconomics* (Eighth edition). Pearson Education Prentice Hall.

References

1. Koutsoyiannis, A. (1990). *Modern Microeconomics*. Macmillan.

2. Maddala, G.S. & Miller Ellen (2013). *Microeconomics Theory and Applications,* (Tenth Edition). McGraw Hill Education Private Limited.

3. Mankiw, N. G. (2016). *Principles of microeconomics* (8th ed.). Cengage Learning Custom Publishing.

4. Salvatore, D. (2003), *Microeconomics - Theory and Applications* (Fourth Edition), Oxford University Press.

5. Samuelson, P.A., & W. D. Nordhaus (special edition 2020). *Economics*. New Delhi: Tata McGraw Hill.

UNIT 3

Change in Supply

Learning Outcomes

After learning this unit, the learner will be able to:

- explain the changes in supply and quantity supplied
- get familiarise with the elasticity of supply
- get introduced to the factors determining the elasticity of supply

Prerequisites

You might have experienced situations where the goods which are easily available most of the time are not available at certain other times. During the time of the COVID 19 pandemic, electronic parts of phones and laptops were not easily available as they used to be. The reason is that, due to the global lockdown, the availability of inputs used in the production of parts of these goods was rare. This low availability of inputs reduced the supply of electronic parts. The low availability also led to hike in the price of electronic parts.

So, the supply of goods is not constant all the time. The supply may change with the changes in the factors affecting it. We have just discussed that the availability of inputs changes the supply of goods. Supply may change with changes in price or may change with changes in factors other than price. Change in the supply of a commodity due to the change in price and factors other than price such as availability of inputs, price of inputs, availability of technology etc. are dealt separately in this unit.

Keywords

Expansion and contraction of supply, Increase and decrease of supply, Price elasticity of supply, Linear and non-linear supply

2.3.1 Changes in Quantity Supplied – Expansion and Contraction of Supply

You have already learnt that the quantity supplied refers to a particular quantity of a commodity supplied at a particular price. So, the quantity supplied is a point on the supply curve. The supply curve on the other hand is the locus of points of quantities supplied at their respective prices.

A change in quantity supplied can be an increase or decrease in the quantity supplied. An increase in the quantity supplied refers to the situation when the price of the commodity increases leading to the increase in the quantity supplied under 'ceteris paribus' condition. This increase in quantity supplied is known as the expansion of supply. Similarly, when the price of the commodity falls, the quantity supplied will also fall. This decrease in the quantity supplied is known as the contraction of supply. The increase and decrease in the quantity supplied or the expansion and contraction of the supply are shown along the supply curve. Hence, the expansion and contraction of supply are experienced under the ceteris paribus condition where only the price of the commodity affects the supply of the commodity.

Take the case of the supply of rice. The expansion in the supply of rice happens when the price of rice increases in a given period of time with other factors affecting supply remaining the same. Similarly, the contraction in the supply of rice takes place when the price of the rice falls with other factors affecting the supply of rice remaining the same. The expansion and contraction can be portrayed using the supply curve of rice.

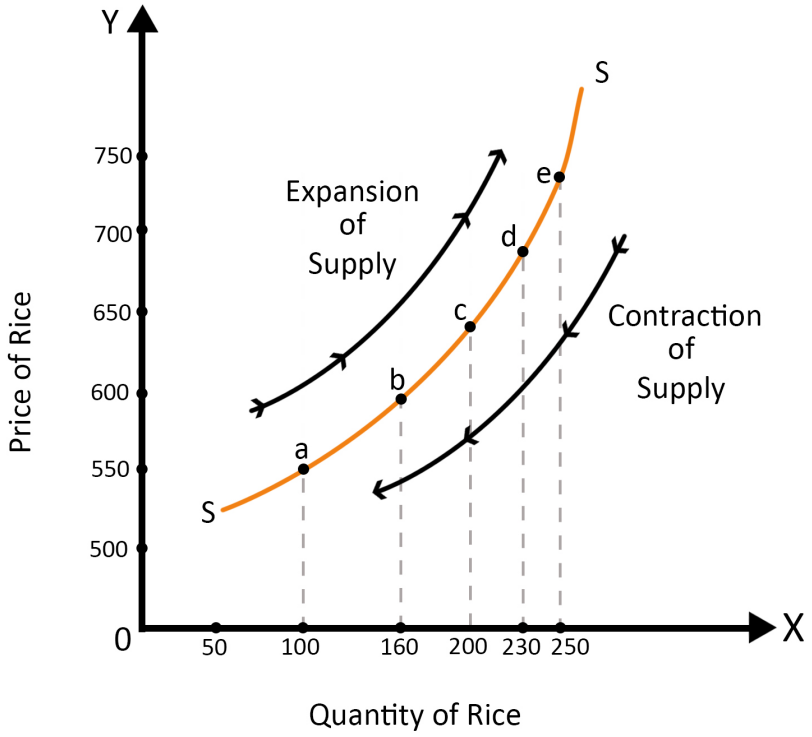


Fig 2.3.1 Expansion and Contraction of Supply

Consider the points on the supply curve, SS in Figure 2.3.1. The points a, b, c, d, and e show the quantity supplied of rice at prices Rs. 550, Rs. 600, Rs. 650, Rs. 700, and Rs. 750 per quintal of rice respectively. Take the point c. At c, the quantity supplied of rice is 200 quintals at Rs. 650 per quintal of rice. Suppose, the price of rice increases to Rs. 700 per quintal, then the quantity of rice supplied will be 230 quintals. This increase in the quantity supplied of rice is shown by a movement along the supply curve SS from 'c' to 'd'. The increase in quantity supplied shown along the supply curve from 'a' to 'e' is the expansion of supply.

Now, suppose the price of rice falls from Rs. 650 per quintal to Rs. 600 per quintal of rice. Then, the quantity supplied falls to 160 quintals of rice. The point on the supply curve with Rs. 600 and 160 quantities of rice is 'b'. This decrease in quantity supplied shown along the supply curve, SS from 'c' to 'b'. So, the decrease in quantity supplied shown along the supply curve from 'e' to 'a' is the contraction of supply. Therefore, the upward movement along the supply curve portrays the expansion of supply, and the downward movement along the supply curve shows the contraction of supply.

The expansion and contraction of the supply are represented under the 'ceteris paribus' condition, when the factors other than price of the commodity determining the supply remain constant. However, in the real world, the factors other than the price of the commodity do change which in turn change the supply leading to shifts in supply curve. Let us discuss this.

2.3.2 Shifts in Supply - Increase and Decrease in Supply

Change in supply refers to an increase or decrease in the supply of a commodity when factors other than the price of the commodity changes. The factors other than the price of the commodity which affects the supply are the price of inputs, technology, number of firms producing the commodity, price of substitute and complementary goods, and future price of the commodity. The change in the supply of a commodity due to factors other than the price of the commodity is known as the shift in supply.

It is important to note that the change in the supply of a commodity is different from the change in quantity supplied of a commodity. The change in the supply of the commodity is due to the factors other than the price of the commodity whereas, the change in quantity supplied is due to the changes in the price of the commodity. Therefore, changes in the supply of commodities is measured by relaxing the assumption of 'ceteris paribus' condition. However, the change in quantity supplied of the commodity is measured by keeping the assumption of the ceteris paribus condition.

A shift in the supply can be shown graphically by the rightward or leftward shift of the supply curve. This section includes two subsections explaining the increase and decrease in the supply.

2.3.2.1 Increase in Supply

Increase in supply shows greater availability of a commodity due to positive changes in the factors other than the price of the commodity. Take the case of price of

inputs. A fall in the input prices increases the supply of a commodity. When input prices fall, the cost of production also falls. A profit maximising firm will produce more of the commodity since the low cost of production creates more profit with more production.

In the case of supply of rice, a fall in rent or wage (the input prices), reduces the cost of production of rice. Since the profit is revenue minus cost, a low cost of production increases the profit. So, the rice producing firm supplies more rice when the input prices such as rent or wage rate fall.

The increase in the supply of the commodity is shown by the rightward shift of the supply curve. Figure 2.3.2 displays the increase in the supply.

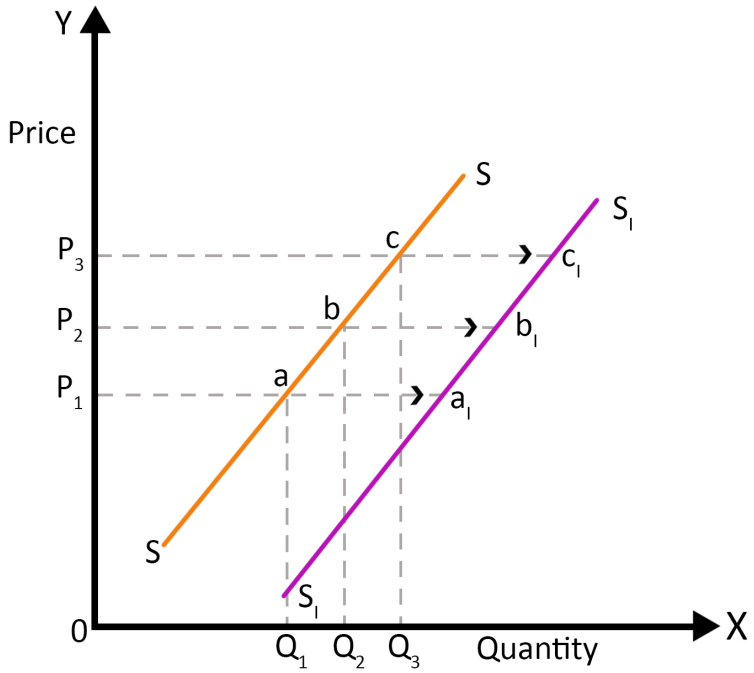


Fig 2.3.2 Increase in Supply

The figure shows the increase in the supply by the rightward shift of supply curve from SS to S_1S_1. Consider, the economy is in point 'a' with P_1 price and Q_1 quantity supplied. Let us suppose the increase in supply is due to the fall in input prices. In the S_1S_1 supply curve, with the original price of the commodity, the quantity supplied is greater than Q_1, the original quantity. This increase in quantity supplied is due to the increase in production caused by the fall in input prices. The figure shows that, with a rightward shift in the supply curve, the firm can supply more quantity of the commodity at each level of price of the commodity.

In addition to fall in input prices, better technology, higher price of substitute goods, lower price of complementary goods, low expectation about the rise in price in the future shifts the supply curve to right showing an increase in supply of the commodity.

2.3.2.2 Decrease in Supply

Decrease in supply refers to lower availability of commodities due to the negative effects of the factors determining supply other than the price

of the commodities. Suppose input prices increase in the economy. Then, the cost of production increases leading to a lower supply of the commodity.

A decrease in the supply of the commodity is shown by a leftward shift of the supply curve. The Figure 2.3.3 shows the decrease in supply.

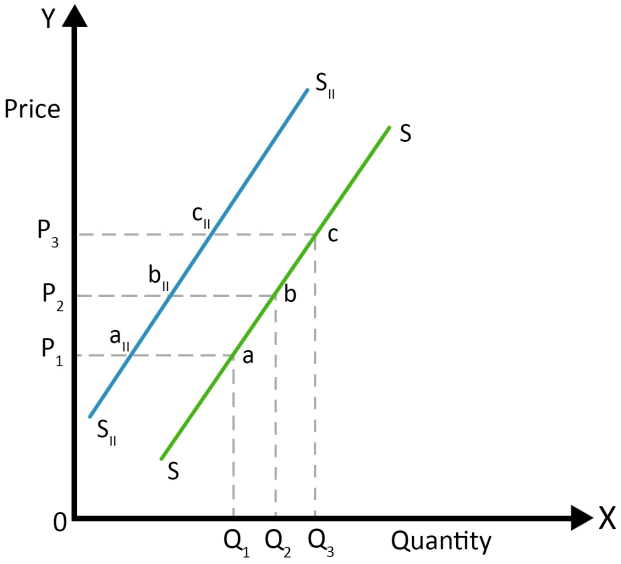


Fig 2.3.3 Decrease in Supply

Decrease in supply is shown by the leftward shift of supply curve from SS to $S_{II}S_{II}$. Suppose the economy is at point 'a'. An increase in rent or wage rate increases the cost of production. This reduces the supply below the original position Q_1. The leftward shift of the supply curve shows that, at each level of price, the supply of the commodity is lesser than the original level.

A leftward shift of supply curve may be due to the increase in the input prices, availability of rudimentary technology which contributes to low productivity, higher price for complementary goods, lower price for substitutes, and higher price expectations for the future.

2.3.3 Determinants of Supply

The supply of a commodity is determined by many factors as we have seen. A change in these factors changes the supply of the commodity. Let us see the determinants.

- ***Price of the Commodity:*** The price of a commodity and its supply are positively related. An increase in the price of the commodity increases the supply and vice-versa. When the price of a commodity increases, a profit-maximising producer increases the production since the increase in production leads to an increase in revenue due to a rise in price. This profit-maximising tendency of a producer causes an increase in supply as a result of an increase in price.

- ***Input Prices:*** Input or factor prices form the major share of the cost of production. When the price of factors fall, the overall cost of production also falls. This makes the producer produce more of the commodity and leads to an increase in the supply. Therefore, an increase in input prices reduces the supply of commodities and a decrease in input prices increases the supply of commodities.

- ***Technology:*** Type of technology affects the supply of commodities. If the producer has the state-of-the-art technology/modern technology, then the productivity of other factors which are related such as labour increases. This increases the supply of the commodity. If the producer has only a rudimentary technology, then it cannot improve the productivity of factors. So, the production falls. Therefore, the availability of modern technology helps in increasing the supply and the shallow technology reduces the supply.

- ***Future Expectations of Price of the Commodity:*** The future rise and fall in the price of the commodity are inversely related to the supply of the commodity in the current period. If a producer expects a rise in the price of the commodity in future, then the producer will reduce the supply in the present period in order to increase the supply in the future period. Because, by increasing the production in future, the producer can increase the profit as price rises in the future. Now, if the producer expects a fall in price in the future, then he will increase the supply in the current period to reap the benefit in the current higher prices.

- ***substitutes and complementary goods:*** The supply of substitutes and complementary goods affects the supply of a good differently. If the supply of substitute goods increases, the supply of the original good falls since there is competition for resources among the substitute goods. In the case of complementary goods, the supply is directly related.

- ***Policies of the Government:*** Government policies such as taxation, subsidies etc. affect the supply of a commodity. In the case of taxation, an increase in tax increases the cost and thereby reduces the supply of the commodity and vice-versa. In the case of subsidy, increase in subsidy reduces the cost of production and increases the supply of the commodity.

- ***Transportation and communication:*** Better infrastructure associated with the production helps in increasing the supply of output.

These are some of the important determinants of supply. Now, let us discuss the elasticity of supply.

2.3.4 Elasticity of Supply

The elasticity of supply shows the responsiveness of supply in terms of changes in price. Unlike the elasticity of demand which is calculated both in response to price and income, the elasticity of supply is measured in terms of price alone.

This section discusses the price elasticity of supply, the point elasticity on the supply curve, the supply function and elasticity, elasticity along the linear and non-linear supply curve, and points out the determinants of elasticity of supply.

2.3.4.1 Price Elasticity of Supply

The price elasticity of supply measures the responsiveness of supply towards the changes in price. That is, the elasticity of supply measures the percentage change in quantity supplied of a good in response to the percentage change in the price of the good.

The elasticity of supply, $e_s = \Delta q / q \div \Delta p/p$……(1)

Rearranging the equation, $e_s = \Delta q / \Delta p \times p/q$……..(2)

The elasticity of supply can be measured more accurately by the midpoint method.

Then, the elasticity of supply, $e_s = \Delta q / \Delta p \times p_1+p_2 / q_1+q_2$……..(3)

Usually, the elasticity of supply is determined by the ease of expanding the output. The ease of expanding output is greater in the long-run than in the short-run. So, the elasticity of supply is more in the long-run than in the short-run.

Point Elasticity of Supply

The measurement of price elasticity at a particular point on the supply curve is called point elasticity. The point elasticity of supply can be explained with the help of a figure.

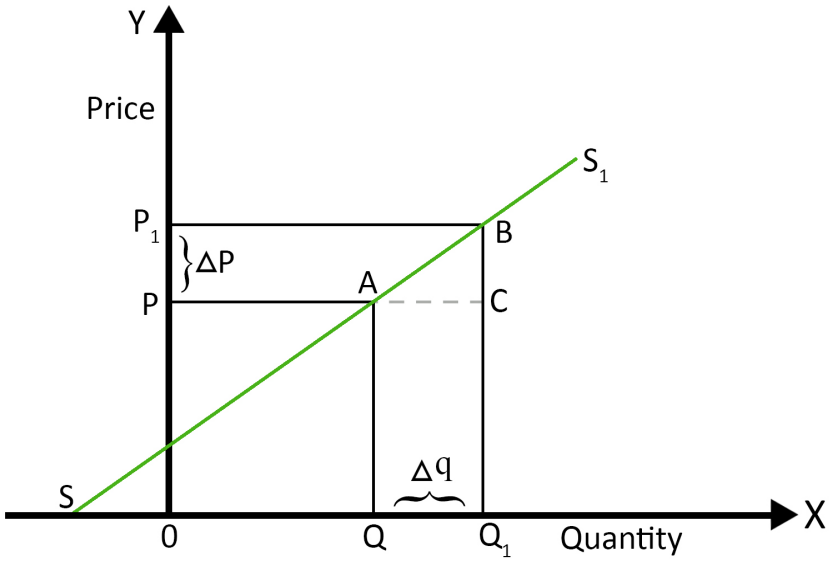


Fig 2.3.4 Point Elasticity on a Supply Curve

The supply curve is SS_1. Here, the supply curve is extended from the vertical axis to the X-axis at S. In order to measure the point elasticity at A, the price elasticity of the supply of A can be written as

$e_{S \text{ at } A} = \Delta q / \Delta p \times p / q$…….(1)

In Figure 5.2.4, the price, p is OP = QA and the quantity supplied, q is OQ. When the price increases from OP to OP_1, there will be a resulting increase in quantity supplied from OQ to OQ_1. Then, Δp is PP_1 and Δq is $Q\ Q_1$.

Therefore, the price elasticity of the supply of A can be written as

$e_{S \text{ at } A} = Q\ Q_1 / PP_1 \times QA / OQ$……(2)

In the Figure, $Q\ Q_1$ is equal to AC and PP_1 is equal to CB, substituting AC and CB for $Q\ Q_1$ and PP_1 respectively,

$e_{S \text{ at } A} = AC / CB \times QA / OQ$……(3)

Consider the triangles SQA and ACB. The two triangles are similar as the angle of ACB and SQA are right angles; the angle of BAC is equal to the angle of ASQ as they are corresponding angles; the angle of ABC and SAQ are also equal as they are corresponding angles.

So, AC / CB = SQ / QA……(4)

Substituting equation (4) in equation (3),

$e_{S \text{ at } A}$ = SQ / QA × QA / OQ……...(5)

$e_{S \text{ at } A}$ = SQ / OQ……(6)

Therefore, the elasticity of supply at point A is a ratio of SQ to OQ. In the figure, SQ is greater than OQ. Hence, SQ / OQ is greater than one.

2.3.4.2 Price Elasticity of Supply and Supply Function

This subsection explains the determination of price elasticity of supply from the supply function. Let us take the supply function to be:

$Q_S = c + dP$……..(1)

Here, Q_S is the quantity supplied of a commodity; 'c' is a constant; 'd' is the coefficient of supply showing the responsiveness of quantity supplied to the price of the commodity; P is the price of the commodity.

'd' is the responsiveness of quantity supplied to the price,

So, 'd' can be represented as,

d = ΔQ / ΔP……..(2)

The price elasticity of supply is

$e_s = \Delta Q / \Delta P \times P / Q$……(3)

Substituting equation (2) in equation (3), as d = ΔQ / ΔP

$e_s = d \times P / Q$……(4)

Let us consider a numerical example to show the relationship between price elasticity of supply and supply function.

The equation (1) gives the supply function as $Q_S = c + dP$

Numerical example for this supply function may be written as

$Q_S = 100 + 20P$……..(5)

Here, 100 represents the vertical constant, and 20 measures the slope of the supply function.

Suppose, the price of the commodity is rupees 25. Then, the quantity supplied will be

$Q_S = 100 + 20 \times 25$

$Q_S = 600$

Then, the elasticity of supply related to supply function, as given in equation (4) is

$e_s = d \times P / Q$

$e_s = 20 \times 25 / 600$

= .833

The price elasticity of supply shows that a one percent change in the price of the commodity changes the supply of the commodity by .833 percent.

Price Elasticity along the Linear Supply Curve

Price elasticity of supply along the linear supply curve may vary. We have already seen the supply function,

$Q_S = c + dP$…….....(1)

Here, d = ΔQ / ΔP……(2)

We know, the price elasticity of supply is

$e_s = \Delta Q / \Delta P \times P / Q$……...…(3)

d = ΔQ / ΔP is the reciprocal of the slope of the supply curve. Since the slope of the linear supply function is constant, the reciprocal, d = ΔQ / ΔP is also constant along the linear supply curve. So, under the price elasticity of supply, the first part ΔQ / ΔP is constant. Hence, the price elasticity of supply varies with the changes in the price-output ratio.

So, when the price-output ratio, P / Q increases along the linear supply curve, the price elasticity of supply increases. When P / Q falls along the linear supply curve, the price elasticity of supply falls. This can be explained using diagrams. Figure 2.3.5 shows the falling price elasticity of supply along the linear supply curve, and Figure 2.3.6 shows the rising price elasticity of supply along the linear supply curve.

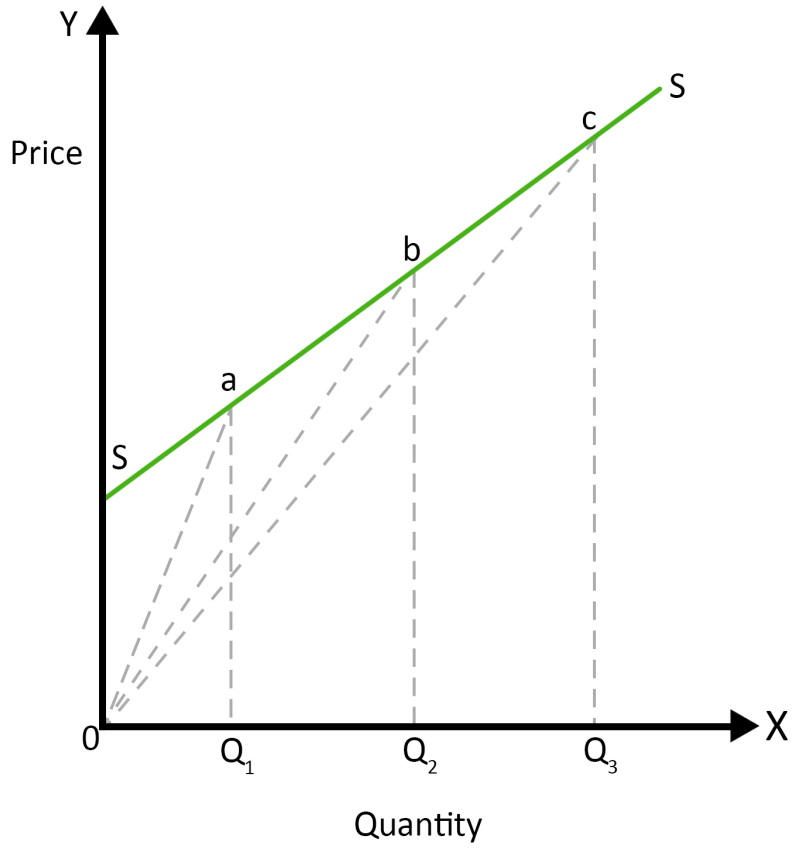


Fig 2.3.5 Falling Price Elasticity of Supply along the Supply Curve

In the figure, the linear supply curve has a vertical intercept. That is, the linear supply curve starts from the Y-axis. As we have mentioned above, since the first part of the price elasticity of supply, ΔQ / ΔP is constant, the elasticity varies with the price-output ratio, P / Q.

P / Q at each point on a, b, and c can be measured by calculating the slope of the rays drawn from the origin to that point. In Figure 2.3.5, the P / Q is falling while moving along the supply curve from 'a' to 'c'. Since P / Q falls along the supply curve, the price elasticity of supply also falls as ΔQ / ΔP is constant, but continues to be greater than one.

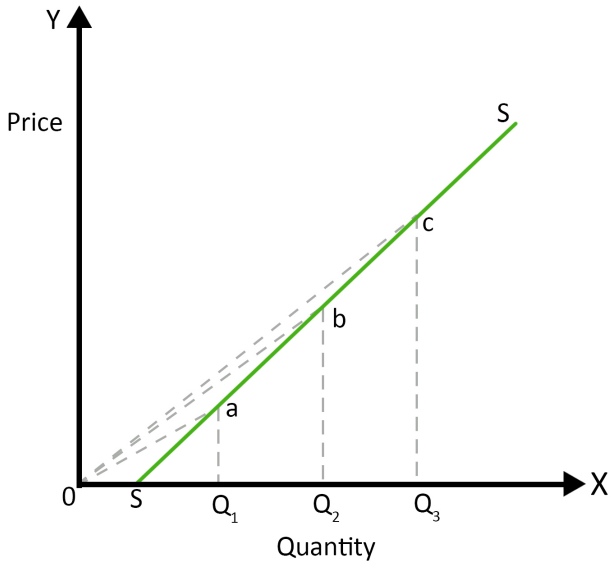


Fig 2.3.6 Rising Price Elasticity of Supply along the Supply Curve

In the figure, the linear supply curve has no vertical intercept. That is, the linear supply curve starts from the X-axis. Similar to Figure 2.3.5, the price elasticity of supply is measured on the basis of changes in P/Q, as ΔQ/ΔP the first part of the price elasticity of supply is constant.

As mentioned earlier, the P/Q at each point on a, b, and c can be measured by calculating the slope of the rays drawn from the origin to that point. In Figure 2.3.6, the P/Q is rising while moving along the supply curve from 'a' to 'c'. Since P/Q increases along the supply curve, the price elasticity of supply also increases, but continues to be less than one.

We have discussed the price elasticity of supply for linear supply curves which starts from Y-axis and X-axis. For the linear supply curve which starts from the Y-axis, the price elasticity of supply falls along the curve, and for the linear supply curve that starts from X-axis, the price elasticity of supply increases along the curve. So, when the linear supply curve starts from the origin, the P/Q will be constant and thus the price elasticity of supply equals to unity.

It is important to note that there are two special cases while measuring the price elasticity of supply. They are:

- When the linear supply curve is horizontal to the X-axis, the supply curve only has a vertical intercept. So, under P/Q, there is no value for quantity. With quantity equal to zero, P/Q becomes infinitive. So, the price elasticity of supply is also infinitive when the linear supply curve is horizontal to X-axis.

- When the linear supply curve is vertical to X-axis, the supply curve only has a horizontal intercept. So, under P/Q, there is no value for the price. With price equals to zero, P/Q also becomes zero. So, the price elasticity of supply is zero when the linear supply curve is vertical to X-axis.

Price Elasticity along Non- Linear Supply Curve

Non- linear supply curves are not straight lines. The Figure 2.3.7 shows a typical non-linear supply curve.

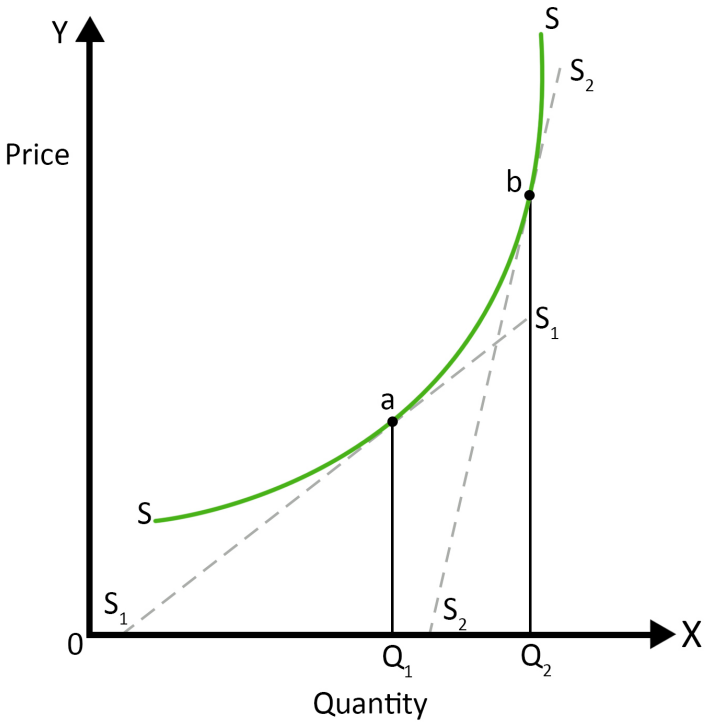


Fig 2.3.7 Price Elasticity of Supply for a Non-Linear Supply Curve

Figure 2.3.7 shows a non-linear supply curve. The elasticity of supply can be determined using the methods of point elasticity of supply. So, at 'a', the point elasticity is S_1Q_1 / O Q_1, and at 'b', the point elasticity is S_2Q_2 / O Q_2.

From the figure, it is clear that S_2Q_2 / O Q_2 is less than the S_1Q_1 / O Q_1. Therefore, along a non-linear supply curve, the price elasticity of supply is varying.

Determinants of Elasticity of Supply

One of the major factors determining the price of the commodity is the price elasticity of supply. The price elasticity of supply is determined by many factors. Major factors determining the elasticity of supply are given below:

(a) Availability of Inputs

The availability of inputs is very important in determining the supply of a commodity. The extent of expansion of production is directly related to the extent of availability of inputs. If inputs are easily available, production will be hiked to a greater extent. Then, the elasticity of supply will be higher.

Consider the example of rice production. If the Government increases subsidies for high yielding varieties of seeds, and fertilisers, the input availability will increase and the price of the inputs falls. This increases production leading to the high elasticity of supply. Suppose, the subsidy is reduced by the Government, then the cropping pattern shifts from rice cultivation to other crops. Therefore, the higher the availability of inputs, the more elastic is the supply, and the lower the availability of inputs, the less elastic is the supply.

(b) Marginal Cost of Production

The elasticity of supply represents the change in output. A higher elasticity of supply refers to easiness in increasing

the output without generating much additional cost of production. If unit cost or marginal cost of production increases with an increase in the production, the supply would be less corresponding to the marginal cost. So, the elasticity of supply would be less. The elasticity of supply would be lesser in the short-run than in the long-run. The reason is that, in the short-run, only some factors are variable. When the stock of factors increases as a result of the increase in production, the factors experience diminishing returns. This results in an increase in the marginal cost of production. Therefore, supply is less elastic in the short-run. However, in the long-run, all the factors are variable. The supply of the commodity can thus change. Also, the entry of new firms adds to the supply. Hence, the long-run supply curve is more elastic than the short-run supply. This difference is brought out by the difference in the marginal cost of production.

(c) Availability of Substitutes

Availability of substitutes and elasticity of supply are directly related. When more substitutes are available, small changes in the price create greater changes in the supply of the commodity. Hence, with a large number of substitutes, the elasticity of supply is higher and vice-versa.

(d) Time factor

Time period and elasticity are linked in such a way that the greater the time available for producers, the greater will be the supply. More time leads to more entry of firms . It also creates different kinds of substitute goods. All these factors lead to more elastic supply when the length of time available is greater.

Recap

- Expansion of supply - increase in quantity supplied due to increase in price under 'ceteris paribus'
- Contraction of supply - decrease in quantity supplied due to fall in price under 'ceteris paribus'
- Expansion and contraction of supply take place along supply curve
- Expansion of supply- upward movement along supply curve
- Shift in supply- increase or decrease in supply when factors other than price change
- Increase in supply - rightward shift of supply curve
- Decrease in supply - leftward shift of supply curve
- Price elasticity of supply- responsiveness of supply to changes in price

- Point elasticity measures price elasticity at a particular point on supply curve
- Price elasticity along linear supply curve falls if supply curve starts from Y-axis
- Price elasticity along linear supply curve rises if supply curve starts from X-axis
- For the horizontal supply curve, price elasticity is infinitive
- For the vertical supply curve, price elasticity is zero
- Availability of inputs, marginal cost of production, and duration of time available determine elasticity of supply

Objective Questions

1. Define contraction of supply.
2. How does the contraction of supply represented graphically?
3. What is expansion of supply?
4. How does the expansion of supply represented graphically?
5. What is a shift in supply?
6. How is the shift in supply represented graphically?
7. What is price elasticity of supply?
8. Give a mathematical representation of the price elasticity of supply.
9. Differentiate the elasticity of supply along the linear and non-linear supply curve.
10. What is the price elasticity of supply when the supply curve is horizontal to the X-axis?
11. What is the price elasticity of supply when the supply curve is vertical to the X-axis?
12. Name two factors determining elasticity of supply.

Answers

1. Contraction of supply refers to a decrease in the quantity supplied of the commodity due to fall in the price of the commodity under ceteris paribus condition.
2. Contraction of supply is shown by the downward movement along the supply curve.
3. Expansion of supply refers to an increase in the quantity supplied of the commodity due to the increase in the price of the commodity under ceteris paribus condition.
4. Expansion of supply is represented along the upward movement of the supply curve.
5. Shift in supply refers to an increase or decrease in supply when factors other than the price of the commodity changes.
6. Shift in supply is shown by the rightward or leftward shift of the supply curve.
7. Elasticity of supply refers to responsiveness of supply in terms of the changes in the price.
8. $E_s = \Delta Q / \Delta P \times P / Q$
9. Along the linear supply curve, the price elasticity falls if the supply curve starts from Y-axis and rises if the supply curve starts from the X-axis. For a non-linear supply curve, the elasticity is varying.
10. Infinity
11. Zero
12. Marginal cost of production and availability of inputs

Assignments

1. Distinguish between expansion and contraction of supply using a diagram.
2. Explain the shift in supply.
3. Elucidate on the determinants of supply.
4. Describe price elasticity of supply.
5. How does the point elasticity of supply is determined?
6. Elucidate the determination of price elasticity of supply from supply function.
7. Explain the determination of price elasticity of supply along linear and non-linear supply curves.

Suggested Readings

1. Nicholson Walter and Christopher Synder (2019), *Microeconomic Theory-Basic Principles and Extensions*, Cengage Learning.

2. Pindyck, R.S., Rubinfeld, D.L., & Mehta, P. L. (2017). *Microeconomics* (Eighth edition). Pearson Education Prentice Hall.

3. Samuelson, P.A., & W. D. Nordhaus (special edition 2020). *Economics*. New Delhi: Tata McGraw Hill.

References

1. Dwivedi, D.N. (2012). *Microeconomics: Theory and Applications* (Second Edition). Vikas Publishing House Pvt. Ltd.

2. Koutsoyiannis, A. (1990), *Modern Microeconomics* (Second Edition), Macmillan Education.

3. Salvatore, D. (2003), *Microeconomics -Theory and Applications* (Fourth Edition), Oxford University Press.

Utility Analysis

UNIT

Utility Analysis

Learning Outcomes

After learning this unit, the learner will be able to:

- familiarise with the concept of utility
- narrate the consumer equilibrium under cardinal utility approach
- explain the derivation of demand curve from the marginal utility curve

Prerequisites

In this block, we deal with the concept called 'problem of choice', i.e., how a rational consumer would consume combinations of goods that will maximise the utility (satisfaction) of the consumer when the prices and consumer income are given. Imagine that you are in a supermarket. You have 100 rupees with you and have to buy two commodities, milk and bread. You can buy any combination of these two goods with 100 rupees so that your satisfaction level is maximum. How much milk and bread will you buy? This is the concept of the problem of choice. In the later sections, we will see the concepts of utility and the different approaches of consumer utility analysis and also how a change in the price of the goods or the consumer's income will alter the choice or the purchase decision of the consumer.

Keywords

Utility, Cardinal utility approach, Law of diminishing marginal utility, Equi-marginal utility

3.1.1 Utility Analysis

We buy goods and services as they will be useful to us or beneficial in some way or other. From the consumption of these goods and services, we would be having some satisfaction. Suppose if you are hungry and you buy a sandwich and eat it, the sandwich satisfies you to some extent. Utility refers to the satisfaction derived from the consumption of a good or a service. The term was first introduced in the 18th century by the Swiss mathematician Daniel Bernoulli. It was later introduced to social science by Jeremy Bentham and into economic thoughts by William Stanley Jevons in his book 'Theory of Political Economy' in the year 1871. Simply, utility is the want satisfying capacity of a commodity. It is a subjective concept since different individuals have different utilities for the same good. For example, the utility derived from an air conditioner for a person in a tropical region need not to be necessarily similar to a person living at a hill station. The utility from toys might differ with age groups.

The three main approaches of utility analysis are:

1. Cardinal Approach or Cardinal Utility Approach
2. Ordinal Approach or Ordinal Utility approach (Introspective)
3. Revealed Preference theory or ordinal utility approach (Behaviourist)

The present unit deals with the utility analysis under the cardinal approach. Let us discuss the cardinal utility analysis in detail.

3.1.1.1 Cardinal Utility Analysis or Marshall's Utility Approach

Cardinal approach is considered to be the oldest method of utility analysis. This approach assumes utility as quantifiable and could be measured in terms of numbers and is an important concept in neo classical economics. The main proponents of cardinal analysis are William Stanley Jevons, Léon Walras, and Alfred Marshall. Alfred Marshall introduced the concept of cardinal analysis into consumer equilibrium, hence also known as 'Marshallian Cardinal Utility Analysis'.

Assumptions of Cardinal Utility Analysis

The following are the assumptions of cardinal utility analysis.

1. **Rationality:** Consumers are rational and they aim at maximising their utility subject to their income constraints.
2. **Cardinally Measurable Utility:** The utility of commodities can be measured in cardinal numbers like 1, 2, 3 etc. This ultimately shows us the preference of consumers for different commodities. 'Utils' (an imaginary unit of measure) is used to quantify the utility in the cardinal approach.
3. **Marginal Utility of Money is Constant:** Even though the marginal utility of goods and services are considered to be diminishing with additional units consumed, the marginal utility of

money is assumed to be constant in cardinal utility approach. Alfred Marshall measured the marginal utility of commodities in terms of money. This is only possible when the marginal utility of money is assumed to be constant.

4. **Independent and Additive Utilities:** The utility of a consumer by purchasing a good does not depend on the quantities of other goods consumed but is strictly based on that good only. Thus utility is additive ie., the independent utilities of all the commodities purchased by a consumer could be added to obtain the total utility.

5. **Introspective Method:**

   "Introspection is the ability of the observer to reconstruct events which goes on in the mind of another person with the help of self-observation. This form of comprehension may be just guesswork or intuition or the result of long-lasting experience." Here, the economist by analysing her/his feelings and judgements on a particular problem or situation assumes that others would act similarly and comes to a generalization.

Measures of Utility

According to the cardinal approach, utility is a measurable concept and is measured in terms of total utility and marginal utility.

Total Utility: For a fixed quantity of a commodity, the total utility is the sum of all the individual utilities.

TU = U_1+U_2+U_3+……. U_n, here U_1, U_2, U_3 are the utilities for one, two and three units of the commodity respectively and Un is the individual utility from the consumption of the n^{th} unit if there are 'n' units of a commodity. The sum of these independent utilities is the total utility.

For example, if a consumer consumes three units of a commodity, her/his total utility will be,

$TU=U_1+U_2+U_3$

Marginal Utility: Marginal utility is an important measure used in the quantification of utility. It is the change in utility when an additional unit of the commodity is consumed. Thus, it is the utility derived from the last unit consumed.

For example, if the total utility derived from the consumption of 3 cookies is 15 and the consumption of an additional cookie changes the total utility to 20. The marginal utility,

$$MU = \frac{\Delta TU}{\Delta Q}$$

Here, ΔTU is the change in total utility and ΔQ is the additional consumption by one unit.

$\therefore MU=TU_4 - TU_3$

20-15=5

In general, we can say that, $MU= TU_n - TU_{(n-1)}$, where TU_n is the total utility from consuming 'n' units and $TU_{(n-1)}$ is the total utility of n-1 units of the good consumed.

Also, $TU_n = MU_1+ MU_2+ MU_3+$ ……+ MU_n.

i.e., TU= ∑MU

Table 3.1.1: Total and Marginal Utility

Units	Total Utility	Marginal Utility
0	0	-
1	10	10
2	16	6
3	20	4
4	22	2
5	22	0
6	20	-2

Here $TU_6 = MU_1 + MU_2 + MU_3 + MU_4 + MU_5 + MU_6 = 20$

3.1.1.2 Law of Diminishing Marginal Utility

If you drink a glass of water when you are thirsty, you get immense satisfaction. Now when you drink one more glass of water, you won't get the satisfaction the earlier glass had given. Suppose you have one more glass, your satisfaction from the third glass will be lesser than the second glass of water. If you drink more and more glasses of water, you will reach a situation where you could not drink anymore. This is the saturation or satiation point. After this point, your total utility starts declining and marginal utility becomes negative. This is the concept of diminishing marginal utility.

According to Alfred Marshall, the law of diminishing marginal utility is "The additional benefit which a person derives from a given increase of his stock of a thing diminishes with every increase in the stock that he already has." In other words, when a person consumes more of a commodity, the additional utility she/he derives from each successive unit goes on diminishing.

In table 3.1.1, we can see that when 1 unit was consumed the marginal utility was 10. When one more unit was consumed, the additional utility got reduced to 6.

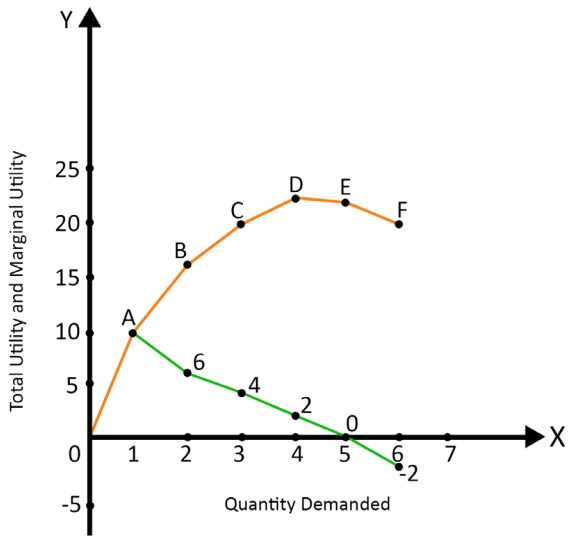


Fig 3.1.1 Graphical illustration of Table 3.1.1-Total and Marginal Utility Curves

Fig 3.1.1 is a graphical illustration of Table 3.1.1. Here the X-axis represents the quantity of the commodity consumed and Y-axis represents both the total utility and marginal utility which the consumer derives from the consumption of that good. Plotting the points on the graph gives us the total utility which is increasing but at a decreasing rate which reaches a maximum point and then declines. Whereas the marginal utility curve declines to reach zero and then becomes negative.

Now let us look into a general graph depicting total utility and marginal utility

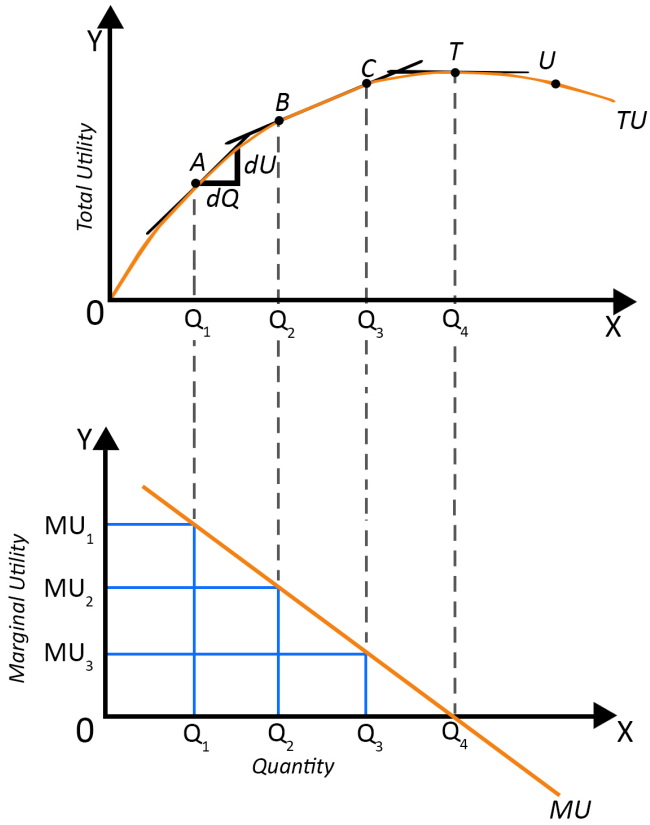


Fig 3.1.2 General graph: Total utility and marginal utility

In the figure 3.1.2, the total utility goes on increasing at a decreasing rate till the Q_4 quantity of the commodity is consumed and this quantity Q_4 is known as the satiation quantity and at point E on the total utility curve, the total utility will be maximum (maximum satisfaction) and is known as point of satiation. Here, the marginal utility will be 0. After this point, the total utility starts declining but remains positive. Correspondingly the marginal utility which is positive at the initial stage declines, reaches zero and then becomes negative. Also, from the graph, we can notice that marginal utility is the slope of total utility. Slope is a ratio of vertical distance between two points to the horizontal distance between the same two points. In the figure dU/dQ represents the slope.

Relation Between Total Utility and Marginal Utility

Marginal utility diminishes when more of a commodity is consumed and it may become zero or negative. Now let us see how marginal utility and total utility are related to one another by analyzing the above figure.

- As long as MU is positive, TU increases but at a diminishing rate.
- TU reaches maximum or reaches the satiation point, when MU becomes zero.
- TU starts declining, when MU becomes negative and this is known as an area of dissatisfaction.

3.1.1.3 Consumer Equilibrium

It is the state at which a consumer with given income maximizes her/his utility for one or more commodities / services. As it is the point of maximum satisfaction, it is a state of rest and the consumer will not have a tendency to move from this position.

Consumer Equilibrium in Cardinal Utility Approach

Now that we have seen total utility and marginal utility, we shall examine how a consumer attains equilibrium in cardinal utility approach. The general rule is that a consumer is always in equilibrium at a point where his total utility is maximized.

Consumer Equilibrium with Single Commodity

Consider that a consumer is having a fixed income and it is spent on a single commodity 'X'. Here the consumer has got two options either to spend his income on the consumption of 'X' or to retain all his money income by not consuming 'X' at all.

In the cardinal utility analysis, we assume the marginal utility of money to be constant ($MU_m = 1$) and the marginal utility of the commodity (MU_X) to be diminishing. If the customer does not purchase commodity X at all, the marginal utility of money will be lesser than that of the marginal utility derived from 'X'. In this situation, being rational, the consumer can increase his total utility by exchanging his money income for commodity X. This could only be done when $MU_X > MU_m$ and when the marginal utilities from both money income and the commodity become equal, the consumer attains equilibrium i.e., $MU_X = MU_{m..}$ Generally when prices of commodities are greater than 1, gives the consumer equilibrium as $MU_X = P_X (MU_m)$. Here since the marginal utility of money is assumed to be 1, $MU_X = P_X$. The single commodity consumer equilibrium is shown in Figure 3.1.3.

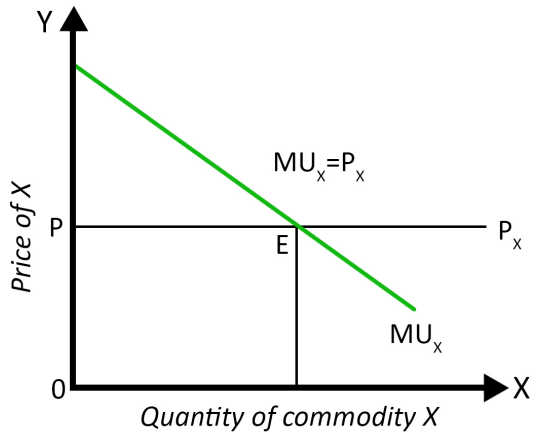


Fig 3.1.3 Single commodity consumer equilibrium

In figure 3.1.3, the quantity of the commodity X consumed is shown in the X-axis and the price of X is depicted in Y-axis. The consumer attains equilibrium at point E where the marginal utility from X is equal to the price of X. i.e., $MU_X = P_X$.

Also, the consumer can increase his total utility by purchasing more of X, if $MU_X > P_X$. On the other hand, a consumer will increase his total utility by reducing the consumption of X, if $MU_X < P_X$.

3.1.1.4 Law of Equi-Marginal Utility

As mentioned earlier, people buy different goods allocating their money income. In this process, one commodity may provide higher utility than other. In order to understand the consumer equilibrium of a utility maximizing consumer, one has to know the concept of equi-marginal utility. The Equi-marginal utility also known as law of substitution/ law of maximum satisfaction/ Gossen's second law. Gossen's second law states that the consumer will distribute his money income in such a way that the utility derived from the last rupee spent on each good is equal.

Consider a rational consumer consuming two commodities X and Y for P_x and P_Y prices respectively.

MUx = Px(MUm), MUy = Py(MUm)

MUx = Px(MUm) i.e. $\frac{MUx}{Px(MUm)} = 1$ ..... (1)

similarly, MUy = Py(MUm) i.e. $\frac{MUy}{Py(MUm)} = 1$ ..... (2)

equating (1) and (2)

$$\frac{MUx}{Px(MUm)} = \frac{MUy}{Py(MUm)} = 1$$

$$\frac{MUx}{Px} = \frac{MUy}{Py}, \text{ or } \frac{MUx}{MUy} = \frac{Px}{Py}$$

Here, $\frac{MUx}{Px}$ shows the MU purchasable for the additional unit of money (Rupees) spent on X. Suppose P_x is Rs.10 and the MU of the last unit of X consumed is 30. Then, 30/10 = 3. i.e., 3 units could be additionally bought by spending an additional amount on commodity X. Likewise, $\frac{MUy}{Py}$ is the MU purchasable for an additional amount of commodity Y. The principle of equi-marginal utility says that the consumer is at equilibrium when the ratios $\frac{MUx}{Px}$ and $\frac{MUy}{Py}$ are equal. This could be presented as $\frac{MUx}{Px} = \frac{MUy}{Py}$ or $\frac{MUx}{MUy} = \frac{Px}{Py}$

Thus, we can conclude that a consumer consuming more than one good with fixed money income would have maximum utility and would be at equilibrium when

$$\frac{MUx}{Px} = \frac{MUy}{Py} = \frac{MUz}{Pz} = \ldots\ldots = \frac{MUn}{Pn}$$

3.1.1.5 Derivation of Demand Curve in Cardinal Utility Theory

The derivation of the consumer demand curve is done using the consumer equilibrium with a single commodity approach.

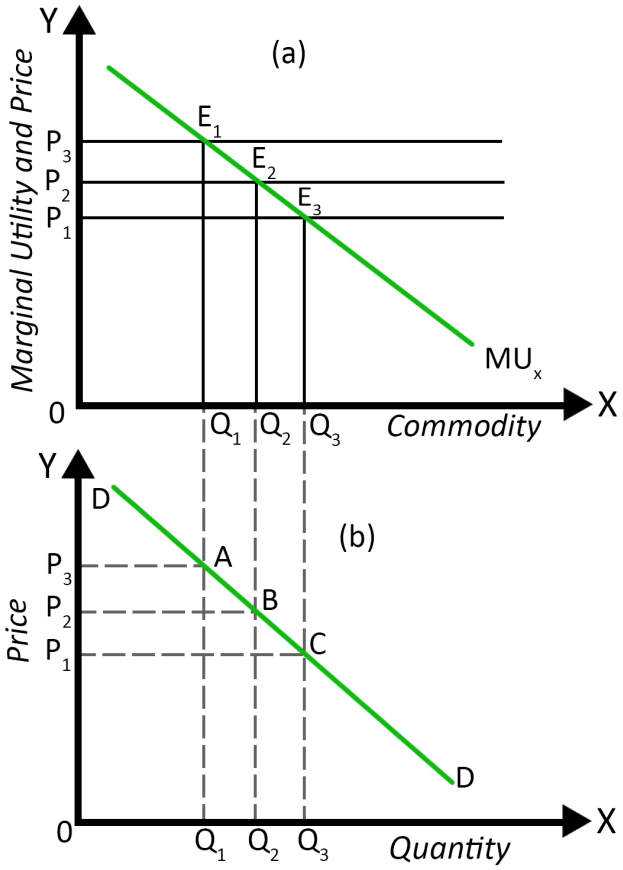


Fig 3.1.4 Derivation of demand curve in cardinal utility approach

The panel (a) of Figure 3.1.4 shows the consumer's equilibrium for a single commodity which we have discussed earlier.

We have seen that the consumer in a cardinal utility approach attains equilibrium when $MU_x = P_x$. This is the basis for consumer's demand curve derivation for commodity X.

The X- axis of panel (a) in the figure 3.1.4 represents the quantities of commodity X consumed and Y- axis represents the Marginal utility derived by the consumer and the price of the commodity. If the consumer's initial equilibrium is at E_1 where the price of the commodity X is P_3 and consumes OQ_1 units of X. So, at E_1, $MU_x = P_3$. Now, if the price of X gets reduced to P_2, the equilibrium point will shift to E_2 where OQ_2 units of X are consumed by the consumer. Similarly, another fall in price of X to P_1 will bring her/his to the equilibrium point E_3 and consumes OQ_3 units of X. Like this with more fall in the price of commodity X, the consumer consumes more quantities of the commodity in order to maximize her/ his satisfaction.

The X- axis of the panel (b) represents the quantity of X consumed and Y- axis represents the price of the commodity X. Panel (b) shows the price and the quantity combinations of the commodity at different equilibrium points. Here, the points A, B and C are the price- quantity combinations corresponding to the equilibrium positions E_1, E_2 and E_3 respectively. By joining these plotted points, we can derive the consumer's demand curve DD for the commodity X.

3.1.1.6 Limitations of Cardinal Utility Approach

1. ***Unrealistic Assumptions:***

   Marshall's approach contains certain unrealistic assumptions, firstly the assumption of measurement of utility with cardinal numbers has been widely criticised. Utility being subjective cannot be quantified. Hence the measurement in utils is also a subject of criticism.

2. ***Constancy of Money:*** Another major drawback of the approach is the assumption of constancy of marginal utility of money. The Marginal utility of money like any other good is subject to changes with the change in the money stock. So, using the marginal utility of money as the measure of utility of other goods is a limitation of this model.

3. ***Ignored Income Effect:*** Marshall failed to distinguish between the income effect and substitution effect. He assumed the marginal utility of money to be constant and the analysis was under ceteris paribus, thus ignoring the income effect. The income effect in demand analysis shows a change in demand caused by the change in real income consequent to a change in price, making the demand curve to be always downward sloping. This made it impossible to explain the exceptions of law of demand like the Giffen paradox.

4. ***Introspection:*** Cardinal utility analysis is based on introspection and generalization which need not always be true. Also, introspection is not a scientific method of analysis.

Recap

- Utility introduced in 18th century by Swiss mathematician Daniel Bernoulli
- Three main approaches of utility analysis-cardinal, ordinal, Revealed Preference
- Cardinal utility approach - utility is quantifiable
- Law of Diminishing Marginal Utility- Alfred Marshall
- Measures of utility- Total utility and marginal utility
- Total utility is the sum of all the individual utilities
- Marginal utility - utility received from the last unit of a commodity consumed
- Consumer equilibrium for a single commodity happens when MUx=Px

- Law of equi-marginal utility equilibrium condition - $\frac{MUx}{Px} = \frac{MUy}{Py} = \frac{MUz}{Pz} = ... = \frac{MUn}{Pn}$
- Demand curve can be derived from cardinal utility theory

Objective Questions

1. Who is the chief exponent of the Cardinal utility approach?
2. When the marginal utility is equal to zero, what will the total utility be?
3. What happens to the Total Utility curve when the Marginal Utility curve is positive?
4. What is the formula for marginal utility?
5. In the case of a single commodity, a consumer attains equilibrium at?
6. When will a consumer start to buy less of commodity X and more of commodity Y?
7. What is the equilibrium condition under law of equi-marginal utility?
8. What is the additional utility that is derived from the consumption of an additional unit of a commodity is known as?
9. What is total utility?
10. What will be the marginal utility of a commodity at the satiation point?
11. What does Marshallian cardinal utility analysis assume interms of MUm?

Answers

1. Alfred Marshall
2. Maximum
3. It increases
4. $TU_n - TU_{n-1}$
5. MUx= Px
6. MUx/Px < MUy/Py
7. $\frac{MUx}{Px} = \frac{MUy}{Py} = \frac{MUz}{Pz} = ... = \frac{MUn}{Pn}$
8. Marginal Utility
9. Sum total of marginal utilities
10. Zero
11. The marginal utility of money as constant

Assignments

1. Examine cardinal utility approach. State its assumptions.
2. Explain diagrammatically the law of diminishing Marginal utility?
3. How is a demand curve for a commodity derived in cardinal utility analysis?
4. Explain the law of equi-marginal utility? How does a consumer reach equilibrium in the Cardinal Utility Approach?

Suggested Readings

1. Hal R Varian(2010) *Intermediate Microeconomics: A Modern Approach*, 8th Edition, W.W Norton and Company/ Affiliated east - West Press (India).
2. Salvatore, D. (2003) *Microeconomics Theory and Applications* (Fourth Edition), Oxford University Press.
3. Nicholson Walter and Christopher Synder (2019), *Microeconomic Theory-Basic Principles and Extensions*, Cengage Learning.

References

1. Dwivedi, D.N. (2012). *Microeconomics: Theory and Applications* (Second Edition). Vikas Publishing House Pvt. Ltd.
2. Maddala, G.S. & Miller Ellen (2013). *Microeconomics Theory and Applications,* (Tenth Edition). McGraw Hill Education Private Limited.
3. Mankiw, N. G. (2016). *Principles of microeconomics* (8th ed.). CENGAGE Learning Custom Publishing.
4. Pindyck, R. S., Rubinfeld, D.L., & Mehta, P.L. (2013). *Microeconomics* (Seventh edition). Pearson Education Prentice Hall.

UNIT 2

Indifference Curve Analysis

Learning Outcomes

After reading this unit, the learner will be able to:

- familiarise with the ordinal utility approach
- be aware of indifference curves and its properties
- explain the concept of the budget line
- explain the consumer equilibrium under indifference curve approach

Prerequisites

Consumption of goods and services gives us satisfaction. However, the consumption of different goods gives different levels of satisfaction. Suppose, your parents have brought different varieties of fruits from the market. Do you like apples and oranges with the same intensity? Or do you prefer mango or bananas to apples? Some people like all types of fruits. But, the intensity of likeness will be different for different fruits. Because, they get different utility from different goods. For example, among the different types of fruits, a person likes mango the most. The second fruit she/he likes is orange. Thirdly, the person prefers apples.

So, people have different intensities of likeness towards different goods. This different intensity in liking goods allows people to rank the goods or order the goods. This is an important concept in utility analysis which we are going to discuss in this unit.

Keywords

Ordinal utility, Transitivity, Consistency, Indifference curve, Marginal rate of substitution, Budget line

3.2.1 Ordinal Utility Analysis or the Indifference Curve Analysis

The ordinal utility analysis was introduced by the economists J.R Hicks and R.G.D Allen in 1934 as a criticism to Marshall's cardinal utility approach. Later, Hicks modified indifference curve theory in his book 'Value and Capital' in 1939. They were of the opinion that utility is not quantifiable rather it could be measured using preferences, rank and order.

Assumptions of Ordinal Utility Theory

1. ***Completeness:*** A consumer can compare and give ranks. Consumer's choice is complete in the sense she/he can prefer A to B, B to A or can be indifferent between the two.

2. ***Rationality***: A consumer will always choose the combination of goods which will maximize his utility subject to the budget constraint.

3. ***Utility is Ordinal:*** Unlike the cardinal approach, the utility cannot be quantified in cardinal numbers. This is a qualitative approach where utility is ranked.

4. ***Non-Satiety:*** Consumer prefers more of each good as she/he has not attained a saturation level of his consumption. A consumer will always prefer more of a commodity to less (Monotonic), for this she/he always tries to move to a higher indifference curve.

5. ***Consistency:*** A consumer will always stick to her/his choice. i.e, if a consumer prefers A to B at one point of time, she/he will not consider B to A at another point of time.

6. ***Transitivity***: Ordinal utility approach assumes consumers' preference to be transitive. By transitive, it means if she/he prefers apples over oranges and the same consumer prefers oranges to bananas, then according to the transitivity assumption, she/he will obviously prefer apples to bananas.

If, apples > oranges

And oranges> banana

Then, apples > bananas.

Consumer Rationality and Preference

In economics, we usually consider a consumer as rational. She/he would always make rational decisions in order to maximise utility or welfare. They are termed as 'Homo economicus'. However, modern branches of economics like behavioural economics do not agree with this, for example, people do not always limit themselves to the budget constraint and often end up in debts. But here we simply assume that the consumer rationally prefers his commodity basket to maximize his satisfaction. Remember that the preference of the consumer will be complete, transitive, and monotonic.

Concept of locus

"A locus is a curve or other figure formed by all the points satisfying a particular equation of the relation between coordinates, or by a point, line or surface moving according to mathematically defined conditions". In short, a locus is a group or set of points which shares a property which results in a curve or a surface.

3.2.1.1 Indifference Curve (IC)

An indifference curve is the locus of points of different combinations of two goods which gives the same level of satisfaction to the consumer. For more understanding, let us examine it with the help of a table.

Table 3.2.1 Combination of Consumption

Combinations	Pizza	Apple
C_1	1	12
C_2	2	6
C_3	3	4
C_4	4	3

Let us consider that consumer A is consuming two goods, pizza and apple with his fixed money income. If A consumes 1 pizza, she/he can have 12 apples subject to her/his budget constraint. Now if A wants one more pizza, she/he should reduce her/his apple consumption to 6. Similarly, for 3 pizzas he could consume only 4 apples and so on. The point to be noted is that all these combinations of pizza and apple will give 'A' the same level of satisfaction.

In the Figure 3.2.1 commodity basket C_1 has one pizza and 12 apples whereas C_2 has 2 pizzas but only 6 apples. Combination C_3 has 3 pizzas and 4 apples and C_4 combination contains 4 pizzas and 3 apples. As we have mentioned earlier, inorder to get more pizza, the consumer has to give up more apples. But the utility that the consumer gains from all these combinations remains the same. Since all the combinations C_1, C_2, C_3, and C_4 in the table 3.2.1 gives the same amount of satisfaction to the consumer and an indifference curve connects all these points, it is also known as iso-utility curve or equal utility curve.

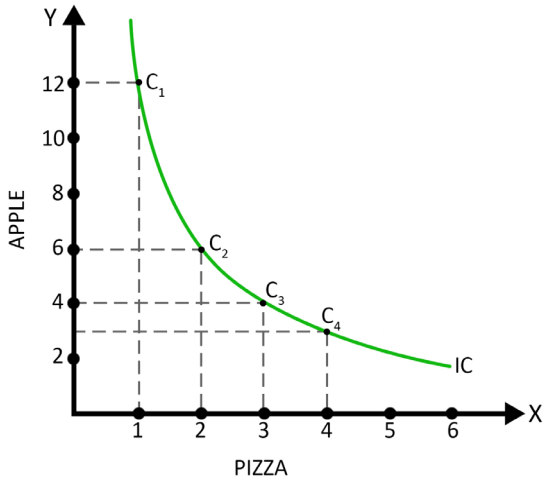


Fig 3.2.1 Indifference curve (well behaved)

Here in the figure 3.2.1 the indifference curve, IC is the locus of points of different combinations (C_1, C_2, C_3, and C_4) of two goods (pizza and apple) which give the same level of satisfaction to the consumer.

3.2.1.2 Indifference Map

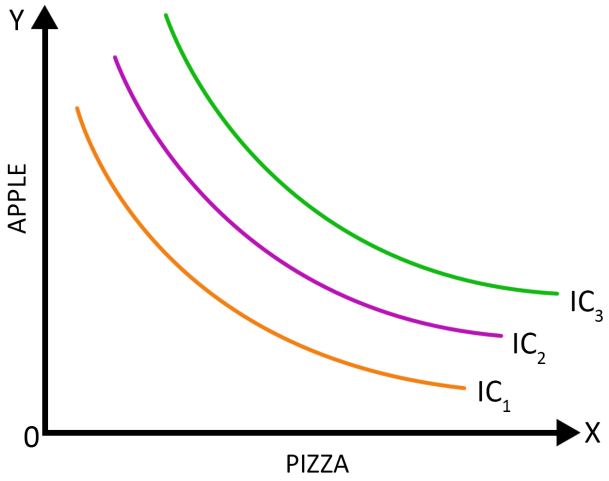


Fig 3.2.2 Indifference map

An indifference map is a graphical representation of a group of indifference curves. Any indifference curve to the right or above another depicts a higher level of satisfaction than the one lying below. Here in the figure 3.2.2 , the utility derived from consuming a combination of pizza and apple from IC_3 will provide more satisfaction to the consumer than IC_2. In a similar manner, satisfaction from IC_2 will be greater than IC_1.

An indifference curve conveys the following details

1. All the points on an indifference curve will give the same level of satisfaction to the consumer.

2. An indifference curve represents a particular level of satisfaction. Higher indifference curve represents higher levels of satisfaction than the lower ones.

3. A rational consumer always prefers higher IC than the lower as it offers her/him a higher level of satisfaction. This is known as monotonic preference (more is preferred to less).

Concept of Slope

Slope, also known as gradient, is a numerical value which gives us an insight of the direction and steepness of the line. The slope of a line could be estimated by finding out the ratio of vertical change to the horizontal change between two points.

Mathematically, the slope of a line is expressed as $m = \frac{Y2-Y1}{X2-X1} = \frac{\Delta Y}{\Delta X}$

3.2.1.3 Marginal Rate of Substitution

The rate at which a consumer would sacrifice or give up one good to obtain more of another good without having a change in the utility level is known as marginal rate of substitution.

$$MRS = \frac{Quantity\ Of\ Goods\ Sacrificed}{Quantity\ Of\ Goods\ Obtained}$$

It can be mathematically shown as

$MRSxy = \frac{-\Delta y}{\Delta x}$ Similarly $MRSyx = \frac{-\Delta x}{\Delta y}$

Marginal rate of substitution is the slope of the indifference curve. The concept of marginal utility is implicit in the definition of MRS.

Fig 3.2.3 Diminishing marginal rate of substitution

In the figure 3.2.3, the X-axis represents the quantity of good X consumed and Y-axis represents the quantity of good Y consumed. Suppose the consumer was consuming the combination 'a' with Y_4 level of good Y, then his consumption of X should be at X_1 level. Now if she/he wants to increase the consumption of X from X_1 to X_2, she/he has to reduce his consumption of Y from Y_4 to Y_3 and move to point b. This concept of rate of change of Y with the increase in X is known as marginal rate of substitution.

From the figure, it is clear that the amount of Y that should be given up in order to increase the consumption of X decreases when the consumption of X increases. We can say that the reduction in consumption of Y is at a diminishing rate which leads the indifference curve to have a negative slope. This is the concept of diminishing marginal rate of substitution.

Relation between Marginal Rate of Substitution and Marginal utility

We have already seen that the $MU = \frac{\Delta TU}{\Delta Q}$ · $\therefore MUx = \frac{\Delta U}{\Delta X}$ and $MUy = \frac{\Delta U}{\Delta Y}$

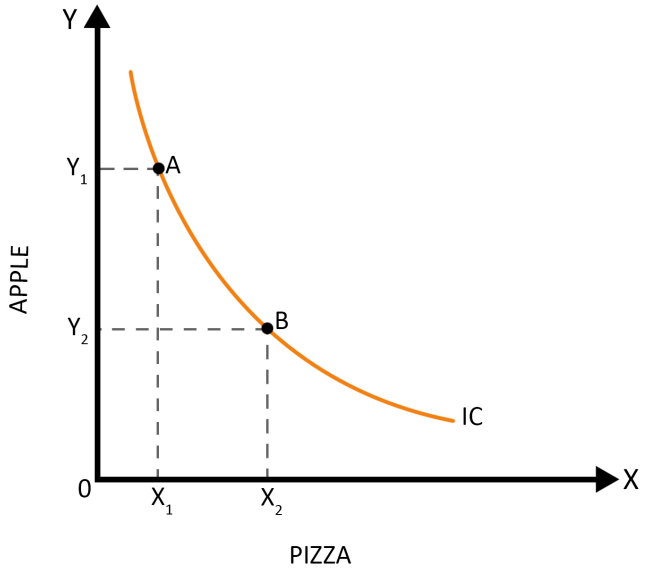


Fig 3.2.4 Downward slope of an indifference curve

ΔU=MUx.ΔX+MUy.ΔY=0(sinceMarginal rate of substitution is the amount of one good a consumer has to give up in order to gain an additional unit of another good without altering the utility, ΔU=0)
MUx.ΔX=−MUy.ΔY

$$\frac{MUx}{MUy} = \frac{-\Delta Y}{\Delta X}$$

$$\text{i.e.,} \frac{MUx}{MUy} = MRS$$

3.2.1.4 Properties of Indifference Curve

1. Indifference curve slopes downward to the right:

The downward slope of indifference curve from left to right implies that if a consumer has to get an additional amount of a commodity, she/he has to forgo the consumption of the second commodity by a certain amount.

Figure 3.2.4 shows the indifference curve IC. Suppose the consumer's initial consumption bundle is A (x_1, y_1) and now if she/he needs more of x, the consumer should move to point B (x_2, y_2) where the quantity of x has increased, but only with a reduction in quantity of y.

So, the slope of indifference is the MRS and an increase pizza is associated with a reduction of apples. i.e., when Δx is positive, Δy becomes negative.

2. Indifference curves are convex to the origin

Another property of an indifference curve is that it is generally convex to the origin. The convex shape of an indifference curve is a reflection of the diminishing marginal utility. Also, the average consumption bundle is preferred to extreme bundles.

3. Higher indifference curve represents higher level of utility

If a consumer consumes more of one good without consuming lesser quantities of other goods or consumes more of both the goods, he would be shifted to a higher indifference curve with higher utility.

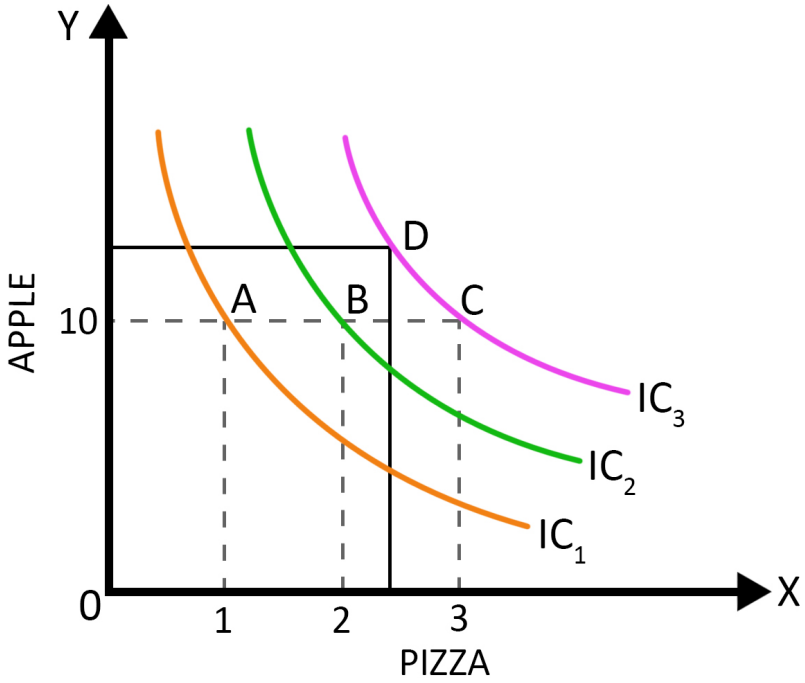


Fig 3.2.5 Higher ICs gives higher levels of satisfaction

Figure 3.2.5 depicts three ICs. Here, utility from $IC_3 > IC_2 > IC_1$. At point A, one could consume 1 pizza and 10 apples but if he could move B or C, she/he could have more pizzas without sacrificing the quantity of apple. Now if she/he move to the point D on IC_3, she/he can have more of both the goods.

4. Indifference curves do not intersect with each other

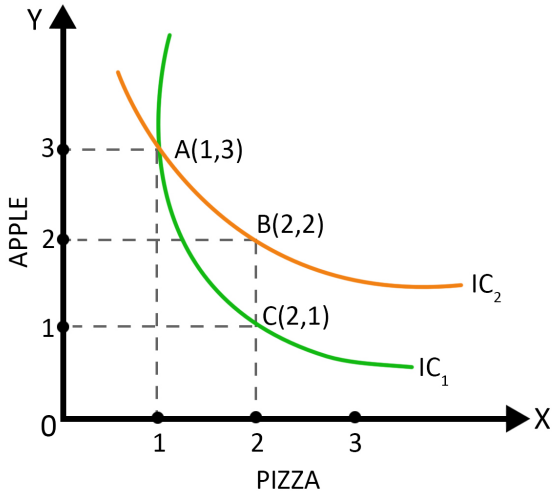


Fig 3.2.6 indifference curves never intersect

Intersection of the indifference curves will contradict other assumptions. For example, in the figure 3.2.6, IC_1 a lower indifference curve and IC_2, an indifference curve with higher level of utility intersects at point A. A and B which falls in IC_2 will have the same satisfaction level. Now A and C are the points on IC_1 and have the same utility level. Thus, the utility gained from B and C should be the same. But from the figure, it is clear that B has more apple and hence, more utility than bundle C. So as to avoid these conflicts between assumptions, it is assumed that indifference curves do not intersect each other.

Other Types of Indifference Curves

We have now learned about indifference curves and its properties. Now let us see the shapes of indifference curves for a few types of goods.

1. ***Substitute Goods:*** Two goods are said to be substitutes when they are used by the consumer for the same purpose and she/he derives the same utility from it, so that the consumer can substitute one for another. E.g., wheat and rice, pepsi and coke, tea and coffee etc.

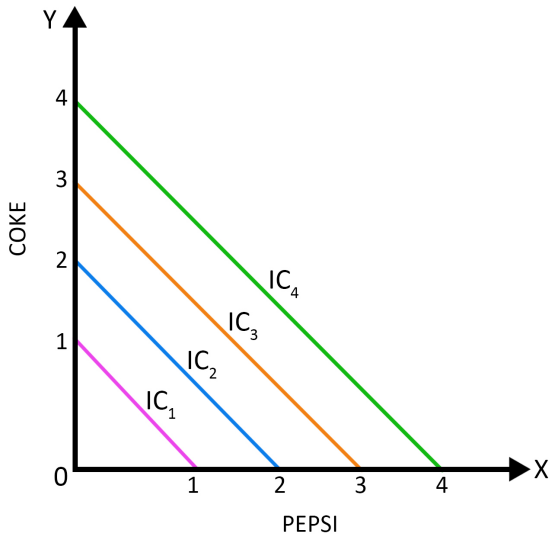


Fig 3.2.7 IC of perfect substitute goods

As mentioned before, the substitute goods have the same utility and therefore MRS between the goods is constant.

In Figure 3.2.7, the X-axis represents the quantity of pepsi consumed and the Y-axis represents the quantity of coke consumed. The quantity of Pepsi given up to get an extra unit of coke is the same. Therefore, the MRS will be a constant and in this case, it will be -1.

The MRS between substitute goods X and Y i.e. $\frac{\Delta Y}{\Delta X}$ and $\frac{\Delta X}{\Delta Y}$ remains constant.

Here, the slope of the indifference curve will not always be -1. If a consumer thinks a 4 Gb pen drive could be replaced with two of 2 Gb pen drives, the slope of the indifference curve with 2 Gb pen drive on Y-axis and 4Gb pen drive on X-axis will be -2.

2. ***Complementary Goods:*** We know that complementary goods are those goods used together. For e.g., tennis balls and tennis racket, DVD player and DVDs etc. Suppose for example, we buy the left shoe and right shoe together, this is an example of perfect complement goods.

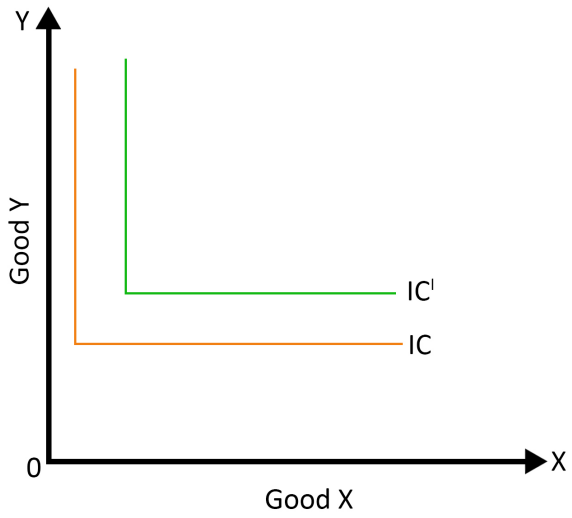


Fig 3.2.8 IC of complementary goods

In Figure 3.2.8, the X- axis of the figure consists of good X and Y- axis consists of the quantity of good Y consumed.

Complementary goods are consumed in a fixed proportion. In such a case, a reduction in the consumption of good Y won't bring a subsequent increment of good X.

i.e., when $\Delta x = 1$, $\Delta y = 0$ therefore MRS = 0.

3. ***Neutral Goods*:** When a consumer does not care about whether he has more or less of a good, it is known as neutral goods. The consumption of a neutral good does not affect the satisfaction of the consumer.

The following figure depicts the cases of neutral goods. The figure given below depicts,

CASE I: X is a normal good and Y is a neutral good.

CASE II: X is a neutral good and Y is a normal good.

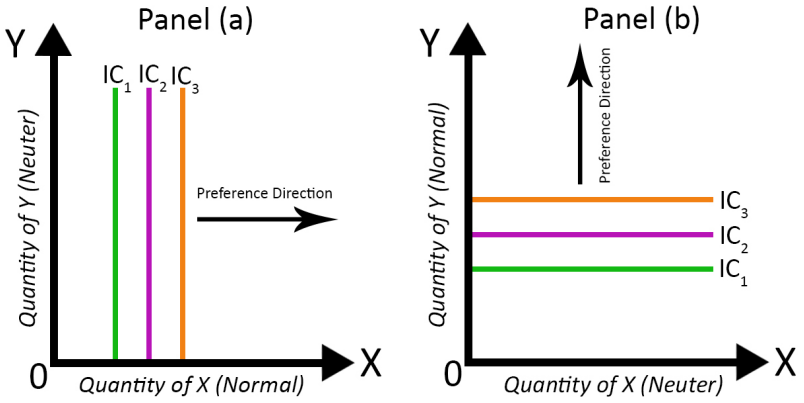


Fig 3.2.9 IC of neutral goods

Panel (a) of the above illustration shows the quantity of the normal good X in the X-axis and the quantity of neutral good Y in the Y-axis. Since the consumer does not care about the quantity of neutral commodity consumed, ie., an increase in the consumption of good Y. Therefore, the indifference curve is a vertical line parallel to the Y-axis.

Similarly, in Panel (b) the good in X-axis is neutral and Y-axis represents a normal good, the indifference curve will be a horizontal line parallel to the X-axis.

3.2.1.5 Budget Constraint

We have seen how the utility of a consumer for two goods is measured with the help of an indifference curve. However, in reality, for a consumer to choose his utility maximizing indifference curve, she/he has to consider two more factors: (a) the limited money income of the consumer and (b) the price of the commodities. These above mentioned two factors act as constraints in maximizing the utility of the consumer. This is known as the budget constraint. i.e., even though many ICs will maximise a consumer's utility, she/he should consider the price of the commodities and it should be within his money income.

Mathematically it could be represented as, PxX+PyY=M…… (1)

Equation (1) is known as the budget line or income-price line of a consumer. A budget line could be defined as the graphical representation of every possible combinations of two commodities that could be bought by a consumer with his limited money income.

Here in (1),

M – money income of the consumer

Px – price of the commodity X

Py – price of the commodity Y

X – quantity of good X consumed

Y – quantity of good Y consumed

Simply a consumer will choose the quantity of the goods to be consumed subject to the price of goods and his income.

Rearranging (1) in terms of X, we get X=M/Px−(PyY)/Px……....(2)

In (2) when X=0, Y=M/Py

and when Y=0, then X=M/Px.

Let us now see a budget line with illustration

Table 3.2.2 Schedule for Budget line

Commodity basket	Apple (X)	Orange (Y)	Money income(M)
A	0	4	80
B	2	3	80
C	4	2	80
D	6	1	80
E	8	0	80

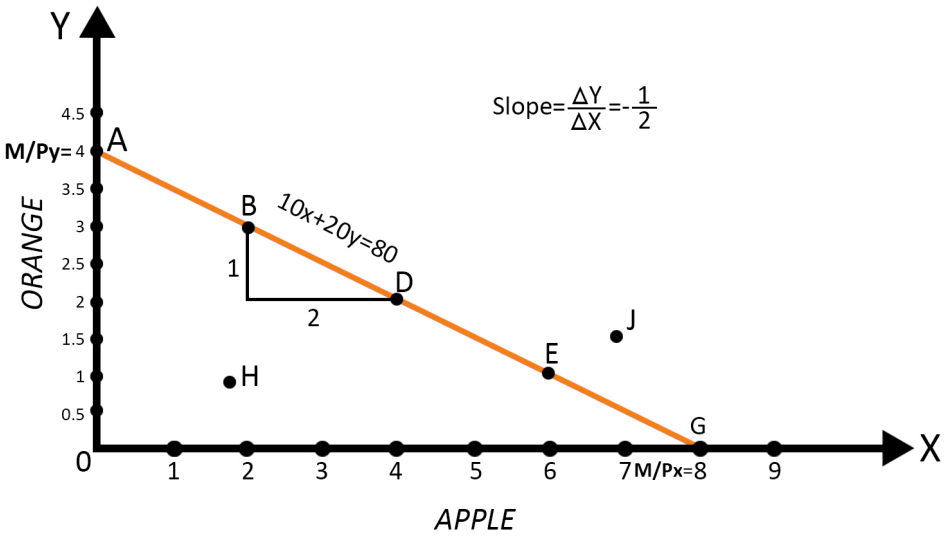


Fig 3.2.10 Budget line

From table 3.2.2 and figure 3.2.10, it must be clear that there are two goods X (apple) and Y (orange). The X- axis represents the quantity of apple and Y-axis represents the quantity of orange consumed. Thus, as mentioned earlier, the equation of the budget line becomes 10x+20y=80 if we assume the price of apple to be Rs. 10 and orange as Rs. 20 If the consumer spent the entire income on apple, she/he would be at G, i.e. $\frac{M}{Px}$ = 8. If she/he consumes only orange, the consumer will be at A which is $\frac{M}{Py}$ = 4. Now the slope of the budget line will be $\frac{\Delta Y}{\Delta X} = \frac{OA}{OG} = \frac{\frac{M}{Py}}{\frac{M}{Px}} = \frac{Px}{Py}$ Always remember any point inside the budget line such as 'H' suggests an inferior combination (feasible but not optimal) and any point outside such as 'J' suggests an unattainable combination (unaffordable and non-feasible).

The Effect of Price and Income Changes on a Budget Line

We have seen a budget line and its properties. Now we know that the price of the commodities and the money income with the consumer are the two factors which determine the position of the budget line. Hence any change to these factors may subsequently change the budget line. Let us have a look into it.

1. Income Change:

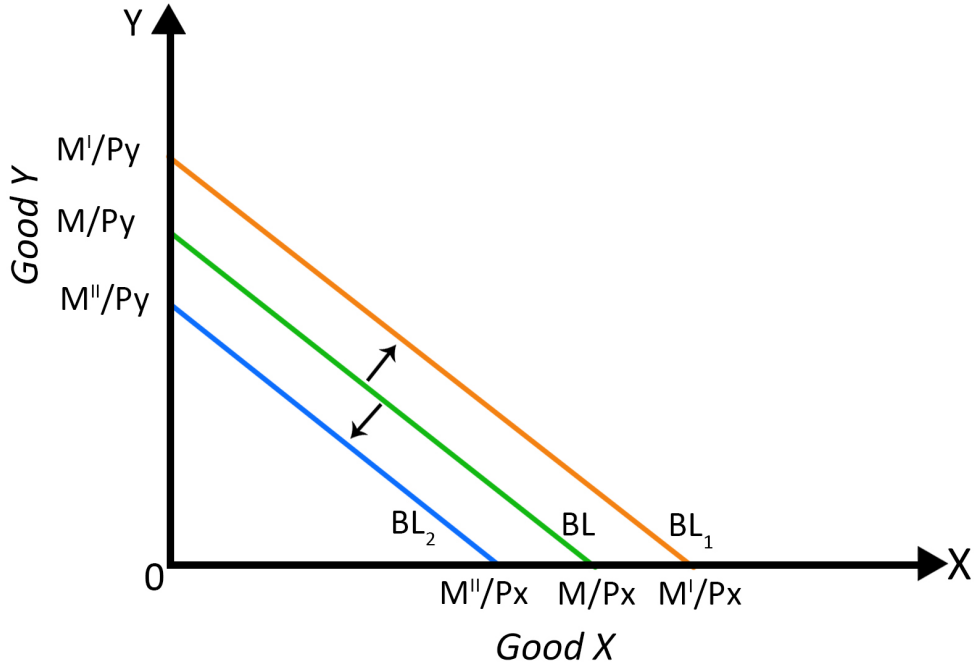


Fig 3.2.11 Effects of income changes on budget line

In the figure 3.2.11, the initial budget line is BL and his money income is M. When his money income increases from M to M^I he can consume more of both goods and this will shift his budget line parallelly upwards to the right to BL_1. Similarly a reduction in income from M to M^{II} reduces consumption of both the goods proportionately and this will shift the budget line parallelly downwards to the right to BL_2.

2. Price Change:

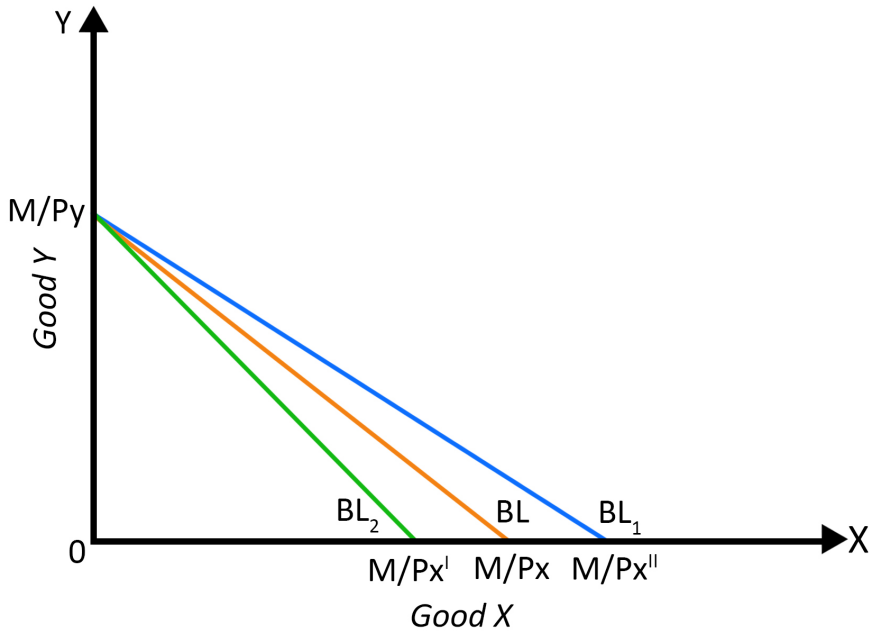
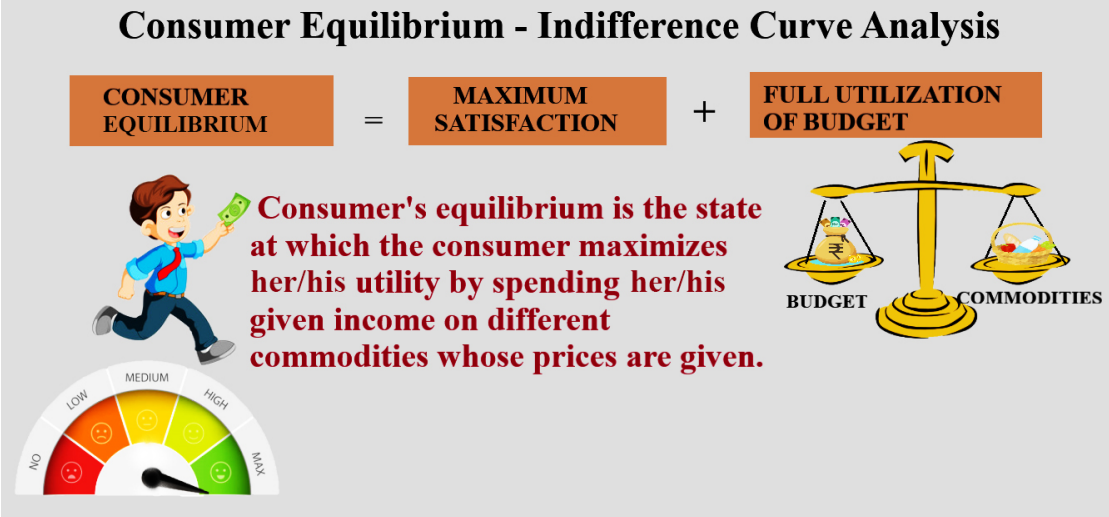


Fig 3.2.12 Effects of price changes on budget line

Now, when the price of X increases the Y intercept does not change. The reason is that though a rise in the price of X from Px to Px^{I}, would reduce the consumer's income, it would not reduce the consumption as a whole but she/he will only cut down the consumption of the good whose price has increased, in this case X. Consequently, the X intercept moves from $\frac{M}{Px}$ to $\frac{M}{Px'}$ i.e., the budget line becomes steeper (BL to BL_2).

Conversely when price of X falls from Px to Px^{II}, X intercept changes from $\frac{M}{Px}$ to $\frac{M}{Px''}$ as consumers increase the consumption of X only due to price reduction. Thus, the budget line becomes flatter (BL to BL_1).

3.2.1.6 Consumer Equilibrium in Ordinal Utility Approach



We have mentioned many times that a consumer is rational and she/he tries to maximise her/his utility by consuming the commodity bundle which is optimal and affordable. Now, let us see how a consumer chooses the quantities of goods (attain highest IC) which are within her/his budget constraints (on the budget line) so that the consumer maximises her/his utility.

The two conditions for consumer equilibrium are as follows:

1. The consumer equilibrium must be on the budget line. Any point below the budget line to the left suggests an unspent income, which would increase the consumer's utility if spent. And any point above and to the right of a budget line shows an unattainable combination. So, the most affordable and feasible choice would lie on the budget line.

2. The consumer equilibrium must consist of the combination of two goods which is most preferred by the consumer.

These two conditions will narrow down the consumer's utility maximizing point to a single point where the consumer's budget line is tangential to the indifference curve.

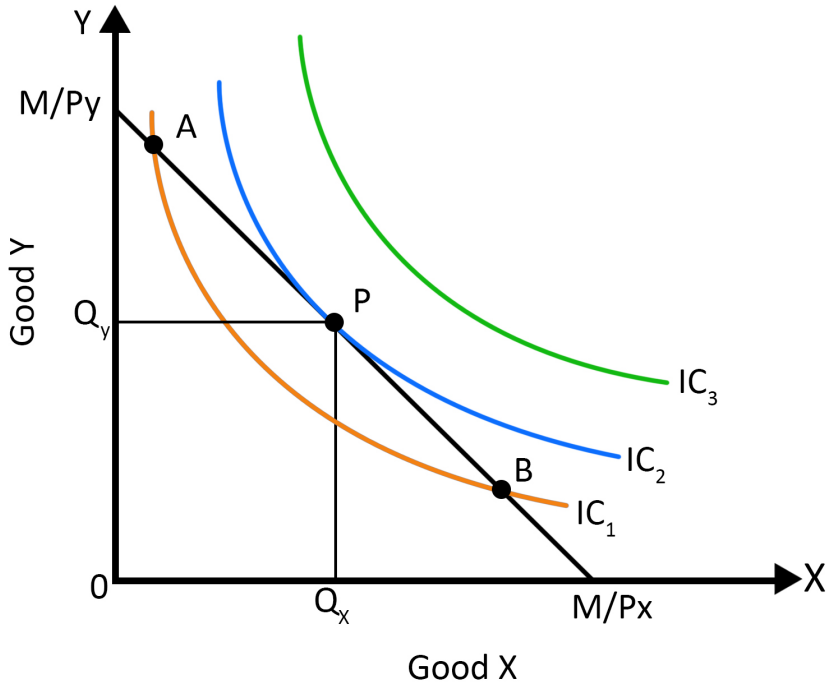


Fig 3.2.13 consumer equilibrium in ordinal approach

In the above figure 3.2.13, the consumer equilibrium is at point 'P'. At this point, IC_2 is tangent to the budget line.

Therefore, at point P, the slope of the BL = slope of the IC i.e., MRSxy = $\frac{Px}{Py}$

At P, Q_x quantity of commodity X is consumed at P_x price and Q_y quantity of commodity Y is consumed at P_y price. Here, equilibrium is not occurring at IC_3 as it is unaffordable to the consumer.

Even though the budget line and IC_1 intersect twice at A and B, they are not consumer's equilibrium. Why?

IC comes under the feasible area of the budget line but the consumer satisfaction is not maximised at neither A or B as both A and B lie on a lower indifference curve IC_1(lesser satisfaction) than IC_2 where P exists (higher satisfaction). At A, the slope of IC_1 is greater than the slope of the budget line. i.e., $MRSxy > \frac{Px}{Py}$. The consumer can consume more of X and less of Y and increase her/his satisfaction to reach P. At B, $MRSxy < \frac{Px}{Py}$, so in order to reach P, the consumer has to consume more of Y and less of X.

Thus, the equilibrium is obtained under the following two conditions:

- First condition - Tangency conditi on: Equilibrium occurs at the point of tangency between the given budget line and the highest possible indifference curve. At this point (P), the slope of the indifference curve is equal to the slope of the price line.

  i.e., $MRSxy = \frac{Px}{Py}$.

- Second condition – Convexity condition: `At the tangency (equilibrium), the indifference curve must be convex. That is, the slope of the indifference curve is diminishing (negative) at the point of equilibrium, and MRS_{xy} is negative.

Recap

- Ordinal utility analysis, also known as Indifference curve approach
- The approach was developed by J.R. Hicks and R.G.D. Allen
- Ordinal utility analysis assumes utility can only be compared and ranked
- IC is locus of points of different combinations of two goods
- All points on IC give same level of satisfaction to consumer
- Indifference map is graphical representation of more than one indifference curve
- Slope of indifference curve is marginal rate of substitution
- The budget constraint of consumer is represented by budget line
- A budget line is mathematically represented as $P_xX + P_yY = M$
- The price ratio of prices of two goods is slope of the budget line
- A change in consumer's income shift budget line inward or outward

Objective Questions

1. What is the locus of various points showing different combinations of two goods which gives the same level of satisfaction known as?
2. How is utility measured in ordinal utility analysis?
3. How is the indifference curve sloped ?
4. Where will be the point of equilibrium in the indifference curve approach?
5. What is the slope of an indifference curve?
6. What will happen to the slope of an indifference curve while moving from left to right?
7. What is a set of indifference curves plotted on a graph?
8. What is represented by a higher indifference curve in an indifference map?

9. Why do two indifference curves never intersect?
10. What is the other name for ordinal utility approach?
11. What happens to the budget line when the consumer's income increases?
12. What is the slope of a budget line?

Answers

1. Indifference Curves
2. Ranking
3. Negative
4. slope of IC = slope of budget line
5. Marginal rate of substitution
6. Decreases
7. Indifference map
8. Higher level of satisfaction
9. Each indifference curve represents different levels of utility.
10. Indifference curve analysis
11. Shifts farther away from the origin
12. Price ratio of goods

Assignments

1. What is ordinal utility analysis? Explain the assumptions on which ordinal utility analysis is based?
2. What are indifference curves? State their properties.
3. Explain the different types of indifference curves.
4. What is a budget line? Examine the effect of change in income and price on the budget line?
5. Explain the consumer's equilibrium condition with the help of indifference curve approach?

Suggested Readings

1. Nicholson Walter and Christopher Synder (2019), *Microeconomic Theory-Basic Principles and Extensions*, Cengage Learning.

2. Salvatore, D. (2003) *Microeconomics Theory and Applications* (Fourth Edition), Oxford University Press.

References

1. Dwivedi, D.N. (2012). *Microeconomics: Theory and Applications* (Second Edition). Vikas Publishing House Pvt. Ltd.

2. Maddala, G.S. & Miller Ellen (2013). *Microeconomics Theory and Applications,* (Tenth Edition). McGraw Hill Education Private Limited.

3. Mankiw, N. G. (2016). *Principles of microeconomics* (8th ed.). CENGAGE Learning Custom Publishing.

4. Pindyck, R. S., Rubinfeld, D.L., & Mehta, P.L. (2013). *Microeconomics* (Seventh edition). Pearson Education Prentice Hall.

UNIT 3

Income and Price Effect

Learning Outcomes

After learning this unit, the learner will be able to:

- familiarise with the decomposition of price effect
- explain the price consumption curve and income consumption curve
- familiarise with the concept of consumer surplus

Prerequisites

You have already learnt that the demand for a commodity is mainly determined by the price of the commodity and income of the consumer. Any change in the price or income changes the demand for the commodity and the consumer's equilibrium. An increase or decrease in the price of a commodity will change the demand for that commodity only whereas, the increase or decrease in income of the consumer will change the demand for all the commodities consumed by the consumer.

In addition to determining the demand for a commodity, the price of a commodity also determines the benefits of the consumer. Sometimes, the price charged on a commodity may be lesser than what the consumer expects. Do you have any such experiences where you thought of a higher price for a commodity, and the seller charges a relatively lower price? You will be really happy if that happens, right? These situations generate benefits to consumers.

The present unit discusses the effect of change in price and income on consumer's equilibrium.

Keywords

Price effect, Income effect, Substitution effect, Price consumption curve, Income consumption curve, Consumer surplus

3.3.1 Income and Price Effect

We know that, under the demand analysis, price of a commodity and income of the consumer are the two important factors which determine the demand for a commodity. So, any change in the price of the commodity or income of the consumer will change the demand for the commodity. A change in the demand for the commodity changes the consumer's equilibrium.

An effect of a change in the price of the commodity on the overall demand for the commodity is known as price effect, whereas, the effect of a change in the real income of a consumer on the demand for the commodity is called an income effect.

Let us discuss this in detail.

3.3.1.1 Price, Income and Substitution Effects

As we have already discussed, keeping all other things constant, a change in price of the commodity can cause a change in the quantity of the commodity demanded. The consumer's reaction to a change in the price of a commodity, other things remaining unchanged, is called the price effect.

Price effect can be divided into income effect and substitution effect.

Before going to income and substitution effects, let us understand the concept of purchasing power.

Purchasing power: Purchasing power is the value of a currency expressed in terms of number of goods and services. Simply, it is the amount of goods or services which could be bought using a certain amount of money.

Suppose the money income is Rs. 400, a consumer purchased 10 kilograms of rice last month for Rs. 40 per kilogram and this month the price of rice has hiked to Rs. 50 per kilogram. Since the money income of the consumer is fixed, her/his purchasing power gets reduced and she/he could only purchase 8 kilograms of rice only. Conversely, if the price of rice falls to Rs. 25 per kilogram, her/his purchasing power increases and could purchase 16 kilograms of rice for Rs. 400.

A change in price of a good has two effects.

Fall in price: Suppose there are two goods X and Y and the price of X falls. In such a situation there are two effects accompanied with this price change.

Since commodity X has now become cheaper compared to commodity Y, the price attraction of X increases and that of Y declines. Hence the consumer has a tendency to buy more of the cheaper commodity by reducing the relatively costlier commodity Y. This change in consumption due to change in relative prices of two goods is known as the substitution effect.

As X is now cheaper, the real purchasing power of the consumer increases. Now the consumer has income for additional consumption. This is known as the income effect.

Generally we can say,

(a) **Income effect:** A change in price may result in the change in real income of the consumer and this is the cause of income effect. This will lead to the change in purchasing power of the consumer. Positive income effect refers to direct relation between income and quantity. Income effect can be positive or negative.

(b) **Substitution effect:** It is the change in demand of a good as a result of the change in the relative price of that good in comparison to a substitute good. Negative substitution effect implies inverse relation between price and quantity. Substitution effect is always negative.

The price effect is a combination of Income effect and Substitution effect and usually occurs simultaneously.

i.e., PE=SE+IE

Theoretically, the income effect and the substitution effect could be separated by eliminating one of these effects.

There are two methods to decompose the price effect into income and substitution effects. They are:

1. Hicksian Method
2. Slutsky's Method

Hicksian Approach of Decomposition of Price Effect

This method of decomposition of price effect has been developed by Prof. John R. Hicks, hence known as the Hicksian approach of decomposing price effect.

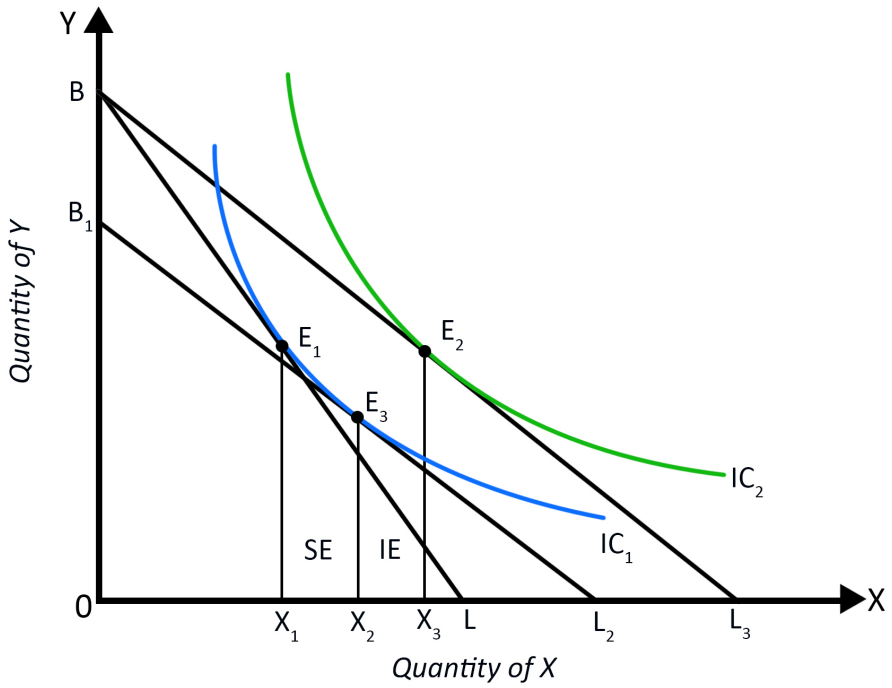


Fig 3.3.1 Price effect decomposition when price of X falls: Hicksian Method

The X-axis in the figure 3.3.1 represents the quantity of good X and the Y-axis represents the quantity of good Y. Consider that a consumer is at equilibrium at E_1 on the indifference curve IC_1 which is tangential to the budget line BL and she/he consumes OX_1 units of X. Suppose the price of the commodity X has reduced. We have seen that a fall in price will make the budget line flatter and more of X is consumed. This is indicated by the budget line BL_3. This new budget line is tangential to a higher indifference curve IC_2 and the consumer establishes a new equilibrium at E_2. This change has happened due to the fall in the price of X and has resulted in the additional consumption of X by X_1X_3 units. This is the total price effect.

The next step is to separate the price effect into income effect and substitution effect. Hicks opined that if income effect is separated from price effect, then the residue will be substitution effect.

For this Hicks introduced a tax, which will reduce the income of the consumer and bring her/him back to the initial indifference curve with the new price ratio. This approach has been named as the income compensation approach by Hicks.

This reduction in income is depicted by a new budget line B_1L_2 which is parallel to BL_3 and is tangential to IC_1 at the point E_3.

After the elimination of income effect through income adjustment, the consumer equilibrium moves from E_2 to E_3 which in turn reduces the quantity of X consumed by X_2X_3. This is the income effect.

According to Hicksian method,

$$PE=SE+IE$$

We know, PE = X_1X_3 and IE = X_2X_3

SE = PE – IE (Substitution effect is left over when income effect is deducted from price effect)

$$=X_1X_3 - X_2X_3$$

$$\therefore SE = X_1X_2.$$

Rise in Price of X:

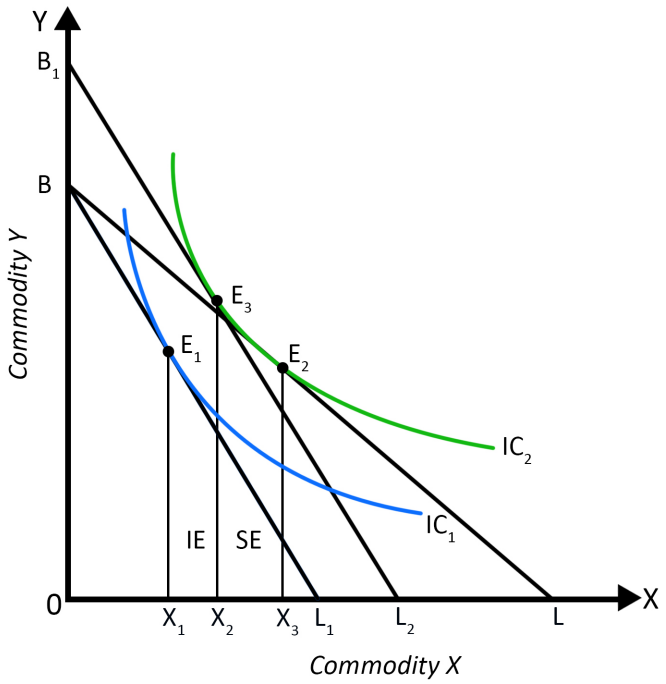


Fig 3.3.2 Price effect decomposition when price of X rise: Hicksian Method

In the above figure X-axis represents quantity of commodity X consumed and Y-axis represents the quantity commodity Y consumed. If the consumer is at initial equilibrium at E_2 where the indifference curve IC_2 is tangential to the budget line BL and consumes OX_3 units of X. If the price of commodity X increases, the budget line gets steeper which is indicated by the new budget line BL_1, where it establishes a new equilibrium at E_1 on a lower indifference curve IC_1. This rise in price is accompanied by a reduction in quantity of X by X_1X_3. This is known as the price effect.

Now in order to decompose the substitution effect and income effect from the price effect, the income compensation approach is used.

So as to eliminate the income effect, it is assumed that a government grant in the form of dearness allowance is provided to the consumer which is as much as to compensate for the loss of her/his real income caused by the price hike. This income compensation will move the consumer back to the initial indifference curve IC_2. The income compensation is indicated by a new budget line B_1L_2, which is parallel to BL_1 suggesting a rise in income and establishes a new equilibrium at E_3.

The movement of the consumer's equilibrium from E_1 to E_3 due to income compensation will result in an increment in the quantity of X demanded by X_1X_2 units. This is known as the income effect.

We know,

$$PE = IE + SE$$

Now similar to the previous analysis

$$PE = X_1X_3 \text{ and } IE=X_1X_2$$

$$SE = PE\text{-}IE$$

$$SE = X_1X_3 - X_1X_2$$

$$SE = X_2X_3$$

Slutsky's Approach of Decomposition of Price Effect

Prof. Hicks was of the opinion that after income adjustment, the consumer will come back to the original indifference curve and will establish a new equilibrium on that indifference curve itself. But Eugen Slutsky, a Russian mathematical statistician and economist favoured the idea of the consumer returning to the initial equilibrium position on the initial indifference curve with the new price ratio after the income compensation. This approach on decomposition of price effect is known as the Slutskian method of decomposition of price effect.

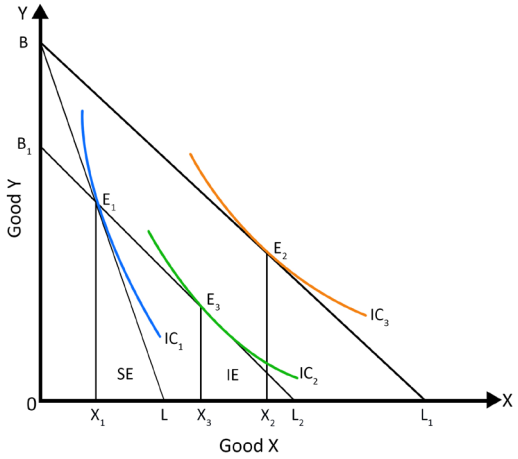


Fig 3.3.3 Price effect decomposition when price of X falls: Slutsky's Approach

In the above-cited figure X-axis represents the commodity X and Y-axis represents commodity Y. Initially the consumer is in equilibrium at point E_1 on the indifference curve IC_1 which is tangential to the budget line BL where OX_1 amount of X is consumed. Suppose there is a fall in price of X, the budget line will get flatter as depicted by BL_1. Now a new equilibrium is established at E_2 on a new and higher indifference curve IC_3 which is tangential to the budget line BL_1. As a result of the fall in price of X, the consumption of X increases by X_1X_2 units. This is the price effect.

Now under the Slutsky method in order to separate the income and substitution effect, the real income of the consumer is reduced so that she/he would be capable of purchasing the initial consumption bundle at the new price ratio. For this, a new imaginary budget line B_1L_2 is drawn which is parallel to BL_1 as well as passing through the initial consumer equilibrium point E_1. This new budget line will establish a new equilibrium at E_3 on indifference curve IC_2 after the adjustments in income.

After the income adjustments, the consumer's equilibrium has changed to E_3 showing a reduction in the quantity of X consumed by X_2X_3 units. Therefore, this is the income effect.

Now the residue after deducting the income effect is the substitution effect. We know,

$$PE = SE + IE$$

$$\text{Here } PE = X_1X_2 \text{ and } IE = X_2X_3$$

$$\therefore SE = PE - IE$$

$$= X_1X_2 - X_2X_3$$

$$= X_1X_3.$$

Income and Substitution Effect for Inferior Goods

Those goods whose demand drops when the income of the consumer rises are known as Inferior goods. When the consumer's income increases, she/he consumes more of a normal good by decreasing the consumption of the inferior good.

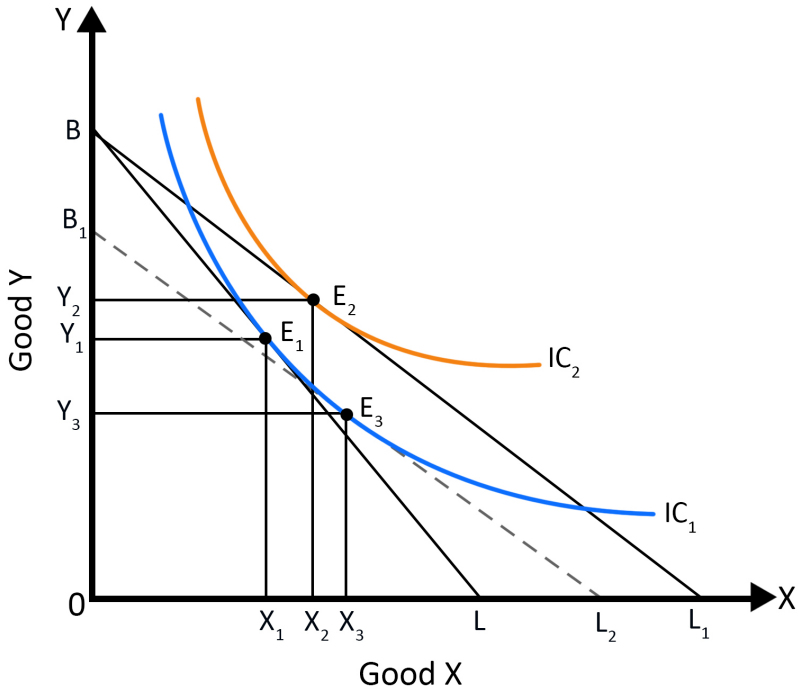


Fig 3.3.4 Price effect decomposition for an inferior good

In the figure 3.3.4, X-axis represents the quantity of good X consumed and Y-axis represents the quantity of good Y consumed. Here the good X is an inferior good and good Y is a normal good. Suppose BL is the consumer's initial budget line and she/he is at equilibrium on E_1 where the budget line is tangential to the indifference curve IC_1. Now if there is a price drop for good X, the budget line gets flatter as indicated by BL_1 and the consumer moves to a higher indifference curve IC_2 and establishes an equilibrium on point E_2. This movement from E_1 to E_2 results in a change in quantity of good X consumed from X_1 to X_2 and good Y from Y_1 to Y_2.

As per Hicksian method, in order to decompose the price effect into income and substitution effect an imaginary compensatory budget line B_1L_2 is drawn which is tangential to IC_1 and establishes an equilibrium at E_3. If this income is given back to the consumer, she/he will shift back to E_2 which results in the reduction of quantity of good X consumed by X_2X_3. This is the income effect.

The consumer's movement from E_1 to E_3 causes an increase in the quantity of X by X_1X_3. This is the substitution effect. In the case of an inferior good the substitution effect is so powerful that it overweighs the total price effect. This makes the income effect negative.

Here PE=SE+IE

$\therefore$IE=PE−SE

i.e., $IE=X_1X_2 - X_1X_3$

$= - X_2X_3$.

Here the negative income effect of a price reduction of the inferior good results in the reduction of quantity of its consumption and the substitution effect causes an increase in the quantity of inferior good consumed.

Income and Substitution Effect for Giffen Goods

The Law of Demand

We have learnt the law of demand in the previous unit. The law of demand states the functional relationship between the price of a commodity and the quantity of the commodity. The quantity of a commodity demanded is determined by other factors like the consumer's income, consumer's taste and preferences, the price of related goods etc. But if we take all these factors as constant, the price of a commodity and the quantity demanded are inversely related. Thus, the law of demand states that 'all other things remaining constant, the quantity demanded of a commodity increases when its price decreases and demand decreases when its price increases.'

But the law of demand will not hold true in all situations. Such a case of deviation from the law of demand is known as the Giffen paradox.

Giffen Paradox

Giffen goods are inferior goods for which the demand for the good increases with an increase in its price and vice versa. Giffen goods are inferior goods and for an inferior good, when the price of the good increases the overall quantity of demand decreases. But here even though giffen goods are inferior goods, the quantity demanded increases with an increase in price and vice versa. This paradoxical behaviour is known as the Giffen paradox.

The Giffen paradox happens in a situation when the giffen good remains relatively cheaper to the superior good

even after a price hike. So, to meet her/ his minimum requirements, the consumer will reduce the consumption of the superior good and spend it on the giffen good, resulting in an increment in demand for the good with a price hike.

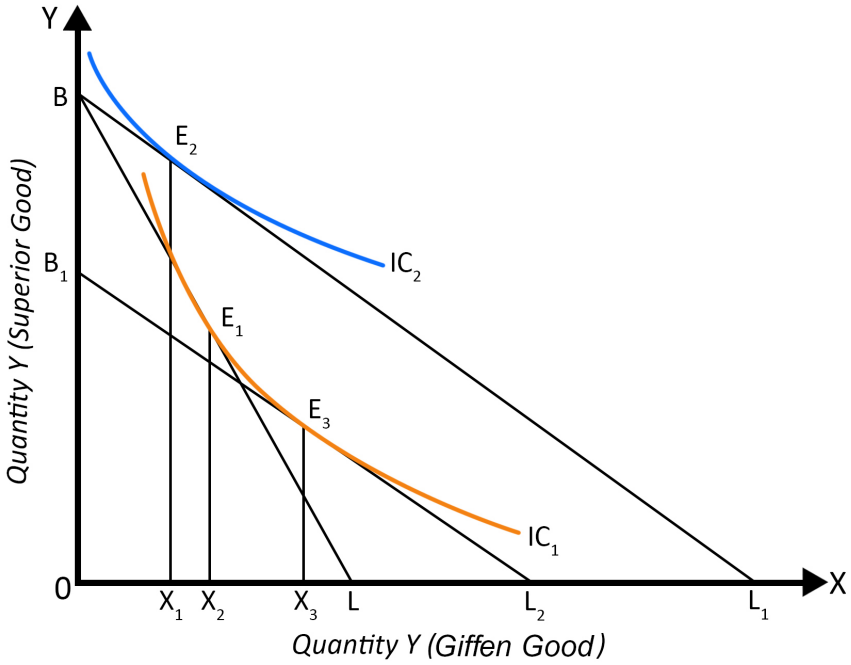


Fig 3.3.5 Price effect decomposition for a Giffen good

In the above-cited figure, X-axis represents the quantity of a giffen good X and Y-axis represents the quantity of a superior good Y. Let us imagine that the consumer is initially on the budget line BL which is tangential to the indifference curve IC_1. Now, if the price of the giffen good falls, it will result in the flattening of the budget line indicated by the pivoting of the budget line to L_1. So, the new budget line represented by BL_1 is now tangential to a higher indifference curve IC_2 and establishes an equilibrium at E_2. Due to this movement, the quantity of the inferior good demanded falls by X_1X_2 units. This is the price effect.

Now as a part of price compensation, an imaginary budget line B_1L_2 is drawn which is parallel to the budget line BL_1 and establishes a new equilibrium on the original indifference curve IC_1 at E_3. The movement of the consumer from point E_1 to point E_3 represents the substitution effect. Due to the substitution effect the consumer's demand for the giffen good rises by X_2X_3 units.

The movement from E_3 to E_2 is the income effect and results in the reduction of quantity of good X consumed by X_1X_3 units. Thus, the income effect is negative and it outweighs the increase in quantity due to substitution effect. As a result, with a fall in price, the demand for Giffen goods decreases and with a price hike, there will be an increment of the quantity of a Giffen good.

3.3.1.2 Income Changes and The Effect of Changes of Income on Consumer Equilibrium: Income Consumption Curve

In the previous unit, we have seen the determination of the consumer equilibrium based on the budget line and indifference

curve. Also, we saw the effects of an income change on a budget line. Now, let us understand what effects an income change would bring to the consumer equilibrium.

Keeping price constant, the effect of change in the money income of a consumer on her/his demand is known as income effect. We have also discussed that there occurs an upward shift in the demand curve to the right in case of an income rise and conversely a downward shift to the left in case of an income fall.

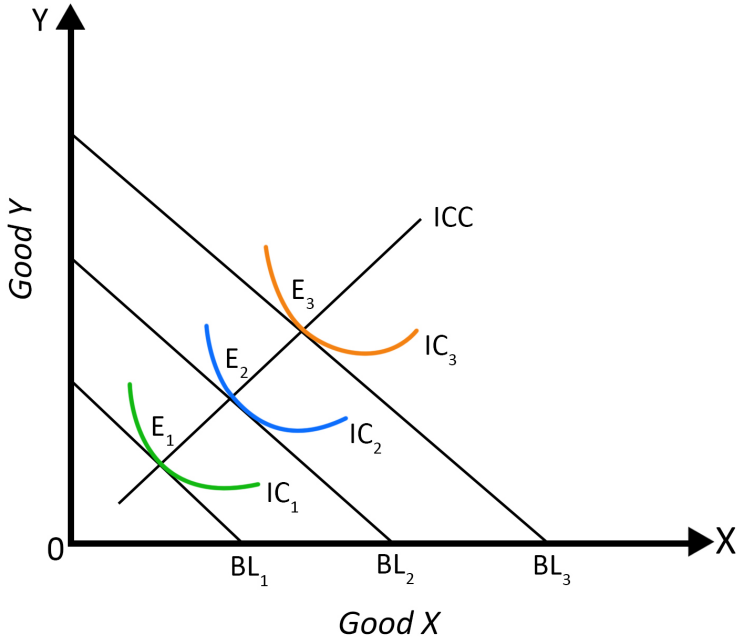


Fig 3.3.6 Income – consumption curve for two normal goods

Income consumption curve is a graph which shows the utility maximizing combination of two commodities at different income levels. It is plotted connecting the consumer's equilibrium at different budget lines as the consumer's income increases (falls) with constant commodity prices.

Normal goods: normal goods are those goods which have a positive correlation between consumer's income and demand. i.e., the consumer will demand more of a normal good with an increase in her/his income.

Both good X (in X-axis) and good Y (in Y-axis) shown in the above diagram are normal goods. Hence, an increase in the consumer's income will increase the quantity demanded of both goods and a decrease in income will lower the quantity demanded of both goods.

Now, if we consider BL_1 as the initial budget line which is tangential to IC_1, the consumer is at equilibrium and maximizes his satisfaction at E_1. Now, if her/his income increases, BL_2 becomes her/his new budget line and establishes a new equilibrium at E_2 where BL_2 is tangential to IC_2 and this continues with further changes in income. Thus, if we join all the equilibrium points, we will get an Income - consumption curve (ICC) which is upward sloping.

Now, what will be the shape of ICC when one of the goods is inferior? Let us examine.

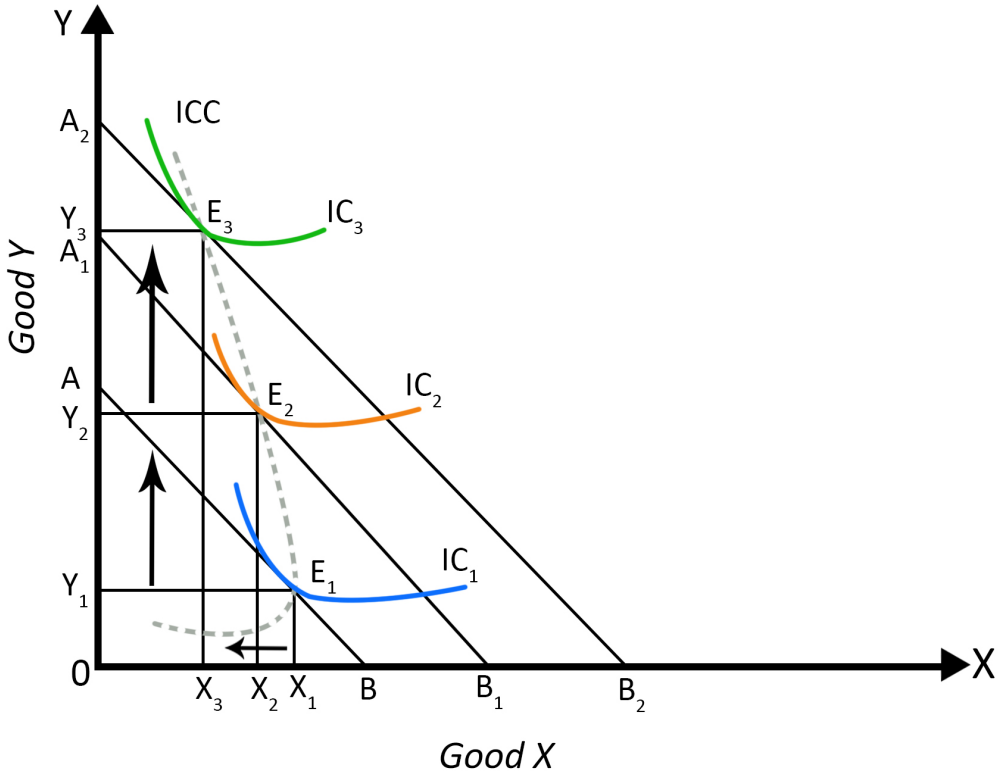


Fig 3.3.7 ICC for normal good and inferior good

Figure 3.3.7 depicts the income consumption curve where good X is inferior and good Y is a normal good. If we take AB as the consumer's budget line which is tangential to the indifference curve IC_1 and at E_1 the consumer maximizes her/his utility. Suppose, the consumer's income has now increased and the new budget line is A_1B_1, Good X being inferior, is now purchased less by the consumer and the quantity of normal good purchased as income increases will increase as usual. Now the new budget line will be tangential to IC_2 (with increased quantity of Y and reduced quantity of X) and establish equilibrium at E_2. This process will continue with further changes in income. Unlike in the case of two normal goods, here we can notice that the ICC which connects the consumer's equilibrium is backward bending or negative.

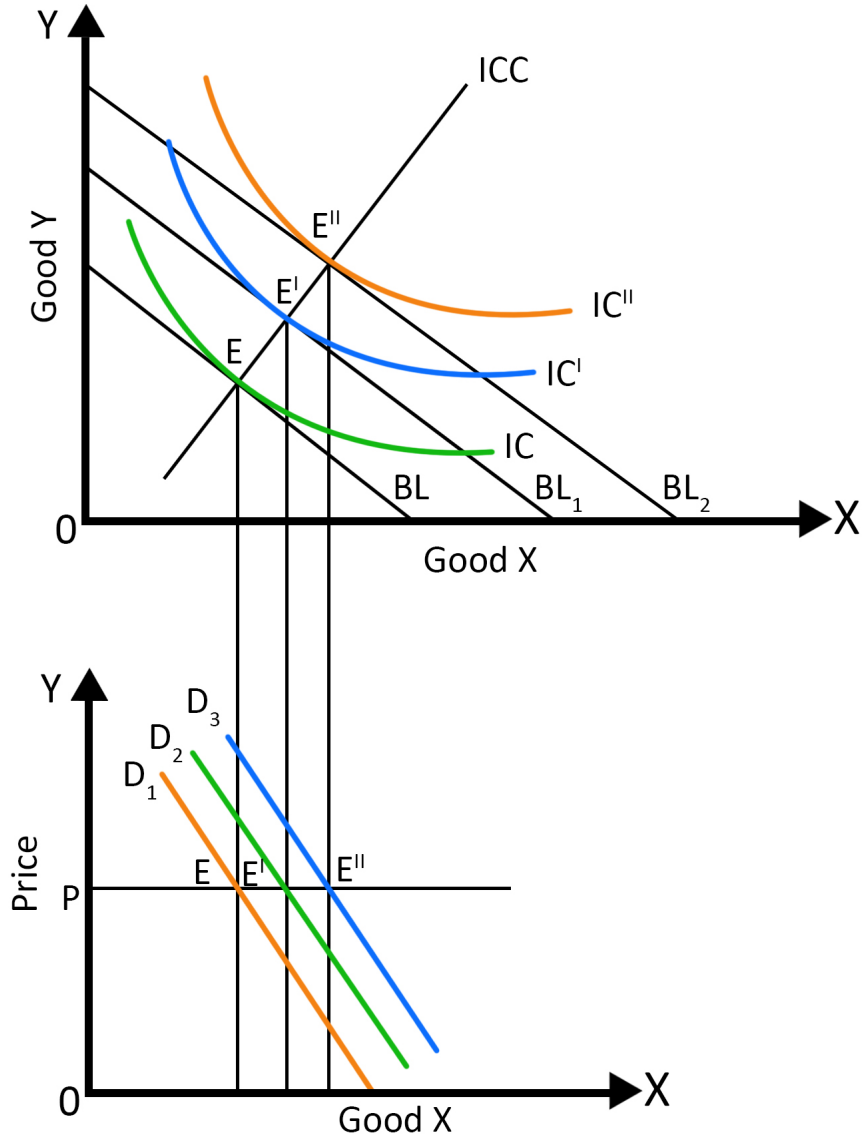


Fig 3.3.8 shift in the demand curve with income change

We have seen the part (a) of the figure 3.3.8 earlier itself, now keeping prices of the commodities constant we can see a rightward shift in the demand curve from D_1 to D_2 and then D_3. The upward slope of the ICC hints that the goods are normal and the increase in income will result in the rightward shift of the demand curve.

3.3.1.3 Price Changes and Consumer Equilibrium: Price Consumption Curve

We have seen a consumer's reaction towards an income change. Now, in this section we will see her/his reaction towards price changes.

A consumer will be better off with a price fall and she/he would be worse off with a price hike.

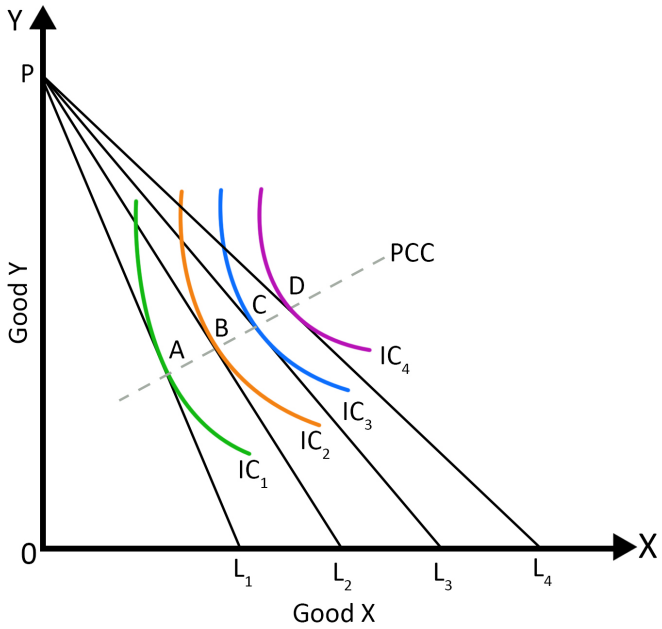


Fig 3.3.9 Upward sloping price consumption curve

The price consumption curve in the figure 3.3.9 is upward sloping. This is the result of a subsequent increment in the quantities of both the goods X and Y as the price of commodity X falls. Also note that, with each fall in price the consumer moves to a higher indifference curve (first from IC_1 to IC_2, then from IC_2 to IC_3, and finally from IC_3 to IC_4) and establishing new equilibrium points (A, B, C, and D).

Will the price consumption curve be always upward sloping?

The upward sloping PCC is only one of the possibilities. Let us now see certain other shaped price consumption curves.

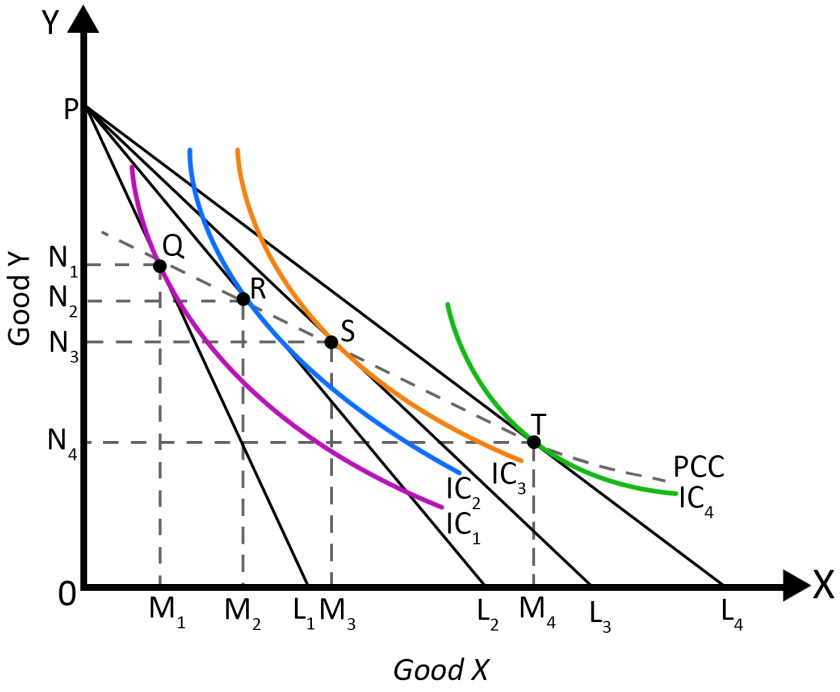


Fig 3.3.10 Downward sloping price consumption curve

In the above illustration in figure 3.3.10, PL_1 is the initial budget line. It is in tangency with IC_1. Here the equilibrium is at Q and she/he will consume ON_1 of Y and OM_1 quantity of X. A fall in price of X will make the budget line flatter indicated by PL_2 tangent to IC_2 where ON_2 of Y and OM_2 of X is consumed at the equilibrium point R. Similarly, further fall in price makes the consumer to establish equilibrium at S where ON_3 of Y and OM_3 units of X is consumed. Similarly, as a consequence of price fall, new equilibrium gets established at T with IC_4 being tangential to much flatter budget line PL_4.

Now if we join all the equilibrium points of consumer equilibriums at different levels of price of commodity X, i.e., Q, R, S etc. we will get the price consumption curve (PCC).

Here, the PCC is downward sloping. This means, with a fall in price of commodity X, the consumer moves to a higher indifference curve consuming more of commodity X. Meanwhile, there will be a decline in the quantity of commodity Y consumed.

Next, we shall look into the backward bending price consumption curve where with a reduction in price, a consumer will consume less of that good than before. Backward bending PCC is seen when one of the goods is a Giffen good.

Giffen good: These types of goods deviate from the law of demand. Giffen goods are those goods whose demand rises with a rise in price and faces a fall in demand with a price fall.

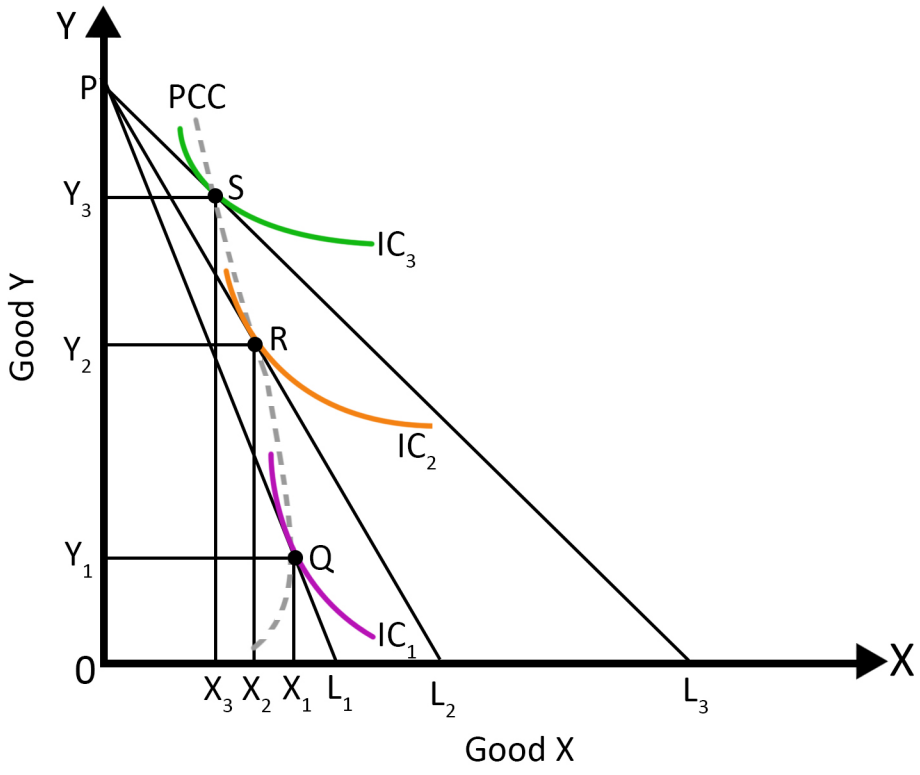


Fig 3.3.11 Backward sloping PCC

In Figure 3.3.11, X is a Giffen good. BL_1 is the initial budget line of the consumer where X_1 and Y_1 quantities of both the commodities are consumed at the consumer equilibrium Q. Now, if the price of X falls, since we assume there are only two commodities and X being a Giffen good is consumed lesser than before and naturally more of Y is consumed. Similarly, with each fall in price, less of commodity X and more Y is consumed by the consumer. Thus, making the PCC backward sloping.

3.3.1.4 Derivation of Demand Curve from Price Consumption Curve

We have already discussed the price consumption curve and now we know that it portrays the relationship between price and the quantity of goods purchased. The demand curve also establishes the same relationship, the price and the quantity demanded by a consumer. Remember the equation of the budget line Px.X+Py. Y=M , thus price is implicit in a price consumption curve. This makes it possible to derive the demand curve from the price consumption curve.

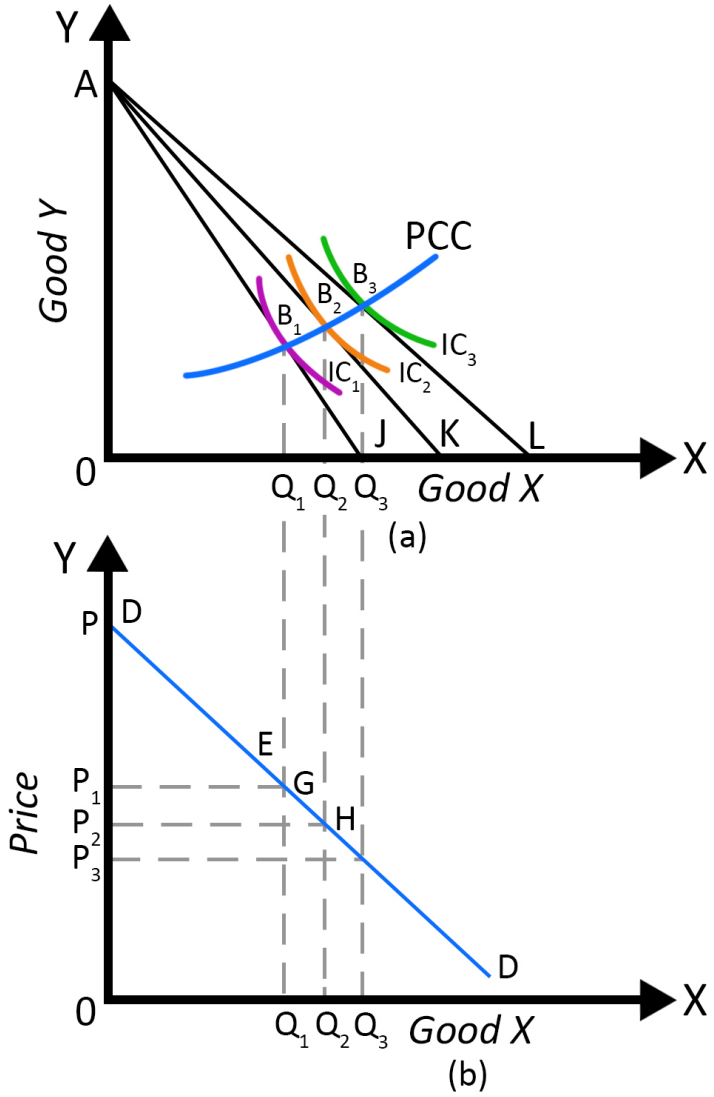


Fig 3.3.12 Derivation of demand curve from PCC

Panel (a) of Figure 3.3.12 has been seen already when we discussed upward sloping PCC. Here, both the goods are normal. So, with a fall in price, the consumption of both goods will increase.

Now AJ is the initial budget line where the price of X is P_1. Now if the price of X falls to P_2 , the budget line becomes flatter i.e., AK. A further reduction in price to P_3 will make the budget line even flatter, depicted by AL.

Now if we analyse, with each fall in price, the quantity of both X and Y increases.

Panel (b) of the figure plots the change in quantity of good X with the change in price. Here DD is the demand curve.

Since X is a normal good, we get a downward sloping demand curve.

Derivation of Demand Curve of a Giffen Good from PCC

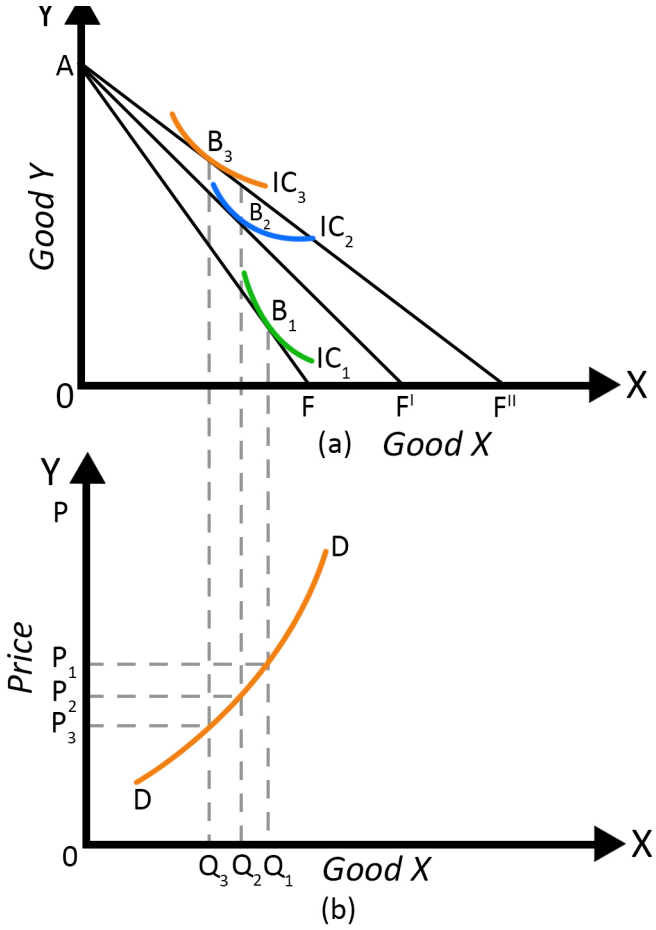


Fig 3.3.13 Derivation of demand curve of a Giffen good

In the panel (a) of Figure 3.3.13, good X is a Giffen good and good Y is a normal good. We know that for a Giffen good, the quantity demanded falls as a consequence of a price fall.

Here, AF is the initial budget line with price P_1 where Q_1 quantity of X is purchased. Now, if there is a price fall for X and the budget line gets flatter with new price P_2, X being a Giffen good lesser quantity than earlier will be consumed. A

further change in price to P_3 will make the budget line even flatter indicated by AF'' and the new quantity consumed will be Q_3 which is lesser than Q_2.

Now, if we plot the above-mentioned changes in price and quantity of X, we will get an upward sloping demand curve DD.

3.3.2 Consumer Surplus

Though the concept of consumer surplus was introduced by Jules Dupuit in the 1840s, it was popularised by Alfred Marshall through his book 'Principles of Economics' in 1890. The concept of consumer surplus is explained by J.R. Hicks.

In Marshallian consumer surplus, it is assumed that

1. Interpersonal utilities are comparable.
2. Utility is cardinally measurable.

Willingness to Pay

Willingness to pay is the maximum amount a consumer is ready to pay to purchase a commodity or service. A consumer is most likely to pay a price equal or less than the willingness to pay and will not pay a higher price.

Consider individuals A, B, C are at a football match and there is only one category of ticket. The table below shows their willingness to pay.

Table 3.3.1 Willingness to Pay

Consumer	Willingness to Pay (Rs)
A	500
B	400
C	250

Now let us have a look at who all will buy the ticket at what all prices.

Table 3.3.2 Demand for the Tickets based on the Consumers' Willingness to Pay

Price of the Ticket	Consumers	No. of Tickets
250 or below	A, B, C	3
251 - 400	A and B	2
401 - 500	A	1
Above 500	None	0

Here, if the price is below Rs. 250, the price is less than that of the willingness to pay of all the three, so all three of them will buy the ticket. If the price is greater than Rs. 250 and less than or equal to Rs.400, only A and B will buy the ticket since the price exceeds the willingness to pay by C. Now if the price is more than Rs.400 and less than or equal to Rs.500, only A will buy the ticket. If the price is

more than Rs.500 which is higher than the willingness to pay of all the three, nobody buys the ticket.

In general,

1. If the price is greater than the willingness to pay, the consumer will not buy the good or service.

2. If the price is less than the amount the consumer is willing to pay, she/he will be happy to buy it.

3. If the price is equal to the consumer's willingness to pay, she/he will be indifferent. i.e., the consumer will either buy it or keep the money.

Consumer surplus

Consumer surplus is the difference in the amount that a consumer is willing to pay for a good or a service and that he actually pays.

Marshall defined consumer surplus as "excess of the price which a consumer would be willing to pay rather than go without a thing over that which he actually does pay is the economic measure of this surplus satisfaction…. it may be called consumer's surplus."

Consumer surplus = consumer's willingness to pay – actual price paid

In the above example, if the price of the ticket is Rs.300, C will not be buying the ticket as the price exceeds his willingness to pay. But A and B will buy the tickets.

As B's willingness to pay is Rs.400,
B's consumer surplus = 400-300 = 100.

Similarly, A's willingness to pay is Rs.500

A's consumer surplus = 500-300 = 200.

Recap

- Price effect-A change in price of commodity causing change in quantity demanded
- Price effect be split into income effect and substitution effect
- Income effect-impact of increase in purchasing power on consumption
- Substitution effect-effect of change in price of good on demand of good
- Two methods of decomposing price effect - Hicksian and Slutsky's Method
- Inferior goods -demand falls when income of consumer rises
- Inferior goods- income effect and substitution effects are negative
- Giffen goods are inferior goods, demand increases when price increases
- ICC-locus of points of consumer's equilibrium at various levels of income

- PCC-locus of points of consumer's equilibrium with change in price of single commodity
- Demand curve derived from PCC
- Consumer surplus = consumer's willingness to pay – actual price paid
- Willingness to pay is amount a consumer is ready to pay to buy a good
- Marshallian consumer surplus based on cardinal utility analysis
- Marshallian consumer surplus approach, Consumer surplus $\sum MU - PQ$
- Hicksian approach to consumer surplus based on indifference curve analysis

Objective Questions

1. What is price effect?
2. What are the two effects associated with the price effect?
3. Name two methods of decomposing price effect.
4. What is income consumption curve?
5. What is price consumption curve?
6. Name the curve from which the Engel's curve is derived.
7. What is Giffen good?
8. What is willingness to pay?
9. For which type of goods the law of demand fails?
10. What will be the income effect for an inferior good?
11. Give an example for a substitute good.

Answers

1. An effect of a change in the price of the commodity on the demand for the commodity is known as price effect.
2. Income effect and substitution effect
3. Hicks method and Slutsky's method
4. Income consumption curve is the locus of points of consumer's equilibrium when income of the consumer changes.
5. PCC-locus of points of consumer's equilibrium with change in price of single commodity
6. Income consumption curve
7. Giffen goods are those inferior goods whose demand increases with increase in price.
8. Willingness to pay is amount a consumer is ready to pay to buy a good
9. Giffen goods
10. Negative
11. Coke and Pepsi

Assignments

1. Explain income effect and substitution effect under normal and inferior goods.
2. Describe the Hicksian approach of decomposition of price effect.
3. Examine Slutsky's approach of decomposition of price effect.
4. What is income consumption curve? Draw diagrams to show income consumption curve in case of (a) two normal goods (b) normal and inferior good
5. What is price consumption curve? Explain the derivation of the demand curve from price consumption curve.
6. What is a giffen good? Explain the shape of the demand curve for a giffen good?
7. What is the shape of the price consumption curve for an inferior good? Illustrate it with an indifference curve diagram.

8. What is consumer surplus? How is consumer surplus measured with the help of indifference curve?

Suggested Readings

1. Hal R Varian(2010) *Intermediate Microeconomics: A Modern Approach*, 8th Edition, W.W Norton and Company/ Affiliated east- West Press(India).

2. Salvatore, D. (2003) *Microeconomics Theory and Applications* (Fourth Edition), Oxford University Press.

3. Nicholson Walter and Christopher Synder (2019), *Microeconomic Theory-Basic Principles and Extensions*, Cengage Learning.

References

1. Dwivedi, D.N. (2012). *Microeconomics: Theory and Applications* (Second Edition). Vikas Publishing House Pvt. Ltd.

2. Maddala, G.S. & Miller Ellen (2013). *Microeconomics Theory and Applications*, (Tenth Edition). McGraw Hill Education Private Limited.

3. Mankiw, N. G. (2016). *Principles of microeconomics* (8th ed.). CENGAGE Learning Custom Publishing.

4. Pindyck, R. S., Rubinfeld, D.L., & Mehta, P.L. (2013). *Microeconomics* (Seventh edition). Pearson Education Prentice Hall.

UNIT

Revealed Preference Theory

Learning Outcomes

After learning this unit, the learner will be able to:

- familiarise with the revealed preference theory
- explain the concepts such as consistency and transitivity
- narrate derivation of demand curve under Revealed Preference Theory

Prerequisites

Different individuals prefer goods differently. We all prefer some goods over another. Suppose, among the fruits, you may like apples very much. But, your friend may like grapes over all other fruits. In the case of site seeing, you may prefer to go to beaches, but your family member may like to go to hill stations. So, individuals have their own preference of goods from among the available goods.

How do we understand the preference of a person? Take the case of fruits. We can understand that an individual prefers apples if the person chooses apples over other fruits. So, the choice of a person reveals the person's preference. This unit deals with the theory explaining choice and preference.

Keywords

Revealed preference theory, Consistency, Transitivity, Revealed preference axiom

3.4.1 Revealed Preference Theory

Hicks' Indifference curve approach of utility analysis was an advancement over the Marshallian approach as it considered utility to be ordinal. But it was still based on introspection. In 1948, Prof. Paul. A. Samuelson, an American economist, put forward the revealed preference theory. The theory is also known as the "third root of logical theory of demand", which was behaviourist as well as ordinal in nature. This theory tries to explain the consumer's demand from her/his actual behaviour with respect to various price-income situations she/he faces.

Assumptions of Revealed Preference Theory

1. **Rationality**: In this theory, a consumer is assumed to behave rationally i.e., the consumer tries to maximise her/his utility from the resources she/he has.

2. **Consistency**: The consumer always sticks on to her/his choice. If the consumer chooses X over Y at a point of time, she/he will not choose Y at another point of time when X is available.

3. **Transitivity**: If a consumer prefers good X over good Y and she/he prefers good Y over good Z, according to the assumption of transitivity the consumer must prefer good X to good Z

4. **Taste and preference:** Taste and preference of the consumer is constant.

5. **Choice reveals preference:** Consumer's choice reveals her/his preference for that combination over the alternatives she/he has.

6. **Income elasticity of demand is positive:** When the income of the consumer increases, her/his demand will also increase and vice versa.

7. **Monotonicity**: Consumer prefers the combination of more goods to less goods (monotonic).

3.4.1.1 Revealed Preference Axiom

Revealed preference theory is based on the hypothesis that a consumer's choice reveals her/his preference. A consumer will purchase a combination of two goods among the alternative combinations because:

(a) of the relative liking towards that combination in comparison to other combinations.

(b) the chosen combination is cheaper in comparison to other combinations.

But the consumer is said to have revealed his preference only when the price of the combinations is the same and he chooses one combination over another because of his relative liking for it in comparison with the other.

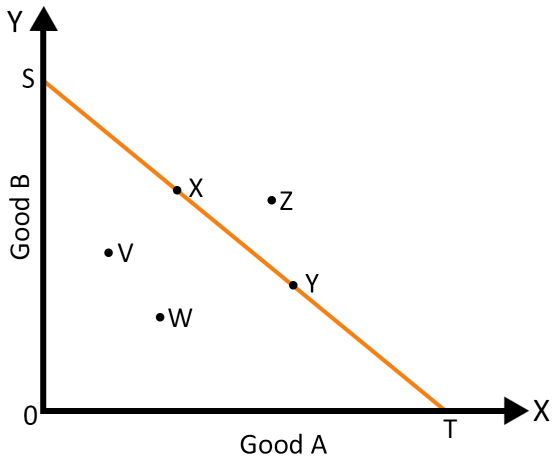


Fig 3.4.1 Revealed Preference Axiom

In figure 3.4.1, X-axis represents good A and Y-axis represents good B. Given the prices of good A and good B, and the consumer's income, ST represents the budget line of the consumer. The triangular area OST is the area of the consumer's choice of combinations of good A and good B subject to her/his budget constraint. So, the consumer can choose between X or Y which is on the budget line or between V or W which is below the budget line. Now, if a consumer chooses the consumption bundle X, she/he reveals her/his preference for combination X to combination Y. Here, the consumption bundle V and W are below the budget line ST and hence it is considered as inferior bundles, therefore the consumer will not reveal his preference for these consumption bundles. Also, any combination above the budget line like Z represents unattainable consumption bundles, as they are expensive. The consumer will not reveal her/his preference for those bundles too.

3.4.1.2 Decomposition of Income and Substitution Effects

The decomposition of price effect into substitution effect and income effect can be illustrated through revealed preference theory.

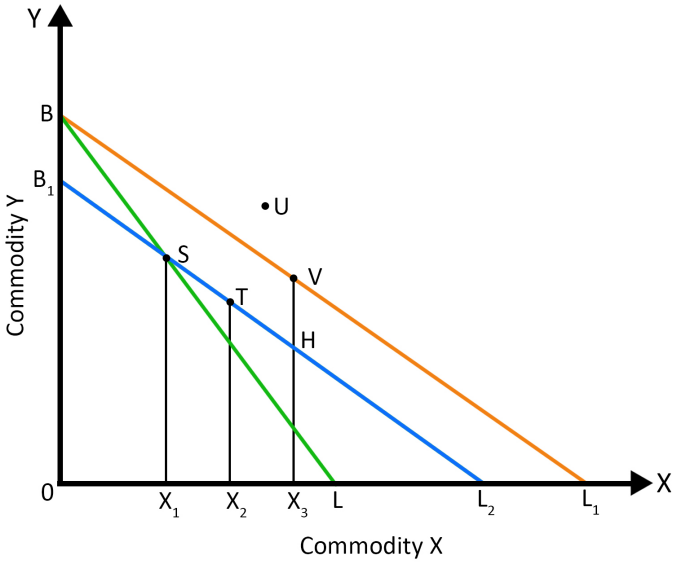


Fig 3.4.2 Revealed Preference Theory

In the above figure 3.4.2, X-axis represents commodity X and Y-axis represents commodity Y. If the consumer initially chooses the consumption bundle S on the budget line BL. Since all the consumption bundles on the budget line are equally expensive, the choice of the consumer to purchase the consumption bundle S means she/he reveals her/his preference for S over all other bundles on the budget line BL.

Now if the price of the commodity X falls, the budget line gets flatter and gets shifted to BL_1 and the consumer shifts her/his consumption to a new bundle 'V'. At 'V' he purchases OX_3 units of X which is more than the previously consumed OX_1 level of X. This is the price effect.

In order to split the price effect into income and substitution effect, the Slutskian approach is used. A new budget line B_1L_2 is drawn parallel to the budget line BL_1 and passes through S. This shows a hypothetical (imaginary) withdrawal of income so that the consumer can buy a combination S, at the reduced price, if he desires so. Now the consumer is capable of buying the initial consumption bundle subject to the new price ratio. The consumer will not consume from the segment B_1S as they were already declared inferior in the first chosen combination (S). The consumer chooses a consumption bundle on the segment SL_2, to be exact between S and H. If the consumer reveals her/his preference for S, the substitution effect will be zero. If the chosen basket is T, there is substitution effect. The price effect will be X_1X_3 and income effect will be X_2X_3. The residue after the elimination of income effect is substitution effect and it will be X_1X_2.

3.4.1.3 Derivation of Demand Curve from Revealed Preference Theory

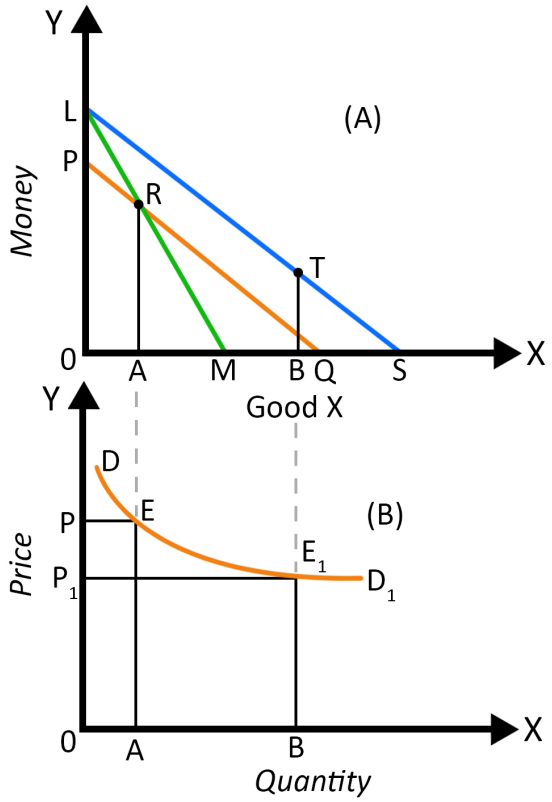


Fig 3.4.3 Derivation of demand curve: Revealed Preference Approach

In the figure 3.4.3 panel (A) shows the change in preference when price of the good X falls, where X- axis represents the quantity of good X and Y- axis, the money income with the consumer. Suppose, the consumer is preferring the consumption bundle R initially. Suppose, the price of good X falls, her/his budget line gets flatter and shifts to LS. Now the consumer's real income changes. This change in income is compensated by drawing an imaginary budget line PQ parallel to LS so that the consumer's income is reduced. Now the consumer can purchase the original bundle if she/he wishes for it as the new budget line PQ also passes through R. The consistent behaviour of the consumer makes her/him consume the consumption bundle R or any point to its right on the budget line PQ.

Since Money income can be written as, $M = P \times X$, if only one commodity is purchased by the consumer, $P = M/X$. In other words, the money income of the consumer divided by the total quantity of good X purchased will give the price of the commodity. Thus $\frac{OL}{OM}$ gives the price OP and $\frac{OL}{OS}$ gives the reduced price OP_1.

The panel (B) of the figure 2.5.3 contains quantity of good X on the X-axis and price of the good on Y-axis and plots the demand curve for the commodity.

Recap

- Revealed preference theory proposed by Paul A. Samuelson
- It is ordinal-behavioural approach towards consumer theory
- The theory assumes consumer's choice reveals her/his preference
- The theory assumes constant taste and preference
- Consistency and transitivity are two important assumptions
- The theory assumes Income elasticity of demand is positive
- The Slutskian approach used to decompose the price effect
- The decomposition of the price effect, without using the indifference curve
- Income effect is positive under the Revealed Preference Approach
- Demand curve can be derived from revealed preference theory

Objective Questions

1. Who put forward the revealed preference theory?
2. Name one theory over which the revealed preference theory is superior?
3. What is consistency?
4. What is transitivity?
5. Give two assumptions of revealed preference theory.
6. What is the fundamental principle of revealed preference theory?
7. How does revealed preference theory explain the decomposition of price effect?
8. Give mathematical relation of money income and price of the commodity when a single commodity is purchased.

Answers

1. P. A. Samuelson
2. Ordinal Utility Analysis
3. If consumer chooses one commodity over another, then consumer will not consume another commodity when first commodity is available.
4. Transitivity means if a consumer prefers good X over good Y and prefers good Y over good Z, then the consumer will always prefer good X over good Z.
5. Consumer is rational, and taste and preference are given
6. Consumer's choice reveals preference
7. The theory explains the decomposition of the price effect, without using the indifference curve.
8. $M = P \times X$

Assignments

1. State and explain Revealed preference theory of demand.
2. Explain two assumptions of revealed preference theory.
3. What is the fundamental principle of revealed preference theory?
4. Explain the derivation of demand curve under revealed preference theory.
5. Examine the decomposition of the price effect under the revealed preference approach.

Suggested Readings

1. Hal R Varian(2010) *Intermediate Microeconomics: A Modern Approach*, 8th Edition, W.W Norton and Company/ Affiliated east- West Press (India).
2. Salvatore, D. (2003) *Microeconomics Theory and Applications* (Fourth Edition), Oxford University Press.
3. Nicholson Walter and Christopher Synder (2019), *Microeconomic Theory-Basic Principles and Extensions*, Cengage Learning.

References

1. Dwivedi, D.N. (2012). *Microeconomics: Theory and Applications* (Second Edition). Vikas Publishing House Pvt. Ltd.
2. Maddala, G.S. & Miller Ellen (2013). *Microeconomics Theory and Applications*, (Tenth Edition). McGraw Hill Education Private Limited.
3. Mankiw, N. G. (2016). *Principles of microeconomics* (8th ed.). CENGAGE Learning Custom Publishing.
4. Pindyck, R. S., Rubinfeld, D.L., & Mehta, P.L. (2013). *Microeconomics* (Seventh edition). Pearson Education Prentice Hall.

Theory of Production

UNIT 1

Production

Learning Outcomes

After reading this unit, the learner will be:

- introduced to the concept of production
- exposed to the behaviour of the profit maximising firm
- familiarised with the shape of Total Product, Average Product, and Marginal Product curves

Prerequisites

We see many goods around us. These can be buildings, roads, clothes, bags, shoes or essential commodities. In a market economy like ours, there are millions of commodities available to us. How are these goods produced? What is this process of production? Production is one of the basic economic functions. Only when exchange of goods and services takes place, an economy can grow. Production is a process in which a firm uses its resources to transform inputs (capital, raw material, labour) into useful products (goods or services). It is therefore a process involved in creating something new for the economy. There are various goods, let us say- a sari to a mobile phone which use different inputs and go through a different kind of production process. If you are a very rich producer, you might not be able to run the production process by yourself. Maybe you can use capital , buy land, set up a factory, and buy machinery. But to produce useful goods, you need expertise. This involves use of labour, adequate machinery, and other raw materials. These become inputs in the production process.The production process involves the use of various inputs in the correct proportion. It follows different path in different time periods. In the short- run, most of the factors of production are fixed and there is only one variable input. Imagine that you are manufacturing bottled water. For this, you require a factory, machinery, raw material (water), and labour. Of these inputs labour and water are the only variable factors of production. You can change the quantity of water

bottles you produce by changing the labour used in the production process. Now, think of a long run situation. In the long-run you can change all factors of production, thus allowing for more flexibility in the production process. You can buy new machines, hire new workers, expand the factory and also look for new sources of water. Thus, the production process becomes different in the short-run and long-run. As production is one of the basic functions of an economy, let us look into different concepts in studying production.

Keywords

Input, Output, Production function, Total product, Marginal product, Average product, Profit

4.1.1 Concept of Production

As we have briefly stated what production is, let us try to analyse it in a little more detailed manner. The basic aim of production is transformation of inputs into outputs. Production in economics is not restricted to physical transformation of goods but also involves provision of services like transportation, and finance. The theory of production in economics is actually about understanding the production function. The theory of production has a very crucial role in price theory. It actually is the basis for analysis of the relation between costs and amount of output. It is also related to the theory of the firm. The theory of the firm looks at the level of output the firm will produce to maximise its profit.

What is this production function? How is it relevant in the theory of production?

4.1.1.1 Production Function

Production Function shows the relationship between the quantity of inputs used to make a good and the quantity of output of that good. A simple mathematical representation of the production function is given below.

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

Q is output, K is capital, and L is labour.

Here, output is a function of capital and labour. As capital and labour are the basic inputs used in the production process, it is used to produce a fixed quantity of output. The technical relation between inputs used and output produced is called the production function. The production function can be studied by allowing certain inputs to be fixed and the others to be variable.

4.1.1.2 Behaviour of Profit maximising Firm

Samsung is a leader in producing consumer appliances like TV, washing machines, and refrigerators. Profit maximisation is the primary goal of the firm. Profit can be defined as the difference between the total revenue and the total cost incurred by the firm. Total Revenue(TR)

is price times the total quantity of output produced by the firm, and Total Cost(TC) is the overall cost incurred while producing the total quantity of output of the firm.

Profits = Total Revenue - Total Cost

$\Pi = TR - TC$

$TR = TC, \Pi = 0$ (Normal Profits)

$TR > TC, \Pi > 0$ (Excess Profits)

$TR < TC, \Pi < 0$ (Loss)

There are two approaches to analyse the profit maximising behaviour of the firm. One is the TR_TC approach and the other is the MC_MR approach. MC is the Marginal Cost. It is the addition to Total Cost when one more additional output is produced by the firm whereas, MR is the Marginal Revenue, and is the addition to Total Revenue when the additional output produced by the firm is sold. Let us explain the TR_TC approach in detail using the below figure.

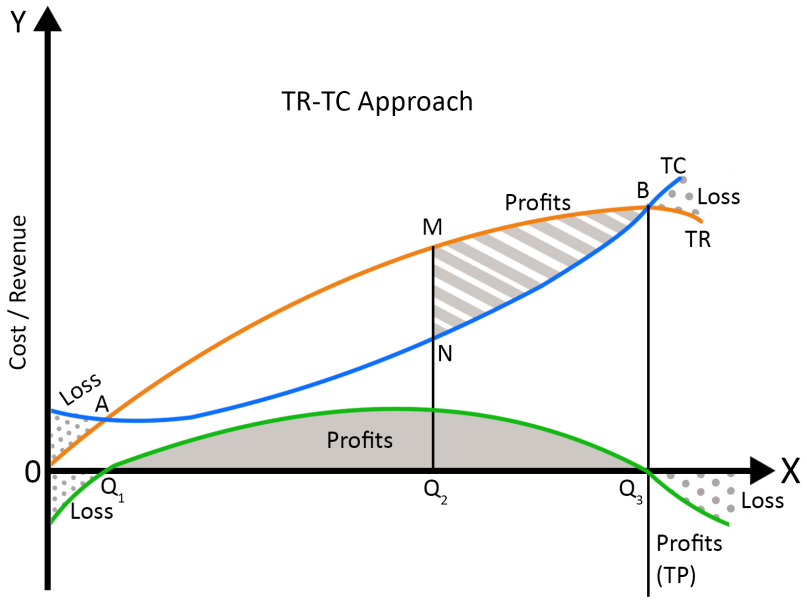


Fig 4.1.1 TR_TC approach to Profit Maximisation

TR is the Total Revenue curve and TC is the Total Cost Curve. The line below the TC and TR curves is the Total Profit line. From the origin point, O, to the point A (on the first intersection of TR and TC curves), TC is greater than TR. Since cost is greater than revenue, the firm experiences loss until the production of Q_1. After the point A and Q_1, TR rises above TC leading to profit. The firm experiencing profit from Q_1 to Q_3 is shown in the figure. After Q_3, TC rises above TR again leading to loss. A rational producer maximises his profit and would ideally prefer the second case, i.e., produce between Q_1 to Q_3.

Profit is negative at low levels of output because the amount of revenue that the firm earns is not enough to cover fixed and variable costs. As production expands and output rises, revenue rises at a faster rate than cost, so that profit slowly becomes positive. Profit increases from Q_1 and continues to increase until output reaches the point Q_2. At this point, the vertical distance between total revenue and total cost is the greatest, i.e., the profit, which is the difference between total revenue and total cost, is the greatest. OQ_2 is the profit-maximising output level. The point where the vertical distance between total revenue

and total cost is the greatest is also the point where the marginal revenue and marginal cost are equal.Note that, at output levels above Q_2, cost rises more quickly than revenue i.e., marginal revenue is less than marginal cost. Thus, profit declines from its maximum when output increases above Q_2.

Under perfect competition, AR = MR = P. It is parallel to the horizontal axis. The MC curve is U-shaped. Profit is maximised when MR and MC are equal.

Whatever be the market conditions, a firm will stop production if total revenue falls short of total variable cost. Profit will be maximised at that point where MR and MC are equal to each other. For any output where MR > MC, the firm will start to produce more. Doing so, it will add more to its revenues than to its costs, thereby increasing profit.

On the other hand if MC > MR, there is no incentive on the part of the firm to raise its output. If it decides to increase output when MC > MR, it will add more to its costs than to its revenues, thus reducing profit. Hence the profit-maximising output occurs at that point when MR = MC as shown in the figure 4.1.2.

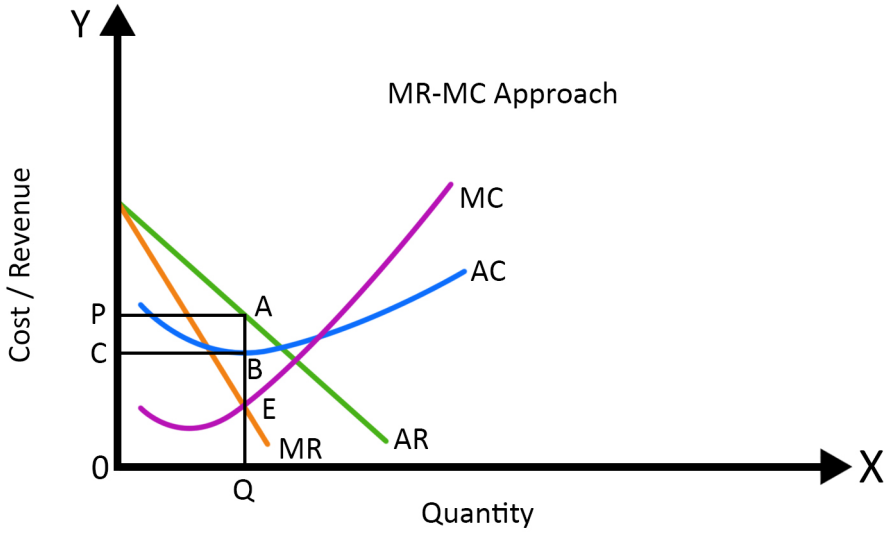


Fig 4.1.2 MR_MC Approach to Profit Maximisation

The rule that profit is maximised when marginal revenue is equal to marginal cost is true for all firms, whether it is competitive or not. The figure shows the equilibrium condition in a non-competitive market structure. The equilibrium is at E where profit is maximised when MC is equal to MR while producing Q level of output. OPAQ is the Total Revenue, and OCBQ is the Total Cost. Hence, the difference, CBAP is the profit. The learner will hear more about the profit maximising under competitive and non-competitive market structure in Microeconomics II.

The MC equals the MR rule can also be derived algebraically.

Profit, P = R - C, is maximised at the point at which an additional increment to output leaves profit unchanged (i.e., $\Delta p / \Delta q = 0$): $\Delta p / \Delta q = \Delta R / \Delta q - \Delta C / \Delta q = 0$

Here, $\Delta R / \Delta q$ is marginal revenue, MR, and $\Delta C / \Delta q$ is marginal cost, MC. Thus we can say that profit is maximised when MR - MC = 0, so that
MR = MC

Mathematical Approach

The main objective of the firm is to maximise profit.

$\Pi = f(Q) = TR-TC$

There are two conditions for maximising profits:

The First Order Necessary Condition(FOC) is $d\Pi/dQ = 0$

($d\Pi/dQ = 0$ is a differential equation of order, one. It shows the derivative of the profit function with respect to output).

As Π is TR-TC, substituting it in FOC makes the equation as, $d(TR-TC)/dQ = 0$, Simplify the equation as,

$d(TR)/dQ - d(TC)/dQ = 0$

$d(TR)/dQ$ is MR (slope of TR). MR is the change in TR due to changes in Q. $d(TC)/dQ$ is MC(slope of TC). MC is the change in TC due to change in Q.

So, $d(TR)/dQ - d(TC)/dQ = 0$ can be also written as MR-MC=0

Rearranging the above equation gives MR=MC

So, the First Order Condition is satisfied as $d\Pi/dQ = 0$ is MR=MC

The Second Order Condition (SOC) is that the slope of the MR is less than MC or $d^2\Pi/dQ^2 < 0$ or $d^2(TR)/dQ^2 - d^2(TC)/dQ^2 < 0$ ($d^2\Pi/dQ^2 < 0$ is a differential equation of order, two)

Rearranging $d^2(TR)/dQ^2 - d^2(TC)/dQ^2 < 0$ is $d^2(TR)/dQ^2 < d^2(TC)/dQ^2$

$d^2(TR)/dQ^2$ is the slope of MR, and $d^2(TC)/dQ^2$ is the slope of MC.

So, the equation $d^2(TR)/dQ^2 < d^2(TC)/dQ^2$ means the slope of MR is less than the slope of MC.

So, the Second Order Condition is also satisfied.

4.1.1.3 The shape of Total Product (TP), Average product (AP), and Marginal Product (MP) Curves

To understand the concepts of TP, AP, and MP, let us take a simple numerical example.

Table 4.1.1 Total, Average, Marginal Product of Labour in a Pen Factory

K	L	TP(Q)	AP (Q/L)	MP (ΔQ/ΔL)
5	0	-	-	-
5	1	20	20	20
5	2	60	30	40
5	3	120	40	60
5	4	160	40	40
5	5	190	38	30
5	6	216	36	26
5	7	224	32	8
5	8	224	28	0
5	9	216	24	-8
5	10	200	20	-16

There is a pen producing factory. To produce pens, two inputs capital and labour are used.

The table given above can be used to understand the concepts of Total Product (TP), Average Product (AP), and Marginal Product (MP).

Total Product refers to the total quantity of output produced with the given labour and capital. The third column shows the total product. In this particular case, it shows the amount of pens produced in the industry.

Average product is the total product divided by labour input. AP = Q/L. In the first phase of production, average product increases but when more than 4 units of labour are used it falls.

Marginal product is the change in the total product with a change in variable input, keeping other factors constant. In the case of the pen factory, the marginal product is the additional number of pens produced when one more unit of labour is used, keeping the technology constant. Using 5 units of capital and 4 units of labour, the factory can produce 160 pens. Now when one more worker is employed what is the change in the number of pens produced? When the number of workers increases from 4 to 5 we see that the total product changes to 190. The marginal product is 30.

Thus algebraically Marginal Product is

MP= (ΔQ/ΔL)

=30/1=30 units

We observe that whenever the Marginal Product is greater than Average Product (MP > AP), AP is increasing. MP is equal to AP when AP is maximum. When AP is declining, MP is less than AP.

TP, AP, and MP curves

So far we have discussed the concept of TP, MP, and AP, now let us look at the shape of these curves.

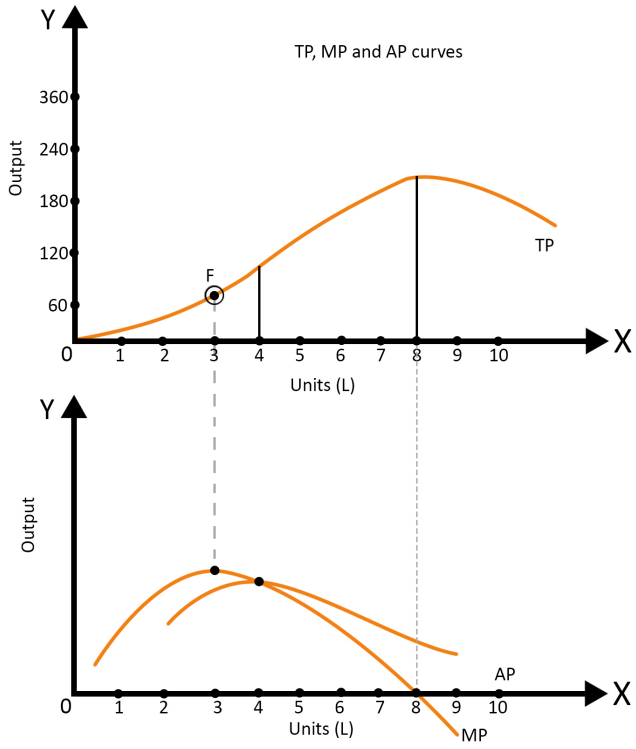


Figure 4.1.3 Total, Average, and Marginal Product Curves

From the above figure we can make the following observations:

1. As long as the Marginal Product (MP) is positive, Total Product will continue to increase. There is an incentive to produce more leading to an expansion of output.

2. When MP reaches zero, TP is at its highest point. When the 8th unit of labour is employed, MP is zero and TP is at its maximum level.

3. When MP is negative, TP decreases and has a falling slope.

4. F is an inflection point. TP increases at an increasing rate until F. Also, the point F corresponds to the maximum point of MP. So, TP increases at an increasing rate until MP is maximum.

5. The maximum TP is 224 units (with a combination of 7 units of labour and 5 units of capital). After this point, even use of additional units of labour input will not increase the TP.

Relationship between AP and MP

6. When MP rises AP also rises though at a lesser rate of increase than MP. Even when MP starts falling but is still more than AP, AP shows a tendency to increase.

7. When AP is at its maximum level, then MP becomes equal to AP. MP cuts AP at its maximum point.

8. When MP decreases, it pulls down AP also. The rate of decrease in AP is less than that of MP.

Recap

- Production is one of basic economic functions
- Production involves converting inputs into useful output
- Production Function-functional relationship between inputs and output
- Mathematically it can be shown as, Q = f(K,L)
- Two approaches to analyse profit maximising behaviour of firm: TR_TC and MC_MR approach
- Profits are maximised when the difference between TR and TC is maximum and when MR=MC
- Marginal Product (MP) is positive, Total Product increases
- When MP reaches zero, TP is at its highest point
- When MP is negative, TP decreases and has a falling slope
- When MP rises, AP also rises though at a lesser rate of increase than MP

- When MP starts falling and above AP, AP shows tendency to increase
- When AP is at its maximum level then MP becomes equal to AP
- MP cuts AP at its maximum point
- When MP decreases it pulls down AP also
- The rate of decrease in AP is less than that of MP

Objective Questions

1. What is production?
2. Define production function?
3. What are the two approaches to study profit maximising behaviour of a firm?
4. What will happen to TP so long as MP is positive?
5. What is the Marginal Product (MP) of a firm?
6. Write the mathematical form of a production function.
7. When does MP become equal to AP?
8. What is the profit maximising condition under perfect competition?
9. If MR>MC, what will happen to the output of the firm?
10. When the MP of a firm decreases what happens to the AP?

Answers

1. The process of transforming inputs to output is called production.
2. Production Function shows the functional relation between input and output.
3. TR_TC and MR_MC approach
4. TP will expand
5. The addition to the total output by producing one more unit of a commodity.

6. Q = f(K, L)
7. MP becomes equal to AP when AP is at its maximum.
8. MC=MR
9. The firm will expand its output and produce more
10. When MP decreases it pulls down AP.

Assignments

1. Describe various approaches to profit maximisation.
2. Using an example, show the relationship between AP and MP.
3. Explain the shape of TP, AP, and MP curves.

Suggested Readings

1. Koutsoyiannis, A. (1990), *Modern Microeconomics* (Second Edition), Macmillan Education
2. Salvatore, D. (2003), *Microeconomics - Theory and Applications* (Fourth Edition), Oxford University Press.

References

1. Pindyck, R.S., Rubinfeld, D. L., and Mehta, P. L. (2013). *Microeconomics* (Seventh edition). Pearson Education Prentice Hall.
2. Samuelson, P. A., & W. D. Nordhaus (1998). *Economics*. New Delhi: Tata McGraw Hill.

UNIT

Laws of Production

Learning Outcomes

After reading this unit, the learner will be:

- able to distinguish between long-run and short-run laws of production
- introduced to the concepts of isoquant, isocost, and MRTS
- familiarised with producer's equilibrium

Prerequisites

An economy can grow only with a very important economic activity-production. From the chair you sit to the toothbrush you use, there are millions of decisions involved in the production process. Goods differ in their nature, form, and also in the way they are produced. In the previous unit, we discussed the concept of production and the various terms associated with it. The time period in which production is organised is very crucial for the producer. Huge projects around you like building ports, railway lines, over bridges etc. require a long period of time. It takes years to complete certain projects and therefore the use of inputs for production can always be altered. The resources and the way in which production is organised in the short-run and long-run are different. But producing our daily use items like soap, plates, glass, and detergents require only a short period of time. The output produced always depends on the right combination of inputs used. Producers do not have flexibility or much of choices during the short period of production. In the long-run, all factors of production can be changed. We will now look into the details. The two laws that are important to analyse production and how the producer's equilibrium is attained are dealt here. To understand these two main themes, we will use concepts like isoquants, isocosts, and MRTS.

Keywords

Law of variable proportions, Returns to scale, Isoquants, Isocost line, MRTS, Producer's equilibrium

4.2.1 Laws of Production

The production process is organised by using a set of inputs. By inputs we mean the use of services of land, labour, capital, and entrepreneur. The end result of any production process is to create a useful output. Output is the commodity we produced with the help of inputs. Without factor inputs and without some way of combining the factor inputs we cannot produce outputs. Therefore there exists a relationship between inputs and outputs. This relationship is studied under the topic production function.

Factors of production or inputs are classified as fixed inputs and variable inputs. Variable factors refered to those factors which can be changed in the short-run. They include labour, power, fuel, and raw materials. On the other hand fixed factors constitute those factors which remain constant in the short-run. Examples of fixed factors are building, capital equipment, and permanent employees. In the short-run, almost all factors of production (inputs) are fixed. In the short-run, we observe changes in output when one of the factor inputs is variable. The Law of Variable Proportions represents short-run law of production, where changes in output happen because of the changes in the variable factor of production.

On the other hand, the long-run is the time period where the producers get sufficient time to change all factor inputs. This again has mixed effects on output. The long-run law of production is understood with the help of laws of returns to scale.

4.2.1.1 Law of Variable Proportions

Production is different in different time periods. In the short-run, it is not possible to change all inputs or factors of production. If you are running a soap factory, in the short-run you might be able to change only one factor of production, labour. You can hire more workers to produce more soaps. Other factors like land for the factory, building, machinery, and capital remain fixed.The effect of hiring more workers may be a mixed one. It is observed that in the beginning with increase in workers the production increases, but after a point employment of more workers leads to a fall in production. Why is this so? To explain the short-run production process, let us look at the Law of Variable Proportions. The Law of Variable Proportions is a short-run law of production which explains how output changes when only one factor of production changes. The other inputs used in the production are kept fixed. The law works when the short-run production aims at changing output by changing the proportion of the variable input used.

When the variable input is increased or decreased (labour as in the example we have given) while keeping other factors fixed, the proportion between the inputs

used is again altered. Suppose there are two factors of production, land and labour, that the producer uses. Land is a fixed factor whereas labour is a variable factor. Now, suppose we have a land measuring 7 acres. We grow rice on it with the help of variable factor i.e., labour. The proportion between the two inputs is 1:7. If the number of labourers is increased to 5, the new proportion between labour and land will be 5: 7. When the factor proportions change, there is a change in total output of the firm.This tendency for the output to change due to a change in the variable factor in the short-run is the Law of Variable proportions.

Let us look into the assumptions of the Law.

Law of Variable Proportions is based on the following assumptions:

- **Constant Technology:** The technology used for production is given and does not change. If there is a new technology used, the production function will automatically shift upward.
- **Factor Proportions are Variable:** Law of Variable Proportions assumes that the proportion between inputs used is variable.
- **Short-Run:** The law operates only in the short-run when it is not possible to change all factor inputs.

Law of Variable Proportions – Explaining with an Example

Suppose you own a piece of land and decide to start wheat cultivation on it. The two factors of production available to you are land and labour. By keeping land as a fixed factor, the production of variable factor i.e., labour can be shown with the help of the following table:

Table 4.2.1 Total and Marginal Physical Product of Labour

Units of Land	Units of Labour	TP	AP	MP
1	1	3	3	3
1	2	7	3.5	4
1	3	12	4	5
1	4	16	4	4
1	5	19	3.8	3
1	6	21	3.5	2
1	7	22	3.14	1
1	8	22	2.75	0
1	9	21	2.33	-1
1	10	20	2	-2

From Table 4.2.1, we see that, total product, average product, and marginal product increases in the beginning. MP reaches its maximum at 3rd unit of labour, and then starts declining. AP reaches maximum while employing the 4th labour, and falls after that. In the case of TP, it maximises when 8 units of labour are employed. It is interesting to note that, though MP becomes negative, TP remains positive as long as AP is positive. The figure 4.2.1 depicts the shape of TP, AP, and MP curves corresponding to the values given in Table 4.2.1.

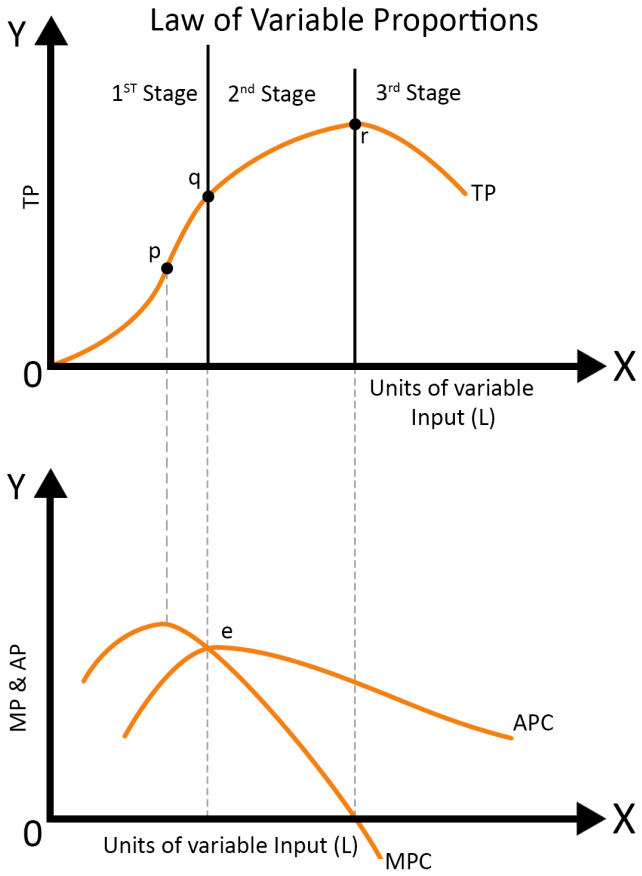


Fig 4.2.1 Law of Variable Proportions

In fig.4.2.1, on the X-axis, we can measure the number of workers while the quantity of output is shown on the Y-axis. TP is the total product curve. MP and AP shown in the lower part depicts the marginal product curve and average product curve respectively. The law of variable proportion is explained in three stages. The figure depicts that the TP, MP, and AP curves increase initially, reaches its maximum, and falls after that. The rate of increase, the maximum point, and rate of fall is different for each of these curves. In the first stage, the TP increases at an increasing rate, reaches its maximum at the second stage, and falls along the third stage. For MP, it reaches the maximum point and starts falling in the first stage itself. Later, MP falls and reaches zero point in the second stage, and becomes negative in the third stage. In the case of AP, it increases and reaches the maximum point at first stage, and continuously falls and remains positive for the entire second and third stage. The three stages of the law of variable proportion is explained in detail below.

Three Stages of the Law

1. **First Stage:** First stage starts from point 'O' and ends up to point q. At point 'e', the average product (AP) is maximum and is equal to marginal product. In this stage, total product increases in the beginning at an increasing rate up to point 'p'. After this point, the TP rises at a decreasing rate. If you look at the marginal product, MP also increases initially and reaches its maximum point at 'p'. Later on, it begins to diminish and becomes equal to the average product at point 'e'. In this stage, the marginal product is more than the average product (MP > AP). It is interesting to note that, TP curve increases at an increasing rate until MP is maximum.
2. **Second Stage:** It begins from the point 'q'. In this stage, total product increases at a diminishing rate and reaches its maximum at point 'r'. The marginal product decreases quickly and becomes 'zero'. Average product is maximum at point 'e' and after that, it begins to fall. In this stage, the marginal product is less than average product (MP < AP).
3. **Third Stage:** This stage begins beyond point 'r'. Here the total product starts decreasing. Average product also falls. Marginal product becomes negative. The Law of diminishing returns sets in at the third stage. In the third stage, firms will not prefer to produce anything.This happens because the marginal product of the labour becomes negative. The employer will suffer losses by employing more units of labourers. However, of the three stages, a firm will like to produce up to any given point in the second stage only.

Decisions of Producers

To make things simple, let labour be the variable factor and land be the fixed factor. Stage I of production sees an increase in AP, so that the total product must also be increasing. This means that the efficiency of the variable factor of production is increasing i.e., output per unit is increasing. The efficiency of the fixed factor is also increasing, since the total product increases in the beginning with increasing use of inputs.

The second stage of production sees decreasing AP and also a declining MP. At this stage, MP decreases but does not become negative. Here, we see that the efficiency of the variable factor is declining while the efficiency of the fixed factor is increasing. The TP continues to increase though at a decreasing rate.

The last stage - stage III has a rapidly falling AP and MP. The MP becomes negative at this stage. Thus, the efficiency of both the fixed and variable factors is decreasing.

The most relevant stage of production is thus Stage 2. A rational producer will produce only at Stage 2 and not in Stage 3 and 1. Suppose if land is a free resource or the producer gets a lot of land for free, then what will be his production decision? During this time, the producer would want to get maximum efficiency from the input for which he is actually paying, ie, labour. Thus, he would want to produce where AP is maximum or at the boundary between stages I and II. On the other hand, if labour is a free resource, then he would want to use land as efficiently as possible; this is the boundary between stages II and III. If the producer has to pay for both the factor inputs, then he would produce somewhere in stage II. His decision is actually determined by the relative price of factor inputs.

Use of Fixed Factor

In the first stage of production, fixed

factors of production like land or machine, are not fully used. Additional units of variable factor, like labour, are needed for the proper utilisation of fixed factors. Whenever more variable inputs are added, the fixed factors are also used to the fullest extent. This is why there are increasing returns to a factor in the first stage of production.

Fixed Factors of Production

The reason for the operation of the Law of Variable Proportions is that the majority of factors of production are fixed. When the fixed factor is used with variable factor, then its ratio compared to variable factor falls. Production is actually the proportional use of inputs to create an output. When an additional unit of a variable factor is used to produce output along with a fixed factor, then the marginal return of the variable factor begins to decrease.

Optimum Production

When the fixed factor is used upto a maximum point, then the marginal returns from the variable input decreases. The simple reason is that after the optimum use, the ratio of fixed and variable factors does not operate in a proper way. Let us suppose a machine is a fixed factor of production. It is put to optimum use when 8 labourers are employed on it. If 9 labourers are put on it, then total production may increase but only by a small amount. This results in diminishing marginal product.

Imperfect Substitutes

Factors are not perfect substitutes. Mrs. Joan Robinson has made the argument that imperfect substitution of factors is mainly responsible for the operation of the law of diminishing returns, after the fixed factors are used to a limit. One factor cannot be used in place of the other factor. After optimum use of fixed factors, variable factors are increased and the amount of fixed factors could be increased by its substitutes. If a perfect substitution of inputs is possible, then production would keep on expanding. In the real world we cannot substitute one factor input for the other.

Real World Application of the law of Variable Proportions

The law holds true in the short-run. It is applicable mainly to agriculture, industry and fisheries sector. In the case of agriculture, it is observed that the moment you increase the variable factor - labour, after a point, diminishing returns set in. Improvement to output is possible through improvement in technology in the long-run.

4.2.1.2 Isoquants

The term Isoquant is derived from the Greek word 'Iso' meaning equal and Latin word 'Quantus' which means quantity. Isoquants are curves showing all possible combinations of inputs that give us the same level of output. They are also known as 'Equal product curves' or 'Production indifference curves'. The figure 4.2.2 represents an Isoquant depicting different combination of labour and capital (A,B,and C) which help to produce the same output. If we can produce 50 kg of sugar using 5 workers and a single machinery and vary this combination by using 4 workers and 2 machines producing the same output, this can be shown using an isoquant. Isoquants show the various combinations of inputs needed for the firm to produce a given output. A set of isoquants, or isoquant map, shows us the firm's production function. Output increases as we move upwards or rightwards in the isoquant maps as shown in Fig. 4.2.3.

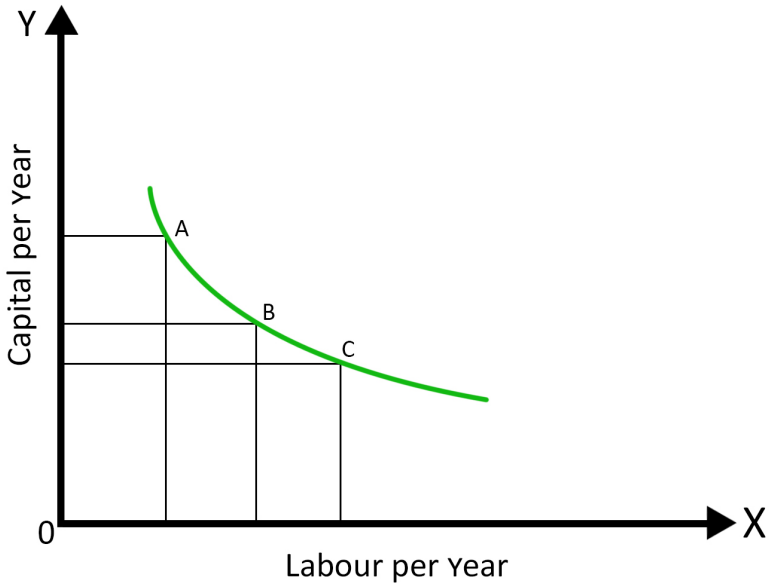


Fig 4.2.2 Isoquant

4.2.1.3 MRTS

So far we have seen what short-run changes can do to output. In the long-run, there are more options for the producer. With two inputs that can be varied, a producer has the option of substituting one input for another.

The slope of each isoquant indicates how the quantity of one input can be traded off against the quantity of the other, while output is held constant. When the negative sign is removed, we call the slope of the isoquant curve, the marginal rate of technical substitution (MRTS). The marginal rate of technical substitution of labour for capital is the amount by which the input of capital can be decreased when one additional unit of labour is employed, so that output remains constant. This is very similar to the marginal rate of substitution (MRS) in consumer theory. The MRTS is always measured as a positive quantity.

MRTS = (-) Change in capital input/ change in labour input

= (-) $\Delta K / \Delta L$ (for a fixed level of output)

Where ΔK and ΔL are small changes in capital and labour along an isoquant.

The shape of the isoquant is convex to the origin, which tells us that if we want to use one more unit of labour, we should use less capital. When the isoquants are straight lines, the MRTS is constant. Thus the rate at which capital and labour can be substituted for each other is the same, no matter what level of inputs is being used.

Diminishing MRTS

The MRTS decreases as we move down along an isoquant. The mathematical explanation of a falling MRTS is that isoquants are convex, or bowed inward. The diminishing MRTS shows that the productivity of any one input is limited. If you add more and more labour to the production process while keeping the other input, capital fixed, the productivity of labour slowly declines. If more capital is added in place of labour, the productivity of capital falls.

The MRTS is connected to the marginal products of labour, MPL, and marginal product of capital, MPK. When some units of labour are added, it must be followed

by reducing the amount of capital so as to keep the output constant. The additional output resulting from the increased labour input is equal to the marginal product of labour times the number of units of additional labour employed. The marginal rate of technical substitution (MRTS) between two inputs is equal to the ratio of the marginal products of the inputs.

So, $MRTS_{LK} = MPL/MPK$

Isoquant Map

When a number of isoquants are combined in a single graph, we call the graph an isoquant map. An isoquant map is another way of describing a production function, just as an indifference map is a way of describing a utility function. Each isoquant represents a different level of output, and the level of output increases as we move up and to the right in the figure. Each isoquant represents different levels of output (60, 75, 90) as shown in the figure below.

4.2.1.4 Properties of Isoquants

The following are the properties of isoquants

- **Isoquants are negatively sloped:** The convex shape of the isoquants indicates the negative slope.
- **A higher isoquant represents a larger output:** As the isoquants move upward or shift towards the right, it shows an expansion of output.
- **No two isoquants cut or intersect each other:** As each isoquant have a different output connected to it, it is impossible for isoquants to intersect, and show that higher isoquants represent higher level of output.
- **Isoquants are convex to the origin:** As a result of diminishing MRTS, isoquants are convex to the origin. When we use more of one input, the producer uses less of the other input to produce the same level of output.

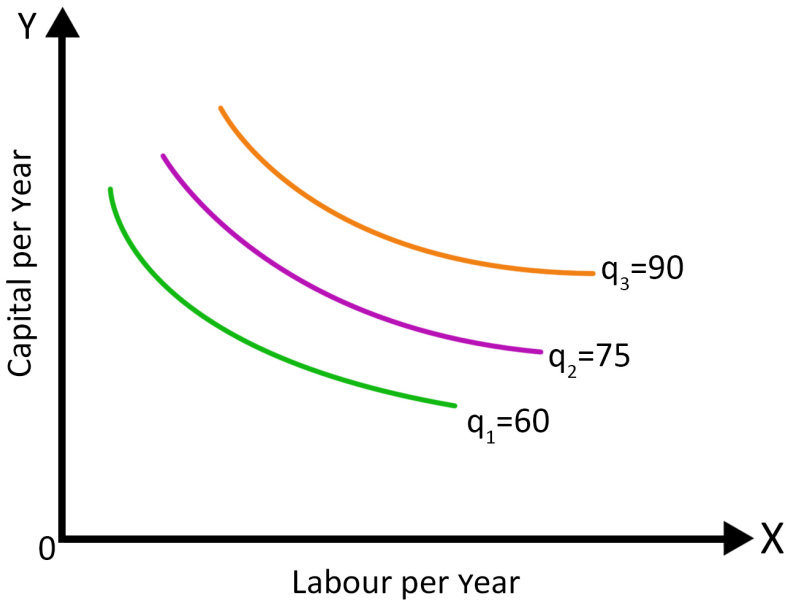


Fig 4.2.3 Isoquant Map

4.2.1.5 Laws of Returns to Scale

In the long-run, there is more flexibility to the producer. He can use inputs in different combinations as his factors of production are variable. However, in the long-run, with all inputs variable, the firm has to choose ways in which it can increase output. A method to expand output is to change the scale of the operation by using more of all of the inputs to production in proportion. If it takes one labourer working with a soda making machine in a factory to produce 10 bottles of soda, what will happen to output if we employ two workers to work with two machines in two factories now? Output in this case logically increases but will it double, more than double, or less than double? Returns to scale is the rate at which output increases as all inputs are increased proportionately. It happens only in the long-run when all factors are variable. Returns to scale can be in different ways: increasing returns to scale, constant returns to scale, and decreasing returns to scale. The following figure gives an idea about the returns to the scale.

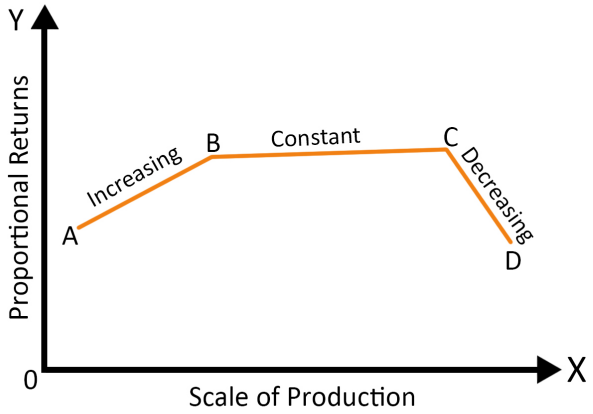


Fig 4.2.4 Returns and Scale of Production

Increasing Returns to Scale

Let us explain each of the returns to scale using examples. Automobile Industry revolution was seen with the introduction of assembly line production. In this method of production, popularly known as the Fordist method of production, each task of producing a car was divided into minute operations to expand output. This is a typical example of increasing returns to scale. If output more than doubles when the inputs are doubled, then there is increasing returns to scale. Increasing returns is possible in the long-run when the large scale of operation of industries allows managers and workers to specialise in their tasks. It also allows them to make use of more innovative technology, expand factories, and purchase new equipment. The increasing returns to scale has important policy implications. In the case of public utilities like electricity and water supply due to increasing returns, it is always more economically viable for a single firm to provide services than more firms trying to provide it.

Constant Returns Scale

Travel companies like Thomas Cook can provide the same service per client and use the same amount of capital and labour when compared to a local travel agency that has only few customers. In Constant Returns to Scale (CRS) output

may double when inputs are doubled. With constant returns to scale, the size of the firm's operation does not affect the productivity of its factors. As one firm using a particular kind of production process can easily be replicated, two firms can produce twice as much output.

Decreasing Returns to Scale

Imagine you are running a mobile manufacturing factory. In the long-run, as a rational producer you are going to expand output by employing more and more units of a variable input. Sometimes you may hire technology experts who might be good at their jobs, but may not be able to co-ordinate workers. This leads to a decrease in productivity of labour and capital. Lack of communication and interpersonal skills may not yield positive results for output. Decreasing returns to scale is observed when output may less than double when all inputs are doubled. Now let us explain law of returns to scale with the help of isoquants.

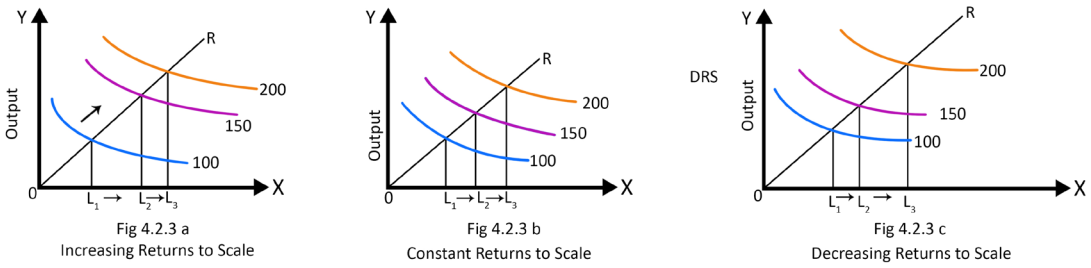


Fig 4.2.5 Returns to Scale

In the figure, the first panel shows increasing returns to scale, second panel shows the constant returns to scale, and third panel shows the decreasing returns to scale. In increasing returns to scale, the successive isoquants with the same level of increase in output lie with smaller distance from the previous isoquants. Under constant returns to scale, the successive isoquants lie equi-distant showing output increases in the same proportion as that of the changes in inputs. For decreasing returns to scale, the successive isoquants lie with higher distance moving away from the origin showing less than proportionate increase in output due to changes in input.

4.2.1.6 Isocost

If you are a producer running a steel factory, the primary concern before you start production is your cost. A budget is already fixed by the producer, which involves cost of raw material, cost of machinery, payment to workers, rent, cost of electricity etc. What is an isocost line? An isocost line shows all possible combinations of labour and capital that can be purchased for a given total cost. To see what an isocost line looks like, let us first understand what the total cost, C of producing any particular output is. It is given by the sum of the firm's labour cost wL and its capital cost rK.

$C = wL + rK$

The Fig. 4.2.6, represents an isocost line.For each different level of total cost, there is a different isocost line. In the isocost line (given IC), it describes all possible cost combinations of labour and capital.

The slope of the isocost line is $\Delta K / \Delta L$ or w /r, which is the ratio of the wage rate to the rental cost of capital.

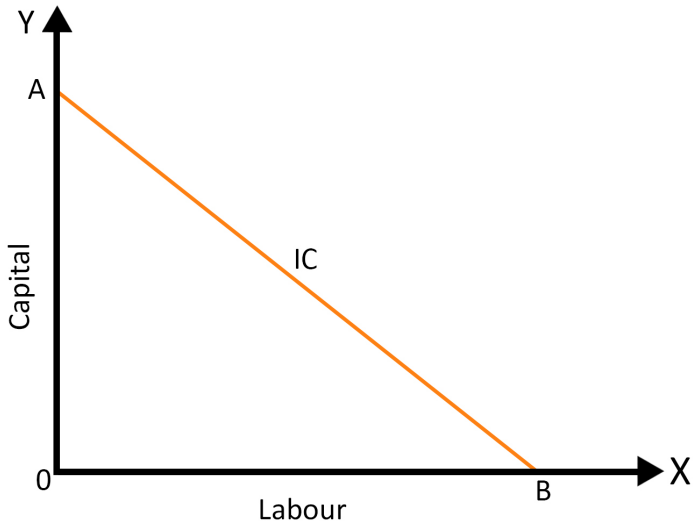


Fig 4.2.6 Isocost Line

4.2.1.7 Producer's Equilibrium

Equilibrium is a position from where the producer does not wish to change. In an equilibrium situation, the producer produces the ideal output at a minimum cost. Suppose we wish to produce at an output level Q. As a rational producer you will think, how can I produce this at a minimum cost? The aim is to choose the point on the isoquant that minimises total cost. At this point, the slopes of the isoquant and the isocost line are just equal. When the expenditure on all inputs increases, the slope of the isocost line does not change because the prices of the inputs have not changed. The intercepts, however, increase. If the price of one of the inputs, such as labour, increases, the slope of the isocost line (w/r) would increase.

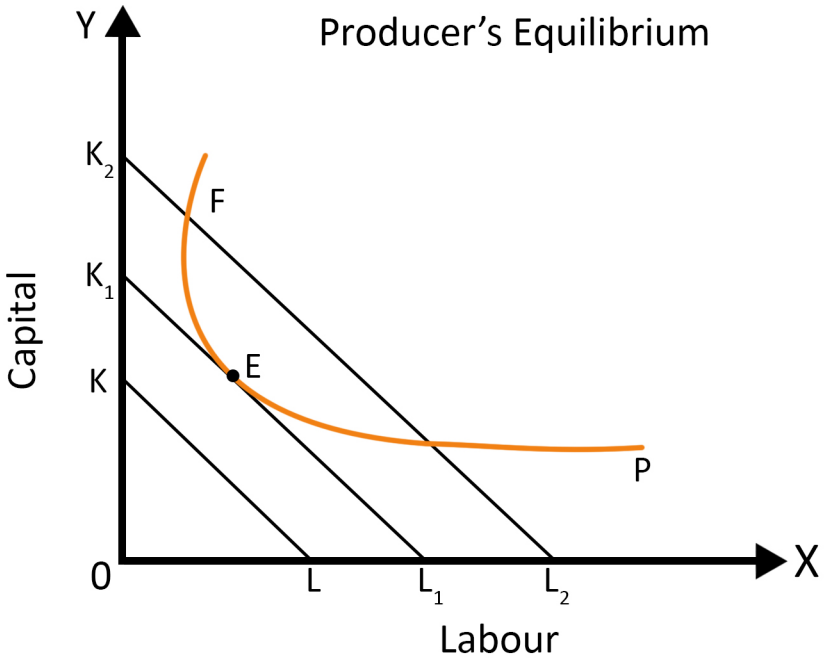


Fig 4.2.7 Producer's Equilibrium

In the diagram, the producer's equilibrium is plotted. There are a series of isocost lines such as KL, $K_1 L_1$, $K_2 L_2$ which show the cost required to produce the particular output Q.The isocost lines are parallel and have the same slope as they are plotted on the assumption that the prices of factors of production are constant. The isoquant is tangent at the point E to the isocost line, $K_1 L_1$. Points lower than E show lower costs , but then the producer will not be able to produce the output Q. Points above E are higher cost combinations which the producer cannot afford.

At point E, slope of isoquant is equal to the slope of the isocost line. i.e.,

MRTS of labour for capital = ratio of price of labour to the price of capital.

The producer's equilibrium shows us the right combination of factor inputs to maximise production at a given cost. It is the point where the MRTS (slope of the isoquant) = Price ratios of factors (slope of the Isocost line). This point of tangency is the most suitable point of production for the producer.

Recap

- Production in short-run is different from production in long-run
- Two laws of production- Law of Variable Proportions and Laws of Returns to Scale
- There are three stages in operation of law of Variable Proportions
- First stage ends when Average Product is made equal to Marginal Product
- The second stage is best possible stage of production
- TP continues to rise at diminishing rate, AP and MP declines in 2nd stage
- Third stage, TP declines. AP also falls. MP becomes negative
- Returns to scale operate in long run when all factor inputs variable
- Three kinds of returns to scale: Increasing, Constant and Decreasing returns to scale
- Isoquants -shows all possible combinations of inputs that give same output
- Isoquants have convex shape due to operation of diminishing MRTS
- A set of isoquants represented together is called isoquant map

- MRTS is slope of isoquant
- Isocost line - all possible combinations of labour and capital that can be purchased for given total cost
- The producer's equilibrium - right combination of factor inputs to maximise production at given cost
- Equilibrium is point where the MRTS = Price ratios of factors

Objective Questions

1. Which are the two laws of production?
2. What is the shape of TP, AP, and MP curves in the first stage of the Law of Variable proportions?
3. Where is the law of Variable Proportions applicable?
4. What is Decreasing Returns to Scale?
5. Give two properties of isoquants.
6. Why the second stage of production is the best under law of variable proportions.
7. What does the convex shape of isoquants show?
8. Can two isoquants cut each other. Why?
9. What is the slope of the isocost line?
10. What is the equilibrium condition for producers?

Answers

1. Law of Variable Proportions and Laws of Returns to Scale
2. In the first stage TP increases, MP reaches its maximum and then falls ,AP becomes maximum and becomes equal to MP
3. Agriculture, industry, fisheries sectors.
4. Decreasing returns to scale is observed when output may less than double when all inputs double in the long run.
5. Isoquants are convex to the origin. Isoquants do not cut each other.
6. In the Second stage, TP is expanding , even at a decreasing rate. AP and MP are falling but remain positive.
7. Diminishing MRTS
8. No, because each isoquant shows a unique combination of inputs to obtain a particular level of output.
9. Ratio of factor prices(w/r)
10. Producers equilibrium-MRTS of labour for capital=Ratio of factor prices (w/r). Equilibrium is the tangency point of isocost line and isoquant.

Assignments

1. Explain different stages of Law of Variable Proportion?
2. Describe the Laws of Returns to Scale?
3. List out the assumptions of the Law of Variable Proportions.
4. What are the advantages that a producer has when he produces in the long run?
5. Construct a table to show Diminishing Marginal Rate of Technical Substitution.

Suggested Readings

1. Koutsoyiannis, A. (1990), *Modern Microeconomics* (Second Edition), Macmillan Education

2. Salvatore, D. (2003), *Microeconomics - Theory and Applications* (Fourth Edition), Oxford University Press.

References

1. Pindyck, R.S., Rubinfeld, D. L., N Mehta, P. L. (2013) *Microeconomics* (Seventh edition). Pearson Education Prentice Hall.

2. Samuelson, P. A., & W. D. Nordhaus (1998) *Economics*. New Delhi: Tata McGraw Hill.

UNIT 3

Homogeneous Production Function

Learning Outcomes

After reading this unit, the learner will be:

- exposed to Homogeneous Production Function
- familiarised with the Cobb- Douglas Production Function
- introduced to Linear Homogeneous Production Function

Prerequisites

Production is the process by which we create value. The effort and result of production can be seen in the use of the right combination of inputs. To understand the technical aspect of production, we use the concept of the production function. Suppose you use 10 workers, working on 3 acres of land, using 5 machines to produce 50 kg of rice. If we double the inputs, it will result in 20 workers, using 10 machines to produce 100 kg of rice. This is a proportional increase in output because of an increase in inputs. This is an example for a homogeneous production function. In the earlier units we have discussed the production function. The production function shows the functional relationship between inputs and outputs. From the production function we are able to understand how much of the inputs are essential to produce output. We can also assess the productivity of inputs like capital and labour from the given production function. Production functions can be of different types. They are broadly divided into homogenous and non homogeneous production functions. In this unit, we are going to look into what homogeneous production functions are. The Cobb-Douglas production function is the most common example of a homogeneous production function. The linear production function is also introduced in this unit.

Keywords

Cobb-Douglas Production function, CES production function, Factor intensity, Elasticity of production, Linear homogeneous production function

4.3.1 Homogeneous Production Function

Production function is the basic tool that helps the producer to decide the right combination of inputs. Homogeneous production functions are those in which the output expands in proportion to the use of inputs. For a homogeneous production function (of any degree), the firm's long-run expansion path would be straight lines from the origin. Some common examples for homogeneous production functions are the Cobb-Douglas Production Function and the CES Production Function.

As the Cobb- Douglas Production Function is discussed in detail later in this unit, let us now look at the Constant Elasticity of Substitution (CES) production function.

The CES production function was developed by Solow, Minhas, Arrow and Chenery

$Q=A[\alpha L^{-\beta}+(1-\alpha)K^{-\beta}]^{-1/\beta}$

$A>0, 0<\alpha<1$ and $o \neq \beta>-1$

α-distributive parameter

β-substitution parameter

$\sigma = 1/1+\beta$

In the CES production function, the elasticity of substitution (σ) is constant but not necessarily equal to one.

4.3.1.1 Cobb- Douglas Production Function (C-D Production Function)

We have discussed before that the production function is the equation that expresses the relationship between the quantities of productive factors (such as labour and capital) used and the amount of product obtained. It actually shows the amount of output that can be obtained from a combination of different factors, given the available efficient means of production. Charles Cobb and Paul Douglas used the particular production function to understand the importance of two factors of production, i.e., labour and capital. They worked with data for the USA (manufacturing output) for the period 1899 to 1922. The exercise was to understand the relative contribution of two inputs to the production process. They limited the output elasticity parameter α and β to the rate (0,1) and the sum to 1, which indicates Constant Returns to Scale (CRS).

The general form of the Cobb-Douglas production function is,

$Q = AL^{\alpha}K^{\beta}$
$A>0$
Q – total output
L – labour input
K – capital input

Parameter A – Technology of the production process

α(alpha) – The elasticity of production of labour or percentage changes in output due to changes in labour

β(Beta) – The elasticity of production of capital or percentage changes in output

due to changes in capital.

The logarithmic function of the Cobb Douglas Production Function is

$\ln Q=\ln A+\alpha \ln L+\beta \ln K$

The Marginal product of the two factor inputs - labour and capital can be written from the Cobb Douglas Production Function:

MP of $L=dQ/dL=\alpha AL^{\alpha-1}K^{B}$

MP of $K=dQ/dK=\beta AL^{\alpha}K^{\beta-1}$

The production function estimated that labour accounted for $3/4^{th}$ of the value added in US manufacturing and the rest of the contribution came from capital. Due to the assumption that output elasticity parameters α(alpha) and β(beta) lie between 0 and 1,(0,1) the second order derivatives with respect to labour and with respect to capital are both negative. This implies that there is Diminishing Marginal returns to a factor. When we add capital or labour (not both), the output increases but at a decreasing rate. This is due to the operation of diminishing returns to a factor. As more and more units of labour or capital are used in production, the output tends to fall after a certain period of time.

When

$\alpha+\beta>1$

It implies increasing returns to scale

$\alpha+\beta<1$

It implies decreasing returns to scale

$\alpha+\beta=1$

It implies constant returns to scale

A Cobb Douglas Production Function is a homogenous linear production function with constant returns to scale.

Another fact that we observe from the Cobb Douglas Production Function is that the elasticity of substitution is unity. There is a one to one substitution between capital and labour. The shape of the isoquants also reveal this. In fig. 4.3.1 the X-axis have labour input and in the Y-axis we have capital input. A series of isoquants plotted in the figure indicate the constant elasticity of substitution in the case of C-D production function.

Now let us try to summarise certain important points about the Cobb-Douglas Production Function.

1. The Cobb Douglas Production Function exhibits elasticity of substitution equal to one.

2. α , β shows the labour and capital's share in output.

3. α , β are also elasticities of output with respect to labour and capital.

4. If one of the inputs is zero, the output will be zero.

5. The expansion path generated by the Cobb Douglas Production Function is linear and it passes through the origin

6. The Marginal Productivity of Labour is equal to the increase in output and when labour input is increased by an additional unit of labour.

7. The Average Product of Labour is equal to the ratio between output and labour.

8. The ratio of α /β shows us the factor intensity. The higher ratio indicates that technology is more labour intensive.

4.3.1.2 Linear Homogeneous Production Function

The linear production function is the simplest form of a production function. It describes a linear relation between the input and the output. The Linear Homogeneous Production Function shows us that with the proportionate change in all the factors of production, the output also increases in the same proportion. If there are two inputs, capital and labour used to produce an output, and if both capital and labour units used are doubled, the output also gets doubled. This is also known as constant returns to a scale.

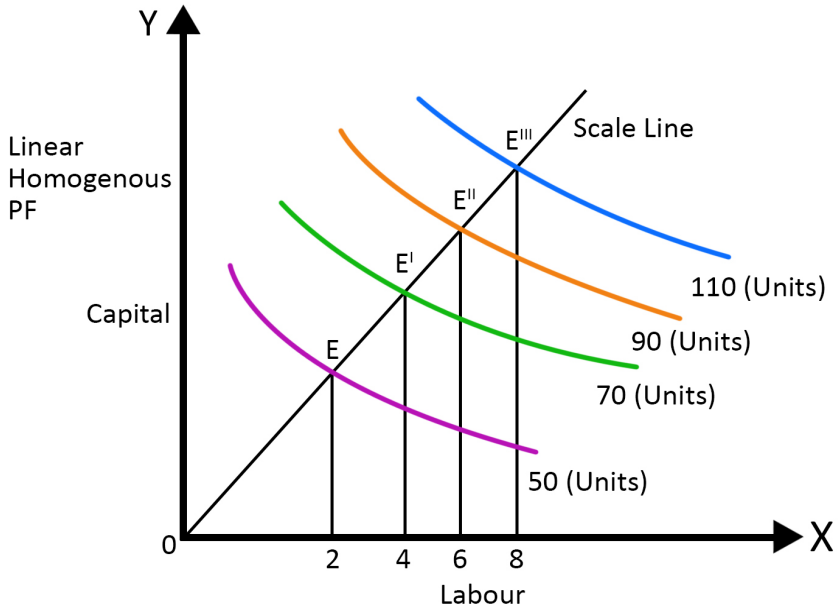


Fig 4.3.1 Linear Homogeneous Production function

The diagram indicates that as the labour input is increased, output increases in proportion to the increase in input. The expansion line or scale line is always a straight line. The proportion between factors is the same irrespective of output levels, assuming that factor prices remain the same. When all inputs are increased in the same proportion, the production function is said to be homogenous. The degree of the production function becomes equal to one.

Mathematically, the linear production function can be written as

$$t(Q)=f(tL,tk)$$

If labour and capital, the two inputs in the production process are increased by t times, the output(Q) also increases by t times. The linear homogeneous production functions are well behaved production functions. While using this production function, it is easy for the producer to find the optimal combination of inputs. As long as the relative prices of factor inputs do not change, the choice can be made easily to expand output.

Recap

- Production function - technical relationship between inputs and outputs
- Homogeneous production function - output increases in proportion to increase in input
- CES production function - example of homogeneous production function
- Cobb Douglas production - linear homogeneous production function
- General form of the Cobb-Douglas production function : $Q=AL^{\alpha}K^{\beta}$
- Ratio of α/β shows factor intensity
- Larger ratio indicates more labour intensive technology
- Linear homogeneous production functions - well behaved production functions
- Mathematically, linear production function : t(Q)=f(tL,tk)

Objective Questions

1. What is a homogeneous production function?
2. Write down the mathematical form of the CES production function.
3. What does α indicate in a CES production function?
4. What is the shape of a linear homogeneous production function?
5. Write down the mathematical form of a Cobb- Douglas production function?
6. What is the Marginal Productivity of Labour in a Cobb- Douglas Production function?
7. What does α and β indicate in a Cobb- Douglas production function?
8. Write down the mathematical form of a linear homogeneous production function.

Answers

1. Homogeneous production function shows us that output increases in proportion to the increase in input
2. $Q=A[\alpha L^{-\beta}+(1-\alpha)K^{-\beta}]^{-1/\beta}$
3. Distributive parameter
4. The expansion path or scale line is always a straight line through the origin.
5. $Q=AL^{\alpha}K^{\beta}$
6. MPL of labour=$dQ/dL= \alpha AL^{\alpha-1}K^{B}$
7. Shows the share of labour and capital in the total output. Also shows the elasticity of output with respect to labour and capital.
8. $t(Q)=f(tL,tk)$

Assignments

1. Give an account of a homogeneous production function.
2. Take a real world example to analyse the production function.
3. Do the following production function exhibit decreasing increasing or constant returns to scale
   a. Q=0.5KL
   b. Q=2K+3L
4. Plot a Cobb Douglas production Function graphically. Explain the logic of the shape of the Cobb Douglas Production Function.

Suggested Readings

1. Koutsoyiannis, A. (1990), *Modern Microeconomics* (Second Edition), Macmillan Education

2. Salvatore, D. (2003), *Microeconomics - Theory and Applications* (Fourth Edition), Oxford University Press.

References

1. Nicholson Walter and Christopher Synder (2019), *Microeconomic Theory-Basic Principles and Extensions*, Cengage Learning.

2. Hal R Varian (2010) *Intermediate Microeconomics: A Modern Approach*, 8th Edition, W.W Norton and Company/ Affiliated east-West Press (India).

Cost and Revenue

Cost

Learning Outcomes

After reading this unit, the learner will be able to:

- distinguish between different types of costs in the short-run and the long-run
- explain the relationship between the total costs and per-unit costs
- derive average and marginal costs curves from total cost curves

Prerequisites

Cost is an inevitable part of a production. Apart from economic and business space, cost has a wide scope. Everything we do is associated with a particular cost. Suppose you spent four hours of time per day on your phone. Here, the cost can be understood from the point of view of the amount of time you spent on the phone which could be used for other purposes like gardening, reading books, spending quality time with family and friends. In the same case, the cost can be viewed from the angle of health too. Four hours of screen time badly affects your eyes and the energy levels.

So, in life, everything has an opportunity cost. Opportunity cost is dependent on our choices. It refers to the benefit that a person has to give up because of choosing an alternative thing. Like its importance in life, the opportunity cost is very important in analysing cost concepts in the economic world. There are different concepts of costs associated with production. This unit deals with costs of production.

Keywords

Opportunity cost, Implicit cost, Explicit cost, Fixed costs, Variable costs, Total costs, Average costs, Marginal costs

5.1.1 Cost Analysis

Cost is a function of output. The cost of production varies with the cost of inputs used in the production. The inputs and their quantity used in the production are different for different time periods. A firm decides the supply of its output based on the cost of the production.

There are different concepts related to costs. The cost concepts vary with the disciplines dealing with the analysis of the cost of production. Also, the concepts related to costs vary with the time period considered in the production. Let us discuss the various cost concepts.

5.1.1.1 Concepts of Cost

There are different concepts related to cost. Cost concepts used by economists may be different from the concepts used by accountants. It is important to familiarise with all the concepts related to costs, especially the concepts used by economists in analysing decision-making in production.

Important concepts of costs used in the economic realm are explicit cost, implicit cost, opportunity cost, accounting cost, economic cost, and sunk cost.

Explicit Cost

Explicit cost includes costs incurred to the payment of factors of production. As a result of the production process, an entrepreneur has to pay rent for the land and building, wages for labourers, interest for the capital he borrowed, and the prices of raw materials. Explicit cost includes all these costs of production.

Explicit cost is also known as accounting cost since only the explicit cost is considered for accounting purposes. However, for an economist dealing with decision-making in the production process, the cost of production includes both explicit and implicit cost.

Implicit Cost

Implicit cost refers to the value of own inputs used for own production. Own inputs used by the firm or entrepreneur may include own capital invested for the business, and entrepreneur's managerial and entrepreneurial ability used for organising the production. The value of the own inputs can be measured in terms of what the inputs could earn if they are used for alternative purposes.

With respect to capital invested, instead of using the capital in their own business, the entrepreneur could invest it somewhere so that the capital earns interest for the investment. For example, if the entrepreneur uses her/his savings of Rs. 5,00,000 in own business. The value of Rs. 5,00,000 can be measured by calculating what Rs. 5,00,000 can earn if the money is invested in any other venture. If 10 percent interest rate is the maximum level of interest rate available in the market, then the value of the capital is 10 percent of Rs. 5,00,000, that is, Rs. 50,000.

In the case of entrepreneurial ability, if the entrepreneur would not organise his own production, the person would be managing the production process of another firm. So, the value of entrepreneurial ability is what the entrepreneur would earn if the person is a manager in another firm. For example, if the maximum amount of

salary an entrepreneur gets as a manager in any other firm is Rs. 2,00,000, then, the value of the entrepreneurial ability is Rs. 2,00,000. So, the implicit cost of a firm using its own capital and entrepreneurial capability in our example is Rs. 2,50,000. Therefore, the value of the inputs can be measured on the basis of what they would earn in their next best alternative or opportunity cost.

Therefore, explicit cost or accounting cost includes remuneration to factors other than the firm's or entrepreneur's own factors, and implicit cost includes remuneration to own factors measured in terms of what it earns in alternative purposes. An economist will consider both explicit and implicit costs while taking decisions on production. On the other hand accountants are only concerned with the explicit costs.

Economic Cost = Implicit Cost + Explicit Cost (Accounting Cost)

Since a firm's economic cost is the sum of implicit and explicit costs, the firm may earn an economic profit when the revenue of the firm is greater than the economic cost.

So, Economic Profit = Total Revenue – Economic Cost

When total revenue is equal to economic cost, the firm earns a normal profit. That is, the firm's revenue covers the implicit and explicit costs.

Opportunity Cost

The concept of opportunity cost arises from the fact of scarcity of resources. Since there is scarcity of resources in the economy, the economy cannot produce all that is required by the society. So, some products are given priority in production while some are not given priority.

The opportunity cost of a product is measured in terms of the value of the next best alternative product that is not produced, due to not enough resources available to produce a product.

In terms of the inputs used in the production, the opportunity cost of any input is what the input can earn in its next best alternative use. The example of opportunity cost is explained earlier. The value of capital is the rate of interest the capital can earn in the next best investment platform. In the case of the entrepreneur of a firm, the value is calculated by measuring the salary if the entrepreneur works as a manager in another firm.

5.1.1.2 Traditional Theory of Cost

There are traditional and modern theories of cost in the cost analysis. In this block, we deal with the traditional theory of cost. The major difference between the two cost theories is based on the shapes of the cost curves discussed in the theories.

In the traditional theory of cost, cost concepts and the respective cost curves are analysed for the short-run and long-run. Separate sections for short-run and long-run are given to discuss the matters in detail.

5.1.1.2.1 Costs in Short-Run

Short-run is a time period where production can be increased by increasing the variable inputs with some inputs as fixed. Consider a textile firm. If the firm decides to increase the production of textile in the short-run, it needs to buy more raw materials such as thread and

dyes, and employ more labour to increase textile production. However, the amount of factors such as building and machinery need not be increased to increase textile production in the short-run. Here, raw materials and labour are variable inputs, and building and machinery are fixed inputs.

Therefore, the cost of production in the short-run includes the variable cost of production and the fixed cost of production. Variable costs are those costs associated with the increase in production due to an increase in the use of variable inputs. Fixed costs are those costs which are fixed in the short-run, and do not increase with the increase in output or production.

In the short-run, costs can also be distinguished between total costs and average costs. Total cost includes adding up all costs whereas, the average cost is the per unit cost. Within the total cost and average cost, there are different cost concepts. Let us discuss them in detail.

Total Costs in Short- Run

In the above section, it is mentioned that the costs in short- run include fixed costs and variable costs. So, the total costs in the short-run include Total Fixed Costs, Total Variable Costs, and Total Costs.

(a) Total Fixed Costs (TFC):

It is the sum of the fixed costs incurred while hiring the fixed factors of production. Fixed factors in the short-run include machines, building, fundamental administrative expenses, property taxes, and so on which are necessary to start production even for a small firm. So, the fixed cost is the cost of hiring these factors. Fixed factors do not change with changes in output, and form the fundamental costs which a firm must incur while setting up a business.

Fixed cost and sunk cost are different. Fixed cost is recoverable in future even when the production is stopped. But the sunk cost is not recoverable in future. Sunk costs include the cost of painting the building which cannot be recovered at any point, while the cost of furniture which is a fixed cost can be recoverable even partly since the furniture is physically available even after stopping the production.

(b) Total Variable Costs (TVC):

It is the sum of the variable costs incurred while hiring the variable factors of production. Variable factors in the short-run include raw materials, labour, transportation, power, fuel etc. So, the variable costs include the price of raw materials, wage payment for labourers, transportation cost, fuel price, cost of power and so on. Variable factors change with changes in output, and hence variable costs are associated with the changes in production. Suppose, a firm decides to increase the production, more variable factors need to be used to increase production. This leads to an increase in total variable costs. Similarly, if the firm decides to stop production for some period, no variable input will be used in the production leading to zero total variable costs. So, total variable costs increase with the increase in production and decrease with the decrease in production.

(c) Total Costs (TC):

Total cost is the sum of Total Fixed Costs and Total Variable Costs.

TC = TFC + TVC

Since the total costs include variable costs, TC changes with changes in the output.

Total Cost Curves

Given the decisions of the firm regarding the short-run production, there will be a total fixed cost, total variable cost, and total cost. Table 5.1.1 gives a hypothetical schedule of the three total costs. Here, costs are calculated on the basis of the opportunity cost. Cost curves can be derived from the cost schedules.

Table 5.1.1 Cost Schedule for Total Fixed, Variable, Total Costs

Amount of Output	Total Fixed Costs (rs)	Total Variable Costs (rs)	Total Costs (rs)
0	40	0	40
1	40	30	70
2	40	40	80
3	40	55	95
4	40	90	130
5	40	155	195

When a firm is organising to start a production, the initial cost the firm incurs is the fixed costs. In our hypothetical example, the fixed costs constitute Rs. 40. Since the fixed cost in the short-run is given and does not change with changes in output, the cost remains forty for any increase in output in the short-run.

When the firm starts the production, the initial variable cost is thirty rupees. While going through the cost schedule, we can see that the total variable costs increase with the increase in output. It increases from Rs. 30 during the initial output to Rs. 155 when the output increases to five.

The total costs before the production is equal to the total fixed cost, which is Rs. 40. When the firm starts producing output, the total costs increase with the increase in total variable costs. So, the total costs are the sum of both total fixed and variable costs.

We can derive the total cost curves by plotting the points in the schedule. Figure 5.1.1 gives total cost curves.

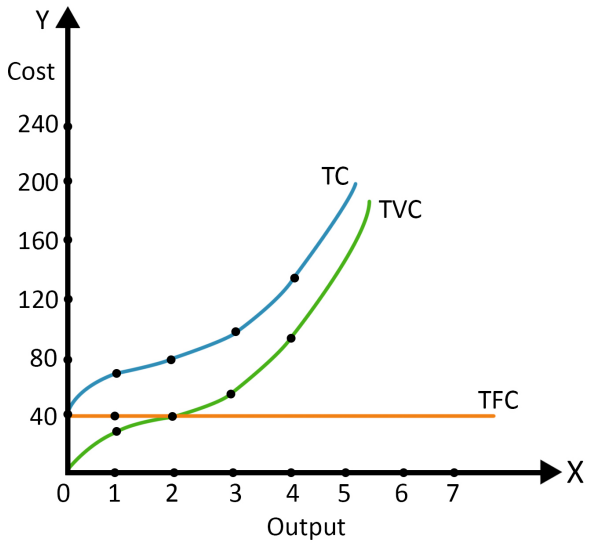


Fig 5.1.1 Total Cost Curves

The total fixed cost is given for all the levels of output. In the figure, it is shown that the total fixed cost curve is horizontal to X-axis with the vertical intercept at 40, since 40 is the total fixed cost in our hypothetical example.

Total variable cost increases with an increase in output. Here, the shape of the total variable cost curve shows that the variable input undergoes diminishing marginal returns. Diminishing mariginal returns state that each additional inputs used will lead to smaller increase in output, which in turn increases cost. During the initial stage, the firm uses only a small stock of the variable input. So, the marginal returns are not diminishing in the early stage and cost increases at a lower rate. Later, with increase in the stock of variable inputs, the diminishing marginal returns start to operate. This leads to an increase in variable costs. So, the total variable cost curve increases at an increasing rate after a point.

The total cost curve has the same shape as the total variable cost curve because the total cost increases with an increase in total variable cost. However, the total cost curve lies 40 points above the total variable cost curve reflecting the fact that it is the sum of total fixed and total variable costs.

Average and Marginal Costs in Short-Run

In the short-run analysis of the cost of production, per unit cost plays a greater role in taking decisions regarding production. Per unit costs refer to the cost of production for each level of output produced. The per-unit cost concepts are available for all the total costs. They are average fixed cost, average variable cost, and average total cost. In addition to these average costs, the per-unit costs also include the marginal cost.

(a) Average Fixed Cost (AFC): AFC is equal to the total fixed cost divided by the total output produced.

$$AFC = TFC / Q$$

Q is the total output produced.

(b) Average Variable Cost (AVC): AVC is equal to total variable cost divided by total output produced.

$$AVC = TVC / Q$$

(c) Average Total Cost (ATC): ATC is equal to total costs divided by total output produced. Since total cost is the sum of total fixed cost and total variable cost, the average total cost is equal to sum of average fixed cost and average variable cost.

$$ATC = TC / Q$$

Or

$$ATC = AFC + AVC$$

(d) Marginal Cost (MC): MC equals the change in the total costs in response to the change in output. It is also equal to a change in total variable costs as a result of change in output. Hence, marginal cost is not associated with fixed costs, and only depends on variable costs. Marginal cost can be measured from total costs since total costs include variable costs and fixed costs.

$$MC = \Delta TVC / \Delta Q$$

Or

$$MC = \Delta TC / \Delta Q$$

It is possible to get the schedules for average costs from their respective total cost curves using the formulas explained in this section. Table 5.1.2 gives the schedule for total costs and per unit costs.

Table 5.1.2 Schedule for Total Costs and Average Costs

Amount of Output	Total Fixed Costs (rs)	Total Variable Costs (rs)	Total Costs (rs)	Average Fixed Cost, AFC(rs)	Average Variable Cost, AVC (rs)	Average Total Cost, ATC (rs)	Marginal Cost, MC (rs)
0	40	0	40	infinitive	0	infinitive	0
1	40	30	70	40	30	70	30
2	40	40	80	20	20	40	10
3	40	55	95	13.33	18.33	31.66	15
4	40	90	130	10	22.5	32.5	35
5	40	155	195	8	31	39	65

AFC can be calculated from TFC/Q. At the initial stage, AFC is given as infinity since no output is produced. However, there are total fixed costs at the initial stage. As AFC = TFC/Q, anything divided by zero (no output) gives the result as infinity. We can see from the table that, as long as the output increases, the average fixed costs fall.

AVC can be calculated from TVC / Q. When output produced is zero, there is no total and average variable costs. AVC column shows that when output increases, the average variable cost falls initially. Later, the costs increase with the increase in output. In the table, the AVC falls for the first three levels of output. However, AVC starts increasing with output from the 4th level of output.

ATC is calculated from TC / Q. The ATC column also shows that when output increases, the average total cost reduces until the 3rd level of output. Then, the average total cost increases corresponding to an increase in output from the 4th level of output.

MC is ΔTVC / ΔQ or ΔTC / ΔQ. Marginal cost is the change in total variable or total cost due to the change in the amount of output. It is given in the table that the MC falls from the first level of output to the second output. Later, it increases with an increase in output.

The schedules for average costs and marginal costs can be used to derive the respective cost curves by plotting the points in the schedule which are calculated from the total costs.

Derivation of Average and Marginal Cost Curves from Total Cost Curves

Average and marginal cost curves can be derived from their respective total cost curves. The average cost curves can also be derived from plotting the points calculated from the respective total costs.

(a) Average Fixed Cost Curve: AFC curve can be derived from the TFC curve. The figure 5.1.2 portrays the AFC curve from the TFC curve.

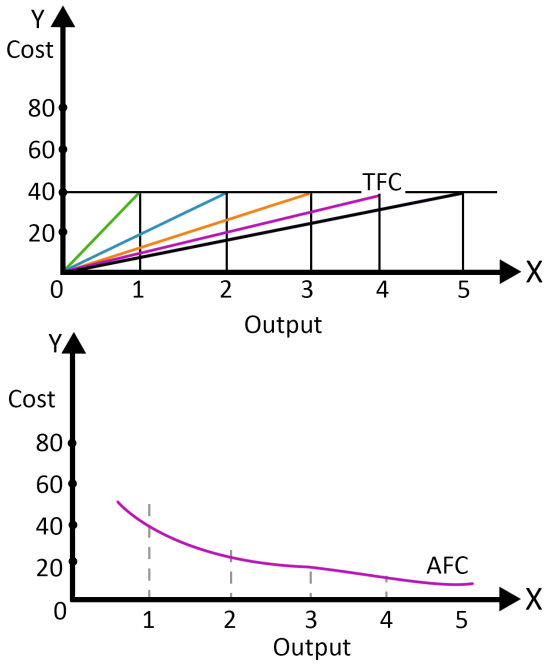


Fig 5.1.2 Average Fixed Cost Curve from Total Fixed Cost Curve

AFC at each point of output is derived from the slope of the line drawn from origin to the corresponding point on the TFC at each point of output. It is clear that the AFC curve is continuously falling with an increase in output. The reason is that since the total fixed cost always remains constant at a point when output increases, the TFC/Q continuously falls. AFC is the only short-run curve which is negatively sloped.

(b) Average Variable Cost Curve: AVC curve can be drawn from the TVC curve. Figure 5.1.3 gives AVC from TVC.

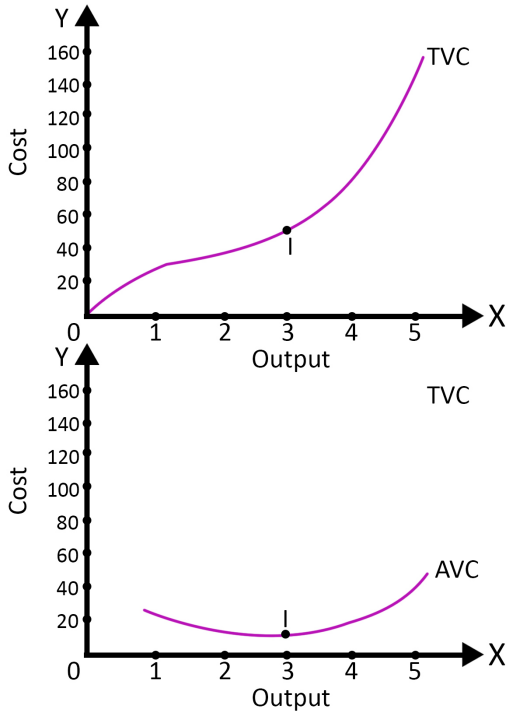


Fig 5.1.3 Average Variable Cost Curve from Total Variable Cost Curve

AVC is also derived as the AFC. The shape of the AVC is 'u' shaped showing the fact that the average variable costs decrease with increasing output until the point I, and increase with increase in output after the point.

(c) Average Total Cost Curve: ATC curve is drawn from the TC curve.

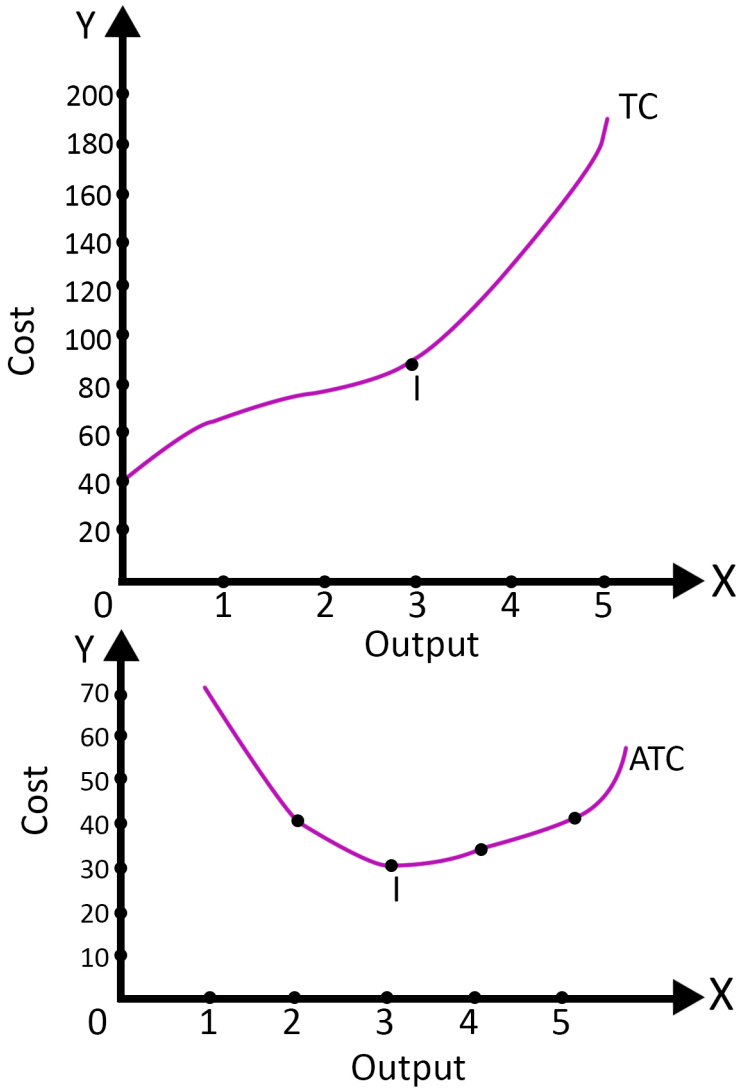


Fig 5.1.4 Average Total Cost Curve from Total Cost Curve

The ATC curve also has a 'u' shape similar to the AVC curve. Average total cost curve falls as output increases till the point, h', and later increases with the increase in output.

(d) Marginal Cost Curve:

MC curve can be derived from the total cost curve or total variable cost curve. The slope of the total cost curve and total variable cost curve are equal.

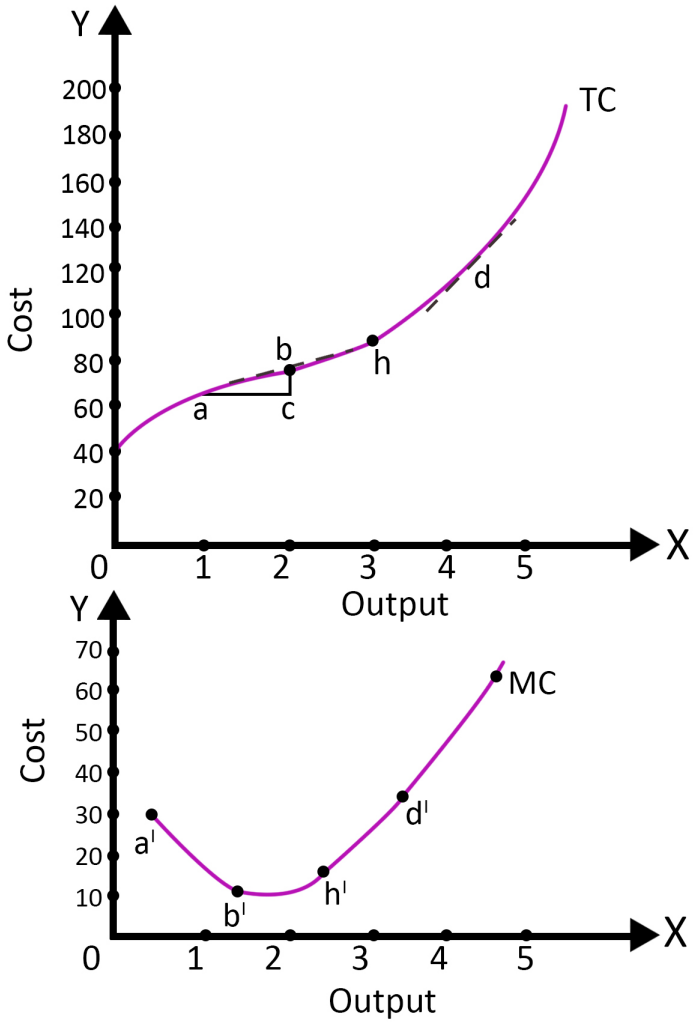


Fig 5.1.5 Marginal Cost Curve from Total Cost Curve

Marginal cost is the slope of the total cost curve since MC is equal to change in costs due to change in output. So, MC is marked at midpoints of points in the X-axis. Hence, each point on the MC curve can be derived from the slope of the corresponding points of the TC curve. Slope of the points on the TC curve can be measured by calculating the slope of the tangent drawn on the points. In the figure, it is given that the slope of the point 'b' is calculated by drawing a tangent at 'b'. Here, the slope is bc/ac. If the distance between a and b are reduced, the slope of the point 'b' becomes a better measure. Similarly, the slope of all the points of the TC curve is measured which are extended on below and joined to form the MC curve.

Relation between Marginal and Average Cost Curves

The relationship between marginal and average cost curves can be explained by picturing all these curves in a single diagram. The figure 5.1.6 shows the marginal and average cost curves.

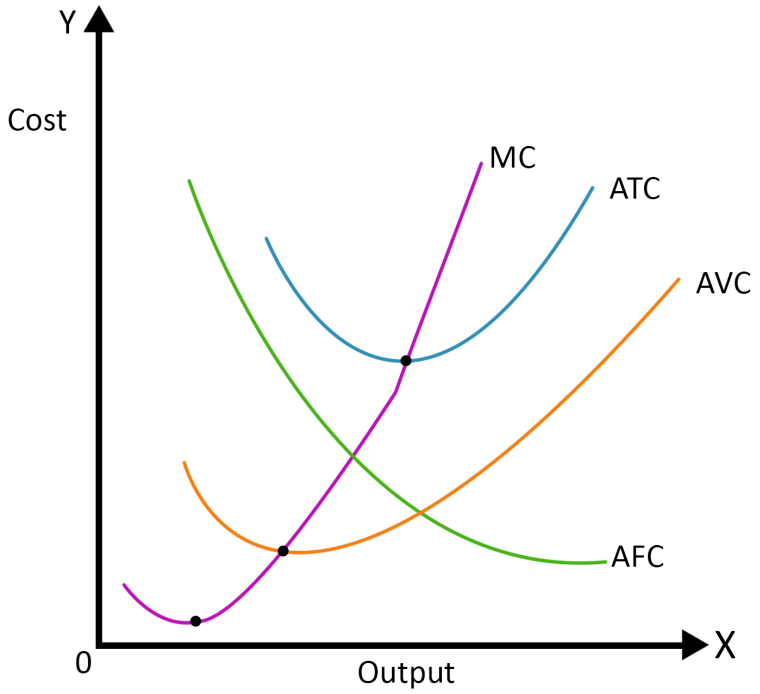


Fig 5.1.6 Average and Marginal Cost Curves

The relationship among cost curves are as follows:

- Among the short-run cost curves, the AFC curve is the only negatively sloped cost curve.
- Both ATC and AVC curves are 'U' shaped. This reflects the law of variable proportion.
- The lowest point of the AVC curve lies to the left of the lowest point of the ATC curve. Since ATC = AFC+AVC, and the AFC curve continually falls even after the AVC curve reaches its lowest point, the rise in the AVC curve for a certain range is offset by the fall in AFC. When the rise in the AVC curve becomes greater than the fall in the AFC, the ATC curve starts to rise.
- The MC curve cuts AVC and ATC at the lowest point from below.

5.1.1.2.2 Costs in Long-Run

The long-run is a time period where output can be increased by altering all the inputs including fixed and variable inputs. The long-run is a planning horizon where the size of the plant is decided. But, the production takes place in the short-run. The long-run plan contains all the available short-run situations that a firm can select to produce its output.

Therefore, long-run cost curves are derived from short-run cost curves. Let us explain the long-run average and marginal cost curves in detail.

Long-Run Average Cost Curve

The long-run cost curve is also called the envelope curve because it is the envelope of short-run cost curves. In other words, the long-run cost curve is formed from the short-run cost curves. The long-

run average cost curve is the long-run total cost divided by total output. The long-run average cost curve is also known as the planning curve since firms plan their output on the basis of the long-run average cost curve and operate in the short-run. Therefore, firms plan in the long run and operate in the short-run. Figure 5.1.7 shows the envelope of short-run cost curves.

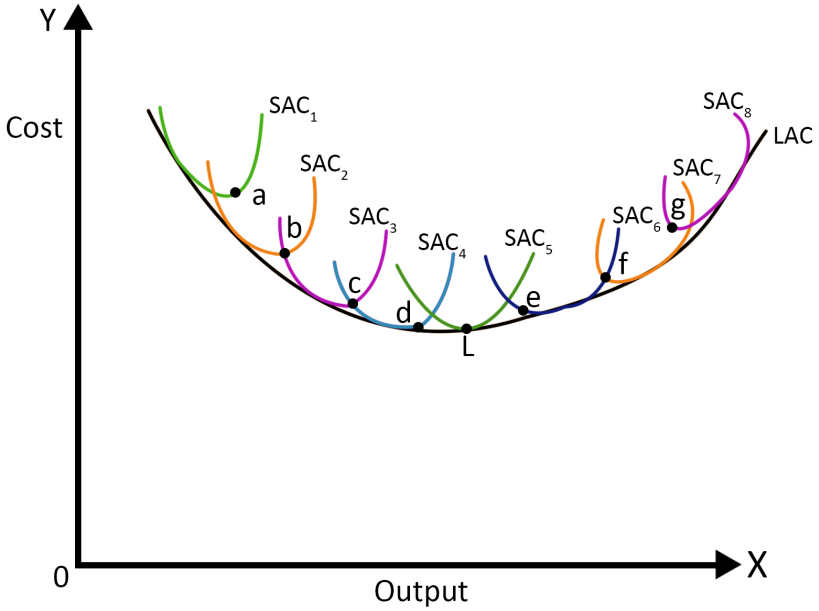


Fig 5.1.7 Long Run Average Cost Curve

The long-run cost curve is the envelope of short-run cost curves. The LAC curve is flatter and more elastic than the short-run average cost curve. The greater elasticity is due to the greater entry and exit of firms in the long-run.

The falling portion of the LAC curve shows the increasing returns to scale and the rising portion of the LAC shows the decreasing returns to scale. At the lowest point of LAC, constant returns to scale exist.

On the falling portion of LAC, the falling portion of SAC is tangential. In the figure, we can see that the points a, b, c, and d are the lowest points of SAC curves. It is clear that these points are not tangential with LAC, but the falling portion of SAC curves are. So, along the falling portion of LAC, the falling portion of SAC is tangential.

At the lowest point of LAC, the SAC_5 is tangential with its lowest point. The point is L.

On the rising portion of LAC, the rising portion of SAC curves are tangential. The points, e, f, and g are the lowest points of SAC curves. However, these points are not tangential to the LAC. Hence, on the rising portion of LAC, the rising portion of the SAC curves are tangential.

Long Run Marginal Cost Curve

The long run marginal cost curve can be derived from the long run average cost curve.

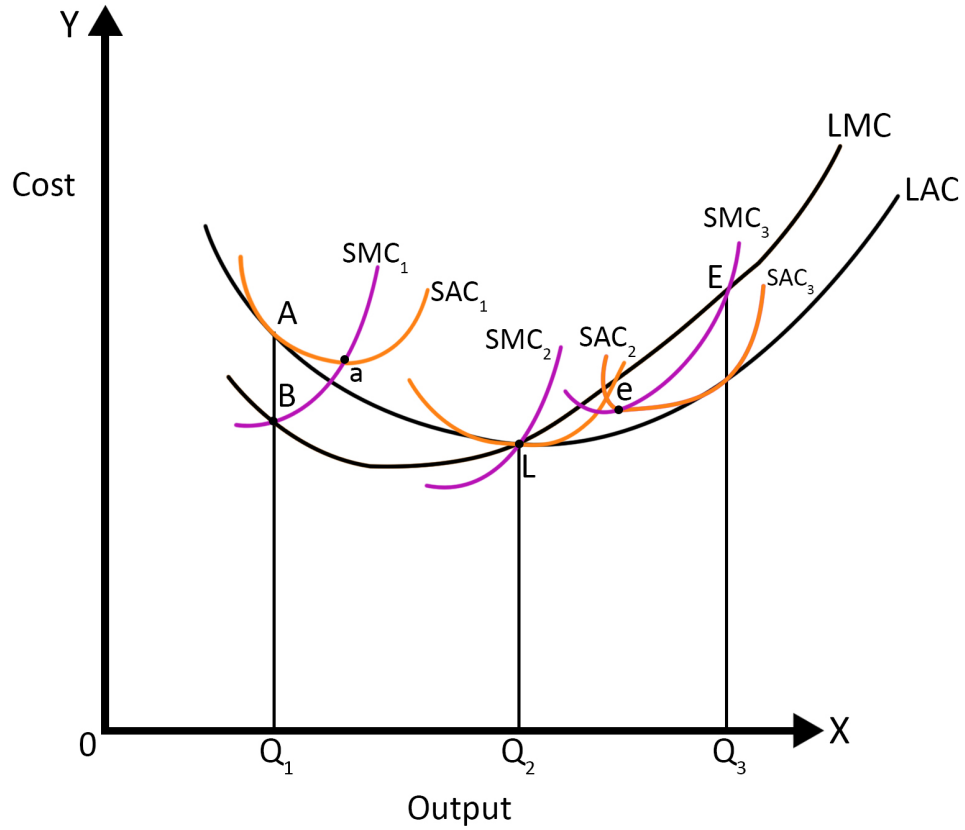


Fig 5.1.8 Long-run Marginal Cost Curve from Long-run Average Cost Curve

The LMC is derived from LAC which is also the envelope of short-run cost curves. The LMC curve is the locus of points of different SMC curves. Suppose, the firm decides to produce Q_1 output in the long-run. This output is decided at the tangency of SAC_1 with LAC at A. Corresponding to the point, A, there is a point B which is on the SMC_1. So, B must be on the LMC.

Now, the firm decides to produce Q_2 output. L is the point where SAC_2 is tangential to the LAC. L is on the SMC_2. Hence, L is a point on the LMC. Again, if the firm decides to produce Q_3 output in the long-run. The SMC_3 contains the point E which is corresponding to the tangential point of SAC_3 with LAC. So, the LMC is the locus of points of B, L, and E.

LMC is 'U' shaped like the SMC. But, the LMC curve is flatter than the SMC curve. The relationship between LMC and LAC is the same as that of the relationship between SMC and SAC. When the marginal cost curve lies below the average cost curve, the average cost will fall, and when the marginal cost rises above the average cost curve, the curve starts rising too. When marginal cost is equal to average cost, the average cost will be at its lowest point.

Recap

- Cost is function of output
- Explicit cost - cost incurred on payment of factors of production
- Implicit cost - cost of own inputs of the firm used in its own production
- Opportunity cost -value of the input that it earns in the next best alternative use
- In the short-run, some factors are fixed and some are variable
- Examples of fixed factors - buildings and machinery
- Examples of variable factors -raw materials and labour
- Total cost - sum of Total Fixed Cost and Total Variable Cost
- TC and TVC rise at decreasing rate, reaches inflection point, then rise at increasing rate
- Total fixed cost curve is horizontal to the X-axis
- AVC = TVC/Q; AFC = TFC/Q; ATC = TC/Q; MC =ΔTVC / ΔQ or ΔTC / ΔQ
- The shape of AVC, ATC, and MC curves are 'U' shaped
- 'U' shape shows working of law of variable proportion
- Shape of AFC curve is negatively sloped
- Lowest point of AVC curve lies to left of lowest point of the ATC curve
- MC curve cuts AVC curve and ATC at lowest point from below
- LAC curve is envelope of SAC curves
- Falling portion of LAC curve, falling portion of SAC curves are tangential
- Rising portion of LAC curve, rising portion of SAC curves are tangential
- Lowest point of LAC, lowest point of SAC is tangential
- LMC curve locus of points of SMC curves corresponding to tangential points of SAC with LAC

Objective Questions

1. What are the important costs used in the economic field?
2. What is explicit cost?
3. Which are the examples of explicit cost?
4. What is implicit cost?
5. What is economic cost?
6. What is normal profit?
7. Define opportunity cost in terms of a product.
8. Give two examples of variable inputs.
9. What is ATC?
10. Express MC mathematically.
11. What is the shape of the AFC curve?
12. Which are the cost curves having a 'u' shape?
13. What is the reason for the existence of the lowest point of AVC to the left of the lowest point of ATC?
14. Express the relation of MC with AVC and ATC.
15. Why is the LAC curve known as the planning curve?
16. What is the other name of the LAC curve?
17. What does the falling portion of LAC represent?

Answers

1. Explicit cost, implicit cost, opportunity cost, economic cost, and sunk cost.
2. Explicit cost measures all the cost incurred while paying the factors of production.
3. Rent for land, wage for labour, interest for capital, price of raw materials.
4. Implicit cost gives the value of own inputs used for own production by a firm.
5. Economic cost is the sum of explicit and implicit cost.
6. Normal profit shows the firm's revenue covers the economic cost.
7. The opportunity cost of a product is measured in terms of the value of the next best alternative product that is not produced in order to have enough resources to produce the first product.
8. Labour and raw materials
9. Average Total Cost is total cost divided by quantity of output.
10. MC =ΔTVC / ΔQ or ΔTC / ΔQ
11. The shape of the AFC curve is negatively sloped.
12. AVC, ATC, MC
13. Because, ATC=AFC+AVC, and AFC is continuously falling even after the rise of AVC. This makes ATC fall for a certain range more than the fall in AVC.
14. MC cuts AVC and ATC at its minimum point. The MC curve cuts the cost curves at their lowest point from below.
15. LAC curve is the planning curve since the firms plan in the long-run and operate in the short-run.
16. Envelope curve
17. The falling Portion of LAC represents the increasing returns to scale.

Assignments

1. Elucidate on explicit cost, implicit cost, and opportunity cost.
2. Describe the total and average costs in the short run.

3. Explain the derivation of average and marginal cost curves from their total cost curves.

4. Give an account of relation between average and marginal cost curves using a diagram.

5. Explain why the long run average cost curve is also called the envelope curve.

6. Graphically represent the derivation of the long run marginal cost curve from the long run average cost curve.

Suggested Readings

1. Dwivedi, D.N. (2012). *Microeconomics: Theory and Applications* (Second Edition). Vikas Publishing House Pvt. Ltd.

2. Pindyck, R.S., Rubinfeld, D.L., & Mehta, P. L. (2017). *Microeconomics* (Eighth edition). Pearson Education Prentice Hall.

3. Samuelson, P.A., & W. D. Nordhaus (special edition 2020). *Economics*. New Delhi: Tata McGraw Hill.

References

1. Nicholson Walter and Christopher Synder (2019), *Microeconomic Theory-Basic Principles and Extensions*, Cengage Learning.

2. Koutsoyiannis, A. (1990), *Modern Microeconomics* (Second Edition), Macmillan Education.

3. Salvatore, D. (2003), *Microeconomics -Theory and Applications* (Fourth Edition), Oxford University Press.

UNIT

Production and Cost

Learning Outcomes

After learning this unit, the learner will be able to:

- explain the relationship between long-run costs and expansion path
- derive the long-run cost curve from the expansion path
- distinguish between the concepts of economies and diseconomies of scale

Prerequisites

In economic analysis, we always speak about rational individuals. Individuals are called rational beings as they try to maximise the benefit they get from the work they do or from the actions they make. The individual may be a rational consumer or a rational producer. In the case of a rational producer, the maximising benefit means maximising profit. Profits can be maximised by resorting to a least cost factor combination in production.

The least cost factor combinations in production are rational paths that a producer chooses. They are expansion paths. The objective of the current unit is to discuss the rational paths available for producers while making decisions regarding production. Cost is an important part in choosing this path. The unit also discusses the relationship of cost with rational choices. Efficiency in production is a result of rational decisions taken as a part of production. The unit discusses the efficiency of production, rational paths available for producers, relation of cost with the paths.

Keywords

Internal and external economies of scale, Least-cost combination, Internal and external diseconomies of scale

5.2.1 Economies and Diseconomies of Scale

We know that, in the long-run, since all the factors are variable, the long-run production experiences return to scale. Usually, in a long-run cost curve, the falling portion shows the increasing returns to scale. That is, the cost falls with increasing output. At the lowest point of LAC, the long-run production experiences constant returns to scale. Hence, along the rising portion of LAC, there is decreasing returns to scale. That is, the cost increases with increase in output.

The efficiency in production is mostly represented as the fall in cost while increasing the output. This is called economies of scale. The inefficiency in production leads to a rise in cost with an increase in output. This inefficiency is termed diseconomies of scale. There are two types of economies and diseconomies of scale. They are internal economies and diseconomies of scale, and external economies and diseconomies of scale.

5.2.1.1 Internal Economies and Diseconomies of Scale

Internal economies and diseconomies of scale are related to efficiency and inefficiency in production due to the factors within the firm. The factors affecting the internal economies and diseconomies are given in the sub-sections.

Internal Economies of Scale

Internal economies of scale refer to efficiency in the production with respect to fall in the cost of production with a rise in the output. The internal economies of scale is shown by the down-ward sloping LAC.

The factors leading to internal economies of scale are the following.

(a) Division of Labour:

With the increase in output, the quantity of factors used for production increases. Then, the factors like labour will be introduced to the division of labour and specialisation. Specialisation is opposite to generalisation which is common in short-run production. In the long-run, there is enough time to materialise the division of labour and specialisation. Specialisation refers to concentrating on a particular task of work. Specialisation ensures the efficiency in the work leading to the overall efficiency in the production.

b) Use of state-of-the-art technology:

The use of modern and efficient technologies for the production increases the productivity of all the factors of production. The increase in productivity leads to an increase in overall production. Moreover, it also helps in reducing the cost of production.

(c) Indivisibility of Factors:

There are some arguments that most of the factors of production are available at indivisible units. Since the factors are indivisible, they are available in large quantities. This greater availability of factors pushes the firm to produce the output in greater quantity. Therefore, greater quantities of output can be produced with lower cost of production.

(d) Financial Economies:

Financial economies operate when the firm purchases the inputs in greater quantities leading to large discounts for

the purchase. Motivated by the large discounts, firms purchase greater quantities of raw materials pushing firms to produce more. This also makes a combination of greater level of output with lower cost of production.

Internal Diseconomies of Scale

Internal diseconomies of scale refer to inefficiency in production leading to an increase in the cost of production with increase in the output. The internal diseconomies are shown by upward sloping LAC.

The factors leading to internal diseconomies of scale are the following:

(a) Very Large Size of the Firm:

When the size of the firm becomes large enough to operate, with no more division of labour or efficient technology, the increase in output beyond a point leads to an increase in cost.

(b) Poor Coordination in Large Sized Firm:

The increase in the size of the firm beyond a point leads to problems such as no coordination, delay of decision making, and lack of proper communication. This leads to issues in the structure of the firm.

(c) Entrepreneur as a Fixed Factor:

When the ability of the entrepreneur is used at its fullest and the entrepreneur is a fixed factor, employment of factors increases the cost of production with an increase in output.

5.2.1.2 External Economies and Diseconomies of Scale

External economies of scale arise when factors other than internal to the firm affect the efficiency in the production of the firm. The external economies and diseconomies are a result of the expansion of output of the industry rather than the individual firm.

External Economies of Scale

The external economies of scale refer to a situation in which the increase in the overall output of the industry reduces the cost of production of the individual firm. The factors causing the external economies of scale are the following.

a) Low Cost Availability of Inputs:

Sometimes, the expansion of the industry will bring about an increase in the availability of inputs used in the industry. This increase in the availability of inputs makes the inputs cheaper. Thus, individual firms get inputs at cheaper price leading to greater production of their output at lower cost.

b) External Technological Advancement:

Like the operation of internal economies due to the use of modern technology, new discoveries may come forth due to the expansion of the overall industry. The new discoveries bring out new technologies. This changes the coefficient of technology for individual firms leading to a greater productivity and low cost.

c) Increase in Skilled Labour:

When the whole industry expands, labour becomes more able and skilled leading to greater productivity. This causes economies of scale as a result of external factors.

d) Introduction of Related Industries:

Increase in related and complementary industries help in the availability of raw materials in a much easier and cheaper

way. Development of related industries helps firms to materialise economies of scale.

e) Better Market Facilities and Transportation in the Economy

Better market and transportation facilities help in greater availability of inputs of production, and sale of finished goods. This results in efficient utilisation of scarce resources. Also, it helps in marketing of goods produced by the firm.

f) Better Availability of Information leading to Better Utilisation of Resources

Availability of information increases with expansion of industry. With greater availability of information, labourers will be able to have greater mobility from one sector to another in response to market conditions, firms will be able to choose employees and other inputs as per their demand. So, availability of information ensures better utilisation of resources which in turn results in economies of scale.

External Diseconomies of Scale

The external diseconomies of scale refer to a situation in which the increase in overall output of the industry increases the cost of production of the individual firm. The factors leading to external diseconomies of scale are:

a) Increase in Price of Certain Inputs:

As a result of the expansion of the industry, the price of inputs may increase due to an increase in the demand for inputs. Price of factors such as wage for labour and price of certain raw materials may increase with the expansion of production in the industry.

b) Scarcity of Resources:

Greater expansion in output may result in a fall in the stock of some rare resources. This may negatively affect the production of a firm. The firm faces a shortage of raw materials. This leads to a rise in the price of inputs causing an increase in the cost of production.

c) General Recession:

Recession in the overall economy affects the production of single firms in the way of falling business expectations, non-availability of raw materials and resultant high price, capital crunch.

Now let us discuss the expansion path in production.

5.2.2 Expansion Path in Production

A rational firm always tries to maximise its profit. For this, the firm will choose a particular factor combination that minimises the cost and maximises the revenue. The expansion path is the graphical representation of the combination of factors that the firm hires to produce the various levels of output at the minimum possible cost.

The optimum expansion path shows the least cost factor combination. The optimum expansion path depends on the factor price represented by the isocost line. Suppose labour and capital are the two factors of production, then the factor prices are wage rate (w) and rate of interest (r). If 'w' and 'r' are given, the optimum expansion path is determined by the point of tangency of successive isocost lines and isoquants.

The expansion path is the locus of points of producer's equilibrium with factor prices constant. A graphical representation of the expansion path is given in the Figure 5.2.1

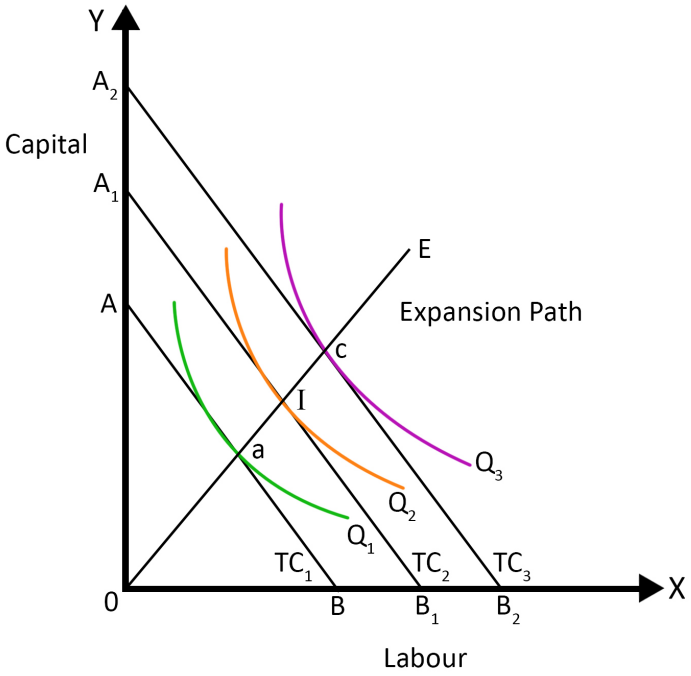


Fig 5.2.1 Expansion Path

The producer's equilibrium is reached when isoquant is tangential to the isocost line. At the equilibrium, $MRTS_{LK}$ = w/r. In the figure, the producer's equilibrium is shown by the points such as a, I, and c. The expansion path is the locus of points of these producer's equilibrium, a, I, and c.

5.2.3 Relation between Expansion Path and Long-Run Cost Curves

Expansion path shows the least cost combination that a firm will adopt to maximise its profit. Since the expansion path gives the cost combination of factors of production, it gives the total costs of production, and thereby helps in the derivation of cost curves.

The relationship between the expansion path and long-run cost curves can be shown by deriving cost curves from the expansion path. The next section explains the derivation of long-run cost curves from the expansion path.

5.2.3.1 Derivation of Long-Run Total Cost Curve from Expansion Path

The derivation of the long-run total cost curve from the expansion path is shown in Figure 5.2.2

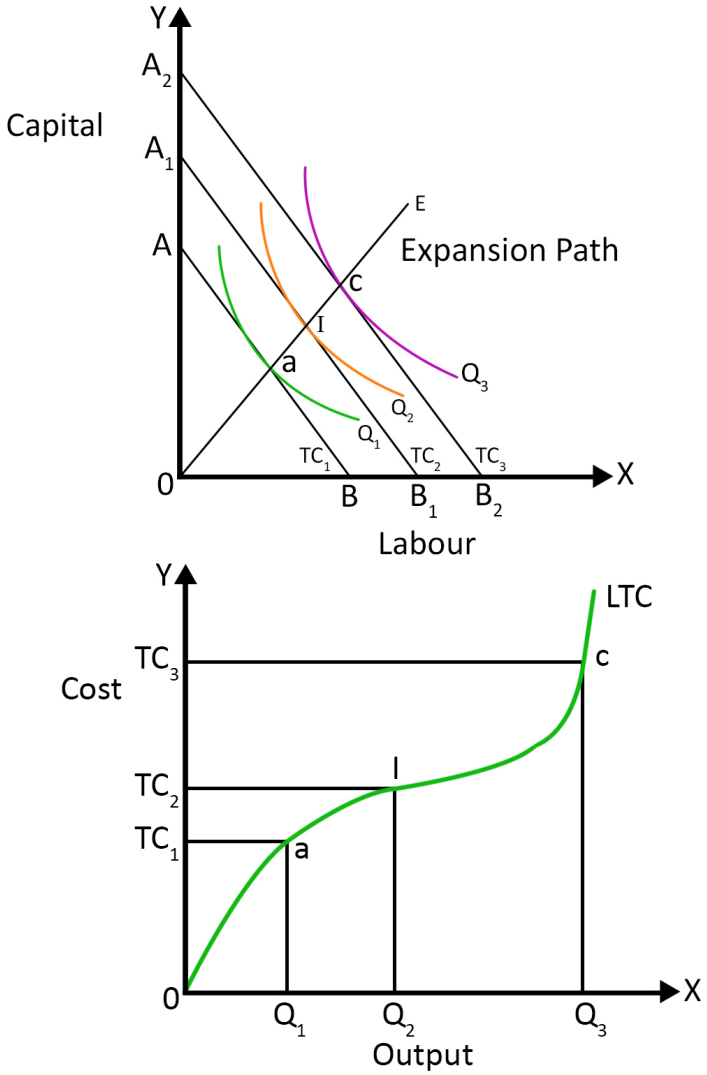


Fig 5.2.2 Long-Run Total Cost Curve from Expansion Path

We have discussed that the expansion path shows the least cost combination. So, we can measure the total cost incurred while producing each level of output from the expansion path. When Q_1 is the level of output produced in the long-run, with the isocost line AB and price ratio of factors as w/r (w-wage, r-rent), the total cost $TC_1 = K_1 \times r + L_1 \times w$. Here, K_1 is the quantity of capital and L_1 is the quantity of labour used for producing Q_1 output. When the level of output produced in the long-run increases to Q_2, with isocost line A_1B_1 and given price ratio of factors, the total cost, $TC_2 = K_2 \times r + L_2 \times w$. Similarly, for Q_3 output, the total cost is $TC_3 = K_3 \times r + L_3 \times w$.

Therefore, for each level of output produced in the long-run, we can measure a total cost with the help of an expansion path. For Q_1 level of output, the total cost is TC_1, for Q_2, the total cost is TC_2, and for Q_3, the total cost is TC_3. Plotting total costs with corresponding outputs give the long-run total cost curve from the expansion path. LTC is the long-run total cost curve which is the locus of points of combinations of total costs and corresponding outputs.

Recap

- Economies of scale - efficiency in production
- Diseconomies of scale - inefficiency in production
- There are internal and external economies and diseconomies of scale in production
- Internal economies and diseconomies due to factors within firm
- External economies and diseconomies due to factors outside firm
- Factors leading to internal economies - division of labour, use of modern technology
- Factors leading to internal diseconomies - coordination issues with big size of the firm
- Factors of external economies of scale- Low cost availability of inputs, introduction of related industries
- Factors of external diseconomies of scale- Increase in price of inputs and scarcity of resources
- Expansion path - locus of points of producer's equilibrium given the factor prices
- Long-run total cost curve can be derived from the expansion path
- $TC = K \times r + L \times w$

Objective Questions

1. What are economies of scale?
2. Differentiate between internal and external economies of scale.
3. What are the factors causing internal economies of scale?
4. Name two factors which lead to external economies of scale.

5. What are the factors causing internal diseconomies of scale?
6. What are the factors leading to external diseconomies of scale?
7. Define expansion path.
8. What determines the optimum expansion path?
9. What is the rational choice of a producer in terms of factor combination?
10. Express total cost mathematically.
11. What are the variables used in the mathematical form of total cost?
12. What is the condition for producer's equilibrium in mathematical form?

Answers

1. Economies of scale refer to efficiency in the production of a firm leading to an increase in output with a decrease in cost.
2. Internal economies are efficiency in the production of a firm due to the factors within the firm whereas, external economies refer to efficiency in production due to factors outside the firm and within the industry.
3. Division of labour and use of modern technology.
4. Better utilisation of information and introduction of related industries.
5. Very large size of the firm, lack of coordination within the large size of firm, entrepreneur as a fixed factor.
6. Increase in price of certain inputs, scarcity of resources, general recession.
7. Expansion path is the locus of points of producer's equilibrium with the factor prices constant.
8. Factor price
9. A rational producer chooses a factor combination that minimises cost and maximises revenue.
10. $TC = K \times r + L \times w$
11. K is capital, r is rent, L is labour and w is wage
12. $MRTS_{LK} = w/r$

Assignments

1. Distinguish between internal economies and diseconomies of scale.
2. Explain the factors leading to external economies and diseconomies of scale.
3. Write a note on the expansion path.
4. Explain the derivation of the long run cost curve from the expansion path.

Suggested Readings

1. Pindyck, R.S., Rubinfeld, D.L., & Mehta, P. L. (2017). *Microeconomics* (Eighth edition). Pearson Education Prentice Hall.
2. Samuelson, P.A., & W. D. Nordhaus (special edition 2020). *Economics*. New Delhi: Tata McGraw Hill.

References

1. Dwivedi, D.N. (2012). *Microeconomics: Theory and Applications* (Second Edition). Vikas Publishing House Pvt. Ltd.
2. Koutsoyiannis, A. (1990), *Modern Microeconomics* (Second Edition), Macmillan Education
3. Nicholson Walter and Christopher Synder (2019), *Microeconomic Theory-Basic Principles and Extensions*, Cengage Learning.
4. Salvatore, D. (2003), *Microeconomics -Theory and Applications* (Fourth Edition), Oxford University Press.

UNIT

Revenue

Learning Outcomes

After learning this unit, the learner will be able to:

- familiarise with the revenue concepts
- explain the derivation of per-unit revenues from total revenue
- identify the relationship between the total and marginal revenue

Prerequisites

In an economic society, producers and consumers are the two most important sections without which the society cannot perform. The activities of these two sections are heavily interconnected. The connection is brought about through demand and supply. Producers supply and consumers demand commodities. In the market, producers sell their supply and consumers purchase their demand.

While making the purchase and sale of commodities, the interconnection between the producers and consumers happens financially when consumers use their income to purchase the commodity, and producers receive their revenue for selling the commodity. So, the revenue which the producers receive is what they earn from selling their output to consumers.

Similar to cost analysis, the revenue analysis is also crucial to determine the profit of a producer since profit is revenue minus cost. Different concepts of revenue are discussed in this unit to have a better awareness of decision-making in production from the angle of revenue.

Keywords

Total revenue, Average revenue, Marginal revenue, Total revenue curve, Average revenue curve, Marginal revenue curve

5.3.1 Revenue Analysis

The revenue of a firm is what a firm earns by selling the various quantities of the commodity it supplies. The price of the commodity is an important factor determining the level of revenue. Usually, revenue is referred to in terms of the total revenue which is the product of price and quantity supplied of the commodity. However, like the cost, revenue is also defined in terms of total, average, and marginal concepts.

Revenue analysis is important for calculating the profit of a firm, since profit is revenue minus cost. Therefore, revenue determination forms a major decision making in production that must be dealt with in detail.

5.3.1.1 Concepts of Revenue

As mentioned above, revenue is defined in terms of total, average, and marginal concepts. Let us go through these concepts.

(a) Total Revenue (TR):

TR is the total of all types of revenue received by a firm. It is calculated by multiplying the price of the commodity and the quantity sold of the commodity.
$TR = P \times Q$

(b) Average Revenue (AR):

AR is the revenue in terms of per unit of output earned by the firm. AR is calculated by dividing total revenue and total quantity sold.

$AR = TR / Q$

When all the outputs are sold at the same price, the average revenue becomes equal to the price of the commodity.

c) Marginal Revenue (MR):

MR is the additional revenue earned by a firm by selling an additional quantity of the commodity. So, marginal revenue is the change in total revenue due to a change in the quantity sold.

$MR = \Delta TR / \Delta Q.$

MR can also be written as $TR_N - TR_{N-1}$. TR_N means total revenue from selling Nth quantity of commodity and TR_{N-1} means the total revenue from selling the second last quantity of the commodity. So, MR represents a change in revenue between the sale of two consecutive quantities of the commodity. Moreover, the sum of Marginal Revenues gives the TR. Table 5.3.1 gives a hypothetical schedule of TR, AR, and MR.

Table 5.3.1 Schedule for Total and Per-unit Revenues

Quantity Sold	Price of Commodity	TR	AR	MR
1	10	10	10	10
2	9	18	9	8
3	8	24	8	6

4	7	28	7	4
5	6	30	6	2
6	5	30	5	0
7	4	28	4	-2
8	3	24	3	-4

The hypothetical schedules of revenues show that TR increases with increase in quantity sold until the 5th quantity. At the 6th quantity, the revenue becomes maximum, and later falls with the sale of more commodities.

AR falls with an increase in quantity sold. However, the value of AR is positive as long as the value of TR is positive. But, in the case of MR, it falls with the increase in quantity sold. It is important to note that the MR becomes zero when TR is maximised. When TR falls after the peak point, the MR becomes negative.

The points on the schedule can be plotted in a diagram to get the TR, AR, and MR curves

5.3.1.2 Derivation of Average and Marginal Revenue Curves from Total Revenue Curve

The Figure 5.3.1 shows the derivation of AR and MR curves from the TR curve.

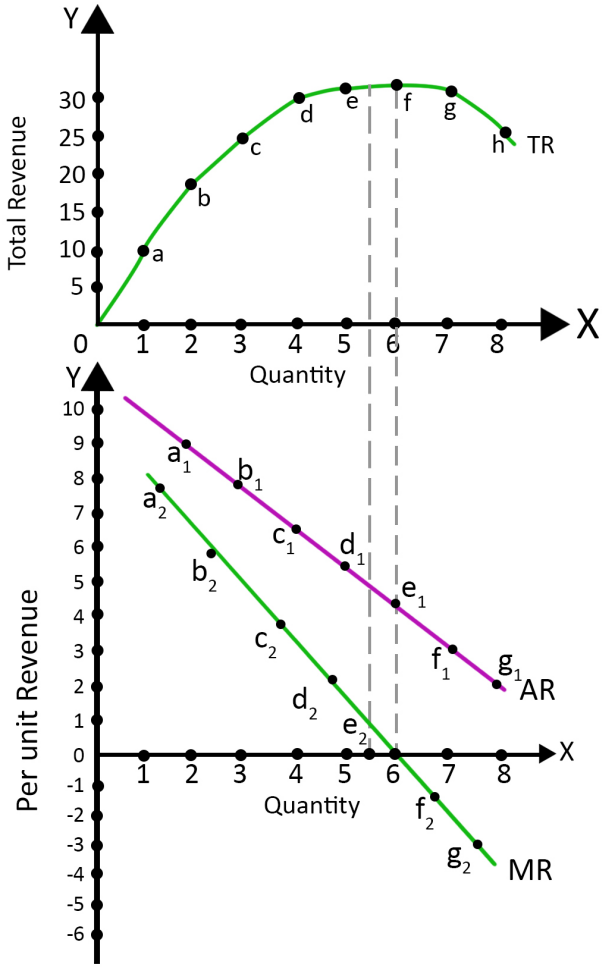


Fig 5.3.1 Total, Average, and Marginal Revenue Curves

In the figure, the TR curve is given above. The AR curve and MR curve are derived from the TR curve. Hence, they are plotted below the TR curve and MR is the change in revenue due to change in output.

As the schedule given above, the figure also shows that, the TR curve increases with an increase in the quantity sold until the 5th quantity. At the 5th quantity of commodity sold, the total revenue becomes 30. At the 6th quantity, the total revenue is the same as the 5th quantity sold. This means the total revenue is maximised when the 6th quantity of the commodity is sold. This point (f) is called the saturation point. After the 6th quantity sold, the total revenue falls if the firm decides to sell more than 6 quantities of the commodity.

With respect to the AR curve, it falls continuously with the increase in quantity sold. However, the AR curve is positive along the range of portions where the TR curve is positive.

In the case of the MR curve, there are interesting facts. MR curve falls with increase in quantity sold. It becomes zero at the 6th quantity sold and later falls to negative with more quantities sold than 6 units.

The figure shows some of the interesting relations among the TR, AR, and MR. The relation is given in the following sections:

5.3.1.3 Relation between Total Revenue and Marginal Revenue

We have discussed that the marginal revenue is the addition to the total revenue when one more additional quantity of commodity is sold. This shows that when the marginal revenue is positive, the total revenue continues to increase. When marginal revenue becomes negative, the total revenue starts falling. This is shown in the figure.

The TR curve is increasing given the MR curve is positive. The increase in TR curve and positive portion of MR curve remain until the 5th quantity sold. At the 6th quantity, the MR curve touches the X-axis showing a zero MR. Here, the TR curve becomes maximum. After the 6th quantity, the MR curve becomes negative. This causes the TR curve to fall.

So, the major relations between TR and MR are as follows:

- TR increases as long as the MR is positive.
- TR is maximised when the MR is zero.
- TR falls when the MR becomes negative.
- TR is the sum of MRs.

5.3.1.4 Relation between Average Revenue and Marginal Revenue

The relationship between AR and MR is clear from the figure 5.5.1. The relationship between AR and MR is mathematical. MR represents change in revenue as a result of change in quantity of commodity whereas, the AR represents average of revenue.It is revenue per unit of output earned by the firm.

Recap

- Revenue - money received by firms by selling various quantities of commodities
- Price and amount of quantity sold determine the revenue
- Revenue defined in terms of total, average, and marginal concepts
- TR price multiplied by quantity
- AR is TR divided by quantity
- MR is change in TR divided by change in quantity
- TR curve increases with increase in quantity sold up to a point
- TR becomes maximum and falls when quantity of commodity sold increases after a certain point
- TR rises until MR is positive
- TR becomes maximum when MR is zero
- TR falls when MR becomes negative
- AR falls when MR is lesser than AR

Objective Questions

1. What is the revenue of a firm?
2. Express TR mathematically.
3. Explain AR in terms of TR.
4. What is the shape of the TR curve?
5. What is the name of the point when TR is maximum?
6. What is MR?

7. What is the value of AR when TR is positive?
8. How is MR represented mathematically in terms of TR?
9. What happens to the TR curve when the MR curve becomes negative?
10. What is the shape of the MR curve?
11. What is the relation between AR and MR?

Answers

1. Revenue of a firm refers to the money received by firms by selling various quantities of commodities they supply.
2. TR = P×Q
3. AR is TR divided by the quantity of commodity sold
4. The TR curve increases up to a quantity of commodity, then reaches maximum and falls.
5. Saturation point
6. MR is change in TR divided by change in quantity
7. Positive
8. $TR_N - TR_{N-1}$
9. TR falls when MR becomes negative.
10. MR is downward facing
11. AR falls when MR is lesser than AR.

Assignments

1. Distinguish between Total Revenue, Marginal Revenue, and Average Revenue.
2. Elucidate the derivation of AR and MR from TR.
3. Explain the relationship between TR, MR, AR.
4. Explain the shape of TR, MR, AR Curves.

Suggested Readings

1. Pindyck, R.S., Rubinfeld, D.L., & Mehta, P. L. (2017). *Microeconomics* (Eighth edition). Pearson Education Prentice Hall.

2. Samuelson, P.A., & W. D. Nordhaus (special edition 2020). *Economics*. New Delhi: Tata McGraw Hill.

References

1. Dwivedi, D.N. (2012). *Microeconomics: Theory and Applications* (Second Edition). Vikas Publishing House Pvt. Ltd.

2. Koutsoyiannis, A. (1990), *Modern Microeconomics* (Second Edition), Macmillan Education.

3. Nicholson Walter and Christopher Synder (2019), *Microeconomic Theory-Basic Principles and Extensions*, Cengage Learning.

4. Salvatore, D. (2003), *Microeconomics -Theory and Applications* (Fourth Edition), Oxford University Press.

Individual Choice Under Uncertainty

UNIT 1

Risk and Uncertainty

Learning Outcomes

After reading this unit, the learner will be able to:

- differentiate between risk and uncertainty
- understand consumer's attitude towards risk
- comprehend methods to reduce risk

Prerequisites

The decisions we take regarding income, prices, costs, rent, and production in an economy so far have been based on sure events. Human beings as rational individuals make choices under conditions of certainty. Your friend Rani goes to a stationary shop. She wants to purchase a bundle of A4 sheets, 10 pencils, 10 pens, and 2 erasers. All these items together cost Rs. 250. All of these items are available in the shop. She already has the money in her purse, and knows that if she pays exactly Rs. 250, she can purchase all the items available in the shop. This purchase is a sure event and its outcome is fully known. Now, what if there is a possibility that the stationary shop is closed or if the items she wants are not available there? What would happen if the money she has is not sufficient for purchase? What if these items are out of stock? This will make the situation unpredictable. In such a case, how will a rational individual take an economic decision? Rani will change her plans and look for alternatives. Her plans suddenly change and therefore the outcome is not exactly predictable. As uncertainty is part of life of an individual, for an economy too, choices made are different under uncertain situations.

Everyday we are uncertain about the events that may happen that day. But does that mean we stop planning for future events? There are many decisions that we take on the basis of our previous experience and there are various choices we

make in risky situations. Let us take a very simple instance. On a cloudy day, you decide to carry an umbrella with you when you go out. Though you are not sure that it may rain, the possibility of rain occurring makes you carry an umbrella. Your immediate response therefore is always to protect yourself from the risk.

Life Insurance Corporation (LIC), the largest public sector insurance provider in India precisely works on this logic. LIC agents market insurance policies by promising huge benefits to your family incase of your death. Though individuals realise that death is inevitable, the probability of encountering risky situations in life is always present. To secure themselves against risks, people opt for various insurance policies like life insurance, vehicle insurance, health insurance etc. Insurance actually acts as a risk diversification mechanism for the individual. All individuals do not exhibit the same risk taking behaviour. Some will be ready to take risks while others may be too afraid to take risks. Some others may exhibit a neutral approach towards risk. To understand this, let us look at the investment behaviour of two individuals, Namit and Naman. Both of them receive the same amount of salary. Namit is afraid to take risks so he saves his money in a bank and also diverts his savings to some fixed deposits. He does not receive much financial gain but does not lose any money either. In the case of the second individual Naman, he keeps some of his investment as fixed deposits and diverts the rest to mutual funds. He is ready to undertake the risk of losing money during market fluctuations. Risk and uncertainty has crucial economic significance. Let's understand this in detail.

Keywords

Probability of outcomes, Expected value, Variability, Standard deviation, Diversification, Insurance, Stocks, Risk averse, Risk loving, Risk neutral

6.1.1 Risk and Uncertainty

Most of the choices we make involve a lot of uncertainty. Majority of us take loans to build a house, buy a car or pay for the college education of children. But for most of us, future incomes are not predictable. The amount we earn can increase or decrease; we may sometimes get a promotion or remain in the same position, we may switch jobs, or even lose our jobs. But if we postpone decisions of buying a house or spending for college education, we are actually taking the risk of a price increase. This could make such purchases less affordable. How should individuals take uncertainties into account while making crucial consumption or investment decisions?

When we face uncertainty we must choose how much risk we are willing to take. What, for example, should you do with your savings? Should you invest your money in a savings account, or divert it to a riskier but more lucrative channel

like investing in mutual funds? Let us take the example of a career decision. Is it better to remain in a stable, secure job, with no chances of improvement or start something on your own, which gives you an opportunity to grow but no guaranteed returns.

Let us now look into the difference between risk and uncertainty. The COVID19 pandemic is an example of an uncertain event. At the beginning of the pandemic we did not know the probability of getting infected by the virus. We also had no idea about the odds of dying due to the pandemic. But after some time we could assess the risk of the pandemic. As data on the number of deaths and the method through which the virus would spread began to be available, individuals began to adjust their behaviour towards the risk. Practising social distancing and taking vaccination can be seen as measures taken to reduce risks of contacting the virus.

Now we can define what uncertain events and risky events are.

6.1.1.1 Differences between Risk and Uncertainty

People use the distinction given by the economist Frank Knight, to understand the difference between risk and uncertainty. Uncertainty shows situations in which many outcomes are possible but the likelihood of each is unknown. Risk on the other hand refers to situations in which we can list all possible outcomes and know the likelihood of each occurring. In the case of COVID19, the beginning of the pandemic was an uncertain event for us, whereas as data began to be available, the risks posed by the pandemic began to be clearly visible.

The following table highlights certain crucial differences between risk and uncertainty.

Table 6.1.1 Difference between Risk and Uncertainty

Risk	Uncertainty
Lesser range of outcomes	Wide range of unknown outcomes
Probabilities of outcomes can be estimated	Cannot estimate probabilities of outcomes
Can purchase insurance protection or diversify	Cannot purchase insurance protection and cannot diversify

Given this difference between risky events and uncertain events, let us now look into how we can measure risks.

6.1.1.2 Measuring Risks

Suppose you are considering investing some amount of money in a gold mine. If the mining turns out to be successful, the company's stock will increase from Rs. 300 to Rs. 400 per share. But if no gold is found, then the price will fall to Rs. 200 per share. In this particular case there are two possible outcomes: Rs. 400 per share price and Rs. 200 per share price. From this we can describe risk. To quantify risk we can state all the possible outcomes of a particular action or event, and also note

down the likelihood that each outcome will occur. Most events cannot be predicted with total certainty. The best we can say is how much they are likely to happen, using the notion of probability.

Probability of Outcomes

In the earlier gold mining example, we find that there are two possible outcomes of investing in a gold mine: either you get a higher share if the exploration is successful or a lower share price if the mining fails. Probability is the likelihood that a given outcome will happen. In our example, the probability that gold mining will be successful might be ¼ and the probability that it is unsuccessful be ¾ (the probabilities for all possible events must add up to 1).

How can we actually derive the probability of an event being a successful one or not? There are two kinds of explanations to this. One is the objective and the other, the subjective interpretation of probability. The objective interpretation of probability is dependent on the frequency with which certain events can happen. If we know that, of the last 100 mining operations, 25 have succeeded and 75 failed. In that case, the probability of success of 1/4 is objective because it is based directly on the frequency of past experiences. But what if this is a new mining operation and there are no past events to help to estimate probable outcomes? In such cases, objective measures of probability cannot be used and subjective measurement of probability is needed. Subjective probability is the perception that an outcome will occur.

When probabilities are subjective, individuals may attach different probabilities to various outcomes. This helps them to make different choices. In the case of our example, if mining for gold takes place in an area where no mining has been done before, there is a tendency to attach a higher subjective probability that the project will have a positive outcome. Sometimes knowledge about mining or the geological conditions may also help the individual to predict the correct outcome. But despite the same amount of information and knowledge about the industry, subjective probability is different among different individuals.

Probability thus can be used for calculating two important measures that help us to identify and compare risky choices. One measure tells us about the expected value and the other shows the variability of possible outcomes.

Expected Value

In the earlier mining example, we know that there are two possible outcomes: a successful operation will result in Rs. 400 per share and a failed one will give Rs. 200 per share. How can we calculate expected value? The expected value aligned with an uncertain situation is a weighted average of the payoffs or values associated with all possible outcomes. Here the probabilities of each outcome are used as weights. The expected value shows us the payoff or value expected from an event on average. For the particular mining example, let us calculate the expected value.

Pr(success) (Rs 400/share) + Pr(failure) (Rs 200/share) = (1/4)(400/share) + 3 /4 (Rs200/share) = Rs. 250/share

Pr refers to 'probability of'. Here we are associating two possible outcomes with the event and assigning probabilities of success and failure to the event. Pay-off can be defined as the value associated with each possible outcome.

If there are two possible outcomes with a_1, a_2 as the payoffs, then the expected value (just like the example above, where there are only two possible-payoffs or outcomes-success or failure) can be given as,

$E(A)=p_1 a_1+p_2 a_2$

If there are a number of possible outcomes (n possible number of outcomes), then expected value is

$E(A)= p_1 a_1+p_2 a_2+\ldots\ldots\ldots\ldots+p_n a_n$

Expected value therefore measures the payoffs or returns from an outcome on an average.

Variability

Another way to measure risk is to understand the variability of outcomes. What is variability? Variability is the extent to which the possible outcomes of an uncertain situation differ. How can we understand this concept better with an example? Suppose you have two options for a holiday job: one is to join a food delivery service and distribute food, and the second is to start a new food joint. The income you earn in the first job depends on how much food delivery is possible in a day. There are two equally likely payoffs for this job: Rs. 2000 for a successful sales effort and Rs.1000 for one that is less successful. The second job is a salary job. It is very likely (0.99 probability) that you will earn Rs.1510, but there is a 0.01 probability that the company will go out of business, in which case you would earn only Rs. 510 as closure pay.

Note that these two jobs have the same expected income. For Job 1, expected income is 0.5(2000) + 0.5(1000) = 1500.....(1). For Job 2, it is 0.99(1510) + 0.01(510) = 1500.....(2) (The probability of a higher return in the first job is 0.5 and the probability of a lower return is 0.5, whereas for salaried job, the probability of the individual getting salary every month is very high, at 0.99 and probability of the business shutting down is 0.01,the returns in each of the cases is given in brackets).

As the expected value is the same in both the jobs, how can we choose the less risky job? If you look at deviations alone, the probability of their weighted average is always 0. Therefore, this will not give us a real picture.

Here, we use standard deviation to measure variability. Standard deviation is the square root of the average of the squares of the deviations of the payoffs associated with each outcome from their expected values.

Let us look at the average of the squared deviations under Job 1,

$0.5(250000) + 0.5(250000) = 250000$.....(3)

Here, 250000 given in two brackets are square of deviation of payoffs associated with each outcomes from their expected value; i.e., first 250000 is the square of deviation between payoff, 2000 and expected value, 1500.

i.e., Square deviation $= (2000-1500)^2$

$= 500^2$

$= 250000$

The second 250000 is the square of difference between payoff, 1000 and expected value, 1500.

i.e., Square deviation $= (1000-1500)^2$

$= (-500)^2$

$= 250000$

The standard deviation is therefore equal to the square root of Rs.250000 (Right Hand Side of equation 3), which is Rs.500.

We see that the probability-weighted average of the squared deviations under Job 2 is 0.99(100) + 0 .01(980100) = 9900.....(4)

Here, 100 and 980100 are also the square of deviation of payoffs associated with each outcome of job 2 from their expected value; i.e., 100 is the square of deviation between payoff 1510 and expected value 1500.

i.e., Square deviation = $(1510-1500)^2$

$= (10)^2$

$= 100$

980100 is the square of deviation between payoff, 510 and expectd value 1500.

i.e., Square deviation = $(510-1500)^2$

$= (-990)^2$

$= 980100$

The standard deviation is the square root of Rs. 9900 (RHS of equation 4), which is Rs. 99.50. This means that the second Job is much less risky than the first; as the standard deviation of the incomes is much lower.

But the choice of jobs actually depends on individuals, on their willingness to take risk or avoid risk. We will discuss the risk taking behaviour in the last part of the unit.

Now let us look into how individuals can minimise risk.

6.1.1.3 Preference towards Risk

There is a risk involved in everything you do. Risky situations in a day involve walking on the road, crossing the road, driving a car or simply standing on the road. In our daily life we try to minimise risks in every way possible. We walk on a footpath, cross the road carefully and try to avoid rash driving. Likewise, as a consumer you will minimise risk by diversifying your activities.

Diversification

The adage "Don't put all your eggs in one basket" is very important, highlighting the risk of losing everything together. Sometimes when we plan to travel long distances, we pack one or two purses with money kept in different bags. This again is a typical diversification strategy.

Diversification helps to reduce risk by allocating resources to a diverse set of activities whose outcomes are not closely related. Let us take the stock market as an example for diversification.

The Stock Market

In newspapers we see the stock market showing various trends. Sometimes there is a boom in the case of certain company stocks and sometimes the stock market just crashes. How can individuals who invest in stock markets reduce risk? Here, diversification becomes a crucial strategy for individuals. An individual who invests all her money in a single stock is therefore taking much more risk than an individual who puts money in different stocks. Stock markets are highly volatile and therefore even if risks cannot be completely eliminated, investing in ten or twenty different stocks can reduce them. Does this mean that you are completely protected in a stock market investment? Though some stock prices increase and others fall, they will respond to changes in economic

conditions. The COVID 19 pandemic has slowed down economic activity and has reduced profitability of many companies. So even with investment in a number of company stocks, the overall market conditions may not protect you completely from risk.

Insurance

Majority of individuals have a tendency to avoid risk. They have risk averse behaviour. Such individuals opt for insurance to ensure that they have the same income, despite any setback occurring. Imagine that there is a 10% probability that floods will damage your house and you will lose Rs. 10000. You have Rs. 50000 worth of property. You decide to purchase insurance worth Rs. 1000. The following table shows how the individual has to face the risk with or without insurance.

Table 6.1.2 Risk with or without Insurance

Insurance	Flood(P_r=0.1)	No Flood (P_r=0.9)	Expected Value S.D	
No	40,000	50,000	49,000	3000
Yes	49,000	49,000	49,000	0

The expected wealth in the case of purchasing or not purchasing insurance is Rs. 49,000. But with no insurance, standard deviation is 3000 and with insurance, it is 0. A risk averse consumer will enjoy higher utility by purchasing insurance.

6.1.1.4 The Value of Information

People often make decisions based on limited information. If more information were available, one could make better predictions and reduce risk. As information is a precious commodity, people will pay for it. The value of complete information is the difference between the expected value of a choice when there is complete information and the expected value when information is incomplete.

Now, let us see how individuals react to risk. On the basis of consumer behaviour or attitude towards risk, we can divide them into risk averse consumers, risk lovers, and risk neutral.

6.1.1.5 Consumers Preference Towards Risk

People are different in their willingness to bear risk. Individuals can be grouped as risk averse, risk loving, and risk neutral depending on their attitude towards risk. An individual who is risk averse opts for a certain given income to a risky income with the same expected value. (Such an individual has a diminishing marginal utility of income). As his income increases the additional utility which he gets from the increase in income actually decreases for such individuals. It is commonly observed that the majority of the people are risk averse. To observe risk averse behaviour we can see that most people not only buy life insurance, health insurance, and car insurance, but also remain in occupations with relatively stable wages.

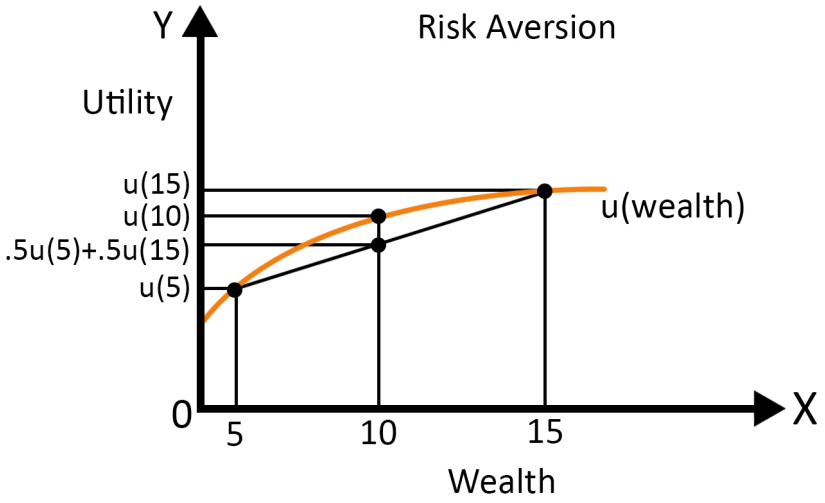


Fig 6.1.1 Risk Averse

The above figure shows that for a risk averse consumer, the utility of the expected value of wealth, u (10), is greater than the expected utility of wealth,

0.5u(5) + 0.5u(15). Let us explain this further.

A consumer has Rs. 10 with him. If he puts this money in a gamble, there is a 50% probability that he will get Rs. 5 and a 50% probability of losing Rs. 5. This means he has a 50% probability of ending up with Rs. 5 or Rs. 15, depending on losing or winning the gamble.

The expected value of wealth here is Rs. 10 and expected utility is

0.5u(15)+0.5u(5)(The expected utility of wealth is the average of u (15) and u (5))

Utility of expected value of wealth is u (10)

U(½ x 15+½ x 5)=u(10)>½ u(15)+½ u(5)

This shows us that for a risk averse consumer, he prefers to have the expected value of his wealth, rather than take the chance of a gamble.

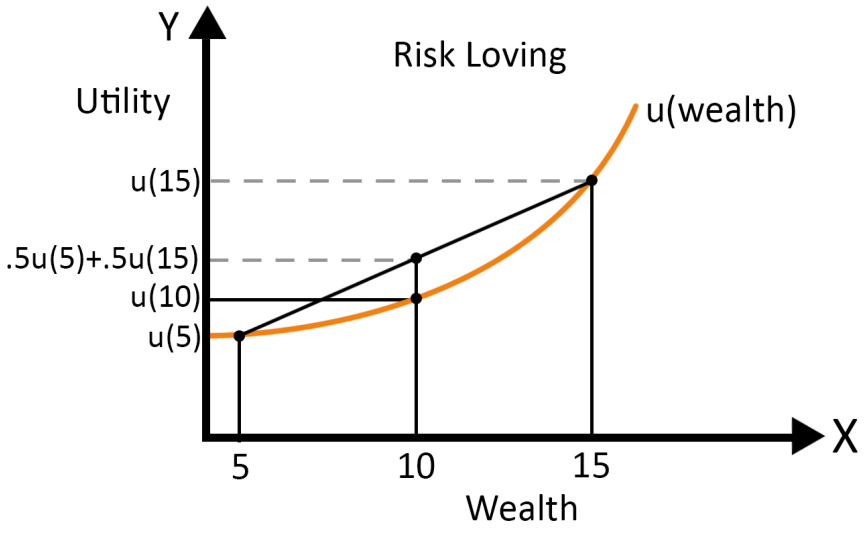


Fig 6.1.2 Risk Loving Consumer

The above cited figure shows us that for a risk-loving consumer the expected utility of wealth, 0.5u(5) + 0.5u(15), is greater than the utility of the expected value of wealth, u (10). There are risk loving consumers who always take lottery tickets or go for gambling to increase their wealth.

Let us explain this further. The risk-loving consumer has a convex shaped utility curve. The curvature of the utility function shows the consumer's attitude towards risk. An individual who is risk loving prefers an uncertain income to a certain one, even if the expected value of the uncertain income is less than that of the certain income.

The expected utility of wealth is 0.5u(5) + 0.5u(15)

The expected value of wealth is u (10)

0.5u(5) + 0.5u(15)> u (10)

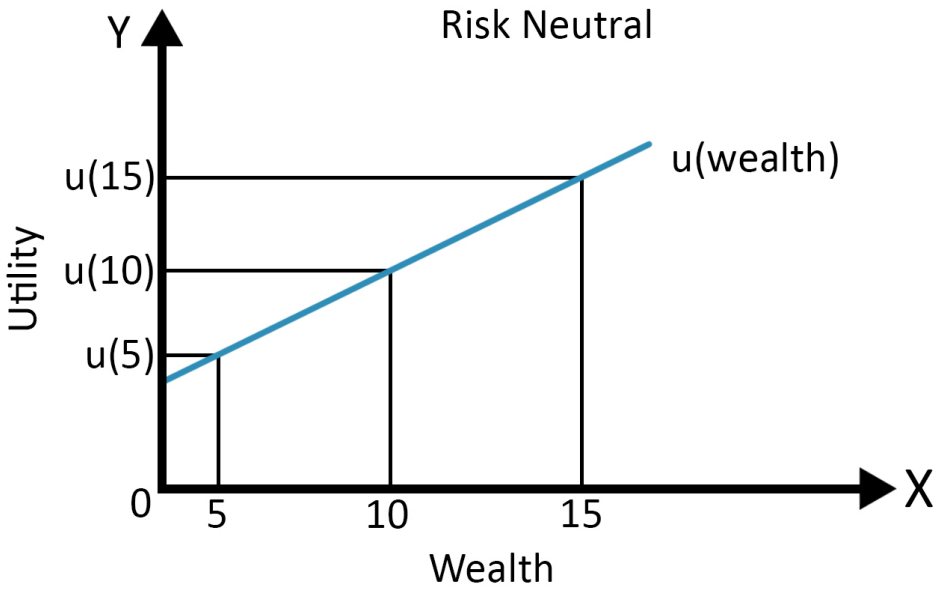


Fig 6.1.3 Risk Neutral Consumer

In the figure, the expected utility of wealth is the utility of its expected value. In this case the consumer doesn't care about the riskiness of his wealth, he only looks at its expected value. A risk neutral person has constant marginal utility of income with a linear utility function. Therefore, she/he is indifferent between a certain income and an uncertain income with the same expected value.

Recap

- Consumption decisions differ under risk and uncertainty
- Risks means lesser range of outcomes, probabilities, insurance, diversification
- Uncertainty-wide range of unknown outcomes
- Understanding Risk- Probability of outcomes
- Objective and subjective probability
- Identify and compare risky choices can be done through using probability
- One measure of probability tells us expected Value and the other shows variability of outcomes
- Expected values is the payoffs or returns from an outcome on an average
- Variability measures the extent to which outcomes can vary under risky situations
- Standard Deviations is a better measure of variability
- Lesser standard deviation means smaller the risk
- Stock market involves with diversification of risk
- Risk averse people get more utility when purchasing insurance
- Value of information
- Consumers attitude towards risk- risk averse, risk lover, risk neutral
- Curvature of the utility function shows risk
- Linear utility function is associated with risk neutral individuals
- Convex shaped utility curve is associated with risk lovers
- Concave Shaped utility curve is associated with Risk averse

Objective Questions

1. What is risk?
2. What is the difference between risk and uncertainty?
3. Name the economist who made the distinction between risk and uncertainty.
4. What is probability?
5. Define subjective probability.
6. What is variability?
7. What is standard deviation in case of probable events?
8. If the expected value is the same in both the jobs, how can you choose the less risky job?
9. What is risk diversification?
10. Give one example for risk diversification.
11. What is the shape of the utility curve for a risk averse consumer?
12. What does the curvature of the utility function show?
13. Under risky situations what does a linear utility curve show?
14. Who are risk-loving consumers?
15. What is the benefit of purchasing insurance?

Answers

1. Risk refers to situations in which we can list all possible outcomes and know the likelihood of each occurring.
2. Risks refer to situations in which probabilities of outcomes can be estimated whereas uncertainty refers to situations where such probabilities cannot be estimated.
3. Frank Knight

4. Probability is the likelihood that a given outcome will happen.

5. Subjective probability is the perception that an outcome will occur.

6. Variability is the extent to which the possible outcomes of an uncertain situation differ.

7. Standard deviation is the square root of the average of the squares of the deviations of the payoffs associated with each outcome from their expected values.

8. We calculate the standard deviation, the spread of risk is lesser if standard deviation is smaller

9. Diversification helps to reduce risk by allocating resources to a diverse set of activities whose outcomes are not closely related

10. Stock purchase

11. Concave

12. The curvature of the utility function shows the consumers attitude towards risk

13. It shows that the consumer is risk neutral.

14. Risk loving consumers prefer a risky income to a certain income with the same expected value.

15. Risk averse individuals opt for insurance to ensure that they have the same income, in case of any emergency.

Assignments

1. Explain the individual's attitude towards risk.

2. Why do people buy insurance?

3. When you are investing in stocks, what does it tell about your nature of taking risks?

4. Draw a risk loving consumer's utility curve. Explain it.

5. Explain the concept of risk diversification.

Suggested Readings

1. Nicholson Walter and Christopher Synder (2019), *Microeconomic Theory-Basic Principles and Extensions*, Cengage Learning.

2. Salvatore, D. (2003), *Microeconomics -Theory and Applications* (Fourth Edition), Oxford University Press.

References

1. Hal R Varian(2010) *Intermediate Microeconomics: A Modern Approach*, 8th Edition, W.W Norton and Company/ Affiliated east- West Press (India).

2. Pindyck, R.S., Rubinfeld, D. L., and Mehta, P. L. (2013). *Microeconomics* (Seventh edition).Pearson Education Prentice Hall.

Choice under Uncertainty

Learning Outcomes

After learning this unit, the learner will be:

- familiarised with the St. Petersburg Paradox and Neumann-Morgenstern Theorem
- able to explain Bernoulli's solution to the St. Petersburg Paradox
- able to distinguish between fair and non-fair games

Prerequisites

In our real world, we experience many situations where making decisions may be difficult. Most of the time, decision-making becomes difficult since the situations may be associated with uncertain events. As we are not sure of the end result of uncertain events in a situation, one must choose an event which is best suitable for the decision maker.

Suppose you are planning to purchase a scooter. You can buy a petrol scooter or an electric scooter. If you want to experience modern technology and use an environmentally friendly vehicle, you can choose an electric scooter. However, electric scooters are relatively new in the country in comparison to petrol scooters. People have less information on mileage, power, charging options, durability, stability etc. of the electric variant. So, purchasing an electric scooter is associated with uncertain events when the electric variant of the scooter is comparatively new.

Sometimes, situations themselves are peculiar that even with enough information, we cannot bring certainty to a situation. So, for any uncertain situation, we have many choices. Choosing the best option available for us is a task. You have already learnt about the attitude of individuals in respect of risk or uncertainty. Let us see how individuals make decisions regarding choice under uncertain situations.

Keywords

Uncertainty, Expected value of uncertain games, Outcome of a game, Probability of an outcome, Marginal utility of money, Utility index

6.2.1 Choice under Uncertainty

Uncertainty refers to the situation where there is more than one end result of an activity or a decision. Here, the probability of results is difficult to arrive at. You have already dealt with the risk, uncertainty, and attitude of people towards risks in the previous unit. This unit discusses the choice under uncertain situations.

The different end results of uncertain situations mean different choices available to people with different probabilities of occurrences. So, an individual chooses the best available choice for her/him from among the different choices. As we have discussed, an individual wanting to purchase an electric scooter faces many uncertainties when making the decision. Similarly, purchasing fruits and vegetables is associated with uncertainty regarding their quality and freshness. In real life, we have to make decisions under uncertain situations where outcomes or end results are not certain.

Some of the situations widely used as examples of uncertain situations are tossing a coin, purchasing a lottery, and gambling. Games are an important example of an uncertain situation where the outcomes are unknown. Different types of uncertain situations have different outcomes. Tossing a coin has only two outcomes viz. getting a head or tail. With respect to purchasing a lottery, different prizes available with a lottery determine the outcomes of the lottery. All these outcomes are associated with a respective probability of occurrence of the outcomes.

This unit discusses how an individual takes a decision in an uncertain situation. This is explained using the St. Petersburg Paradox and Neumann-Morgenstern theorem. Let us go through these in detail.

6.2.1.1 St. Petersburg Paradox

St. Petersburg Paradox refers to the question of why individuals do not take part in uncertain games which are considered to be fair. Fair games are random games having different outcomes and corresponding probabilities of occurrences of such outcomes, with an expected value equal to zero.

It is very important to explain the concept of fair game to explain the St. Petersburg Paradox. Let us explain the fair game with the common example of the uncertain situation in probability theory, the tossing of a coin.

While tossing a coin, the two possible outcomes are getting a head or a tail. Outcomes under the probability theorem refer to results which are possible while doing the experiment. The chances or probability of getting a head or a tail are 50-50 while tossing the coin. Probability refers to the measurement of the possibility of occurrence of an outcome.

Suppose, while tossing the coin, the prize for getting a head is fixed as Rs.1000,

and for a tail is Rs. -1000. That is, if the player wins, he will get Rs. 1000, and if fails will lose Rs. 1000. Then, the expected value of the game can be written as:

$E(x) = 0.5 \times 1000 + 0.5 \times (-1000)$----------(1)

Here, E(x) is the expected value of tossing the coin;

0.5 refers to a 50 per cent chance or probability of getting a head or tail;

1000 refers to the prize for getting a head;

-1000 refers to the prize for getting a tail;

0.5×1000 represents the value of the game from getting a head;

$0.5 \times (-1000)$ represents the value of the game from getting a tail.

So, $E(x) = 0.5 \times 1000 + 0.5 \times (-1000)$

$= 500\text{-}500$

$= 0$

Therefore, the expected value of the game is zero. So, the game can be referred to as a fair game.

You will get more clarity on the concept of a fair game by going through an example of a non-fair game. Suppose, for the same game, tossing a coin, the prize of getting a head is fixed to be Rs. 1500, instead of Rs. 1000 in the previous example, and the prize of getting the tail remains the same.

So, the expected value of the game is,

$E(x) = 0.5 \times 1500 + 0.5 \times (-1000)$

$= 750 - 500$

$= 250$

Here, the expected value from tossing a coin is Rs. 250. Since the expected value is not zero, the game is not a fair game. It is a non-fair game.

However, the game can be changed to a fair game by making the expected value equal to zero. The expected value of the game can be made zero by imposing a fee for playing the game. Here, a fee of Rs. 250 can be charged for participating in the game. So, the expected value of Rs. 250 can be negated by charging a participation fee of Rs. 250.

Usually, people do not participate in fair games when the outcomes are uncertain. That is, even though the total value from a game is zero, people do not take part in such games since the outcome of the game that they receive is uncertain. This is the same even if the winning prize is considerably high. This situation is referred to as the St. Petersburg Paradox.

A mathematician, Daniel Bernoulli gave a solution for this paradox. It is given as Bernoulli's solution. The following section deals with this.

Bernoulli's Solution and Expected Utility

Bernoulli has explained the reason for an individual's reluctance to participate in fair games in terms of the expected utility. Bernoulli states that rational individuals' decisions to take part in uncertain games are on the basis of the utility they expect from the outcomes of the game. So, a rational individual does not take part in an uncertain game by just seeing the monetary value of the outcome of the game. Here, the term 'rational' is very important. Bernoulli's solution discusses the case of a person having no addiction or pleasure from gambling.

Consider the above-mentioned example. Here, the individual does not take part in the fair game by seeing the winning prize

of Rs. 1000 or a loss of Rs. 1000 if she/he fails. Rather, a rational being considers her/his own expectation of utility from the money won and lost through success and failure respectively. The individual will compare the addition in utility in the case of winning the game with the loss of utility from a failure of the game. So, a rational individual will take the decision on the basis of the utility from the outcome rather than the monetary value of the outcome.

Here, the utility from winning or losing the game is the marginal utility of money. The marginal utility of money is the increment or addition to the total utility of money when an additional amount of money is added to the stock of money. In the real world, the marginal utility of money falls when the stock of money increases. So, the gain of marginal utility from winning the game and loss of marginal utility from failing the game would be different even if the money value of gain or loss from the game is the same. When the money value of gain or loss of the game is the same, the expected value will be zero.

So, for a person, the expected utilities from winning or losing the prize of the game decide her/his participation in an uncertain game. If the person wins the game, the additional money will add only a smaller marginal utility since the marginal utility of money falls with additions in money. Conversely, if the person loses the game, the loss of money will reduce the marginal utility of money by a greater extent. The reason is, with loss of money, the total stock of money falls leading to the higher marginal utility for money. A person will compare the smaller addition in the marginal utility of money from winning the game, with the bigger reduction in the marginal utility from losing the game while taking the decision to participate in uncertain games.

Bernoulli's solution can be explained graphically using our example. Figure 6.2.1 portrays the explanation for not participating in a fair game.

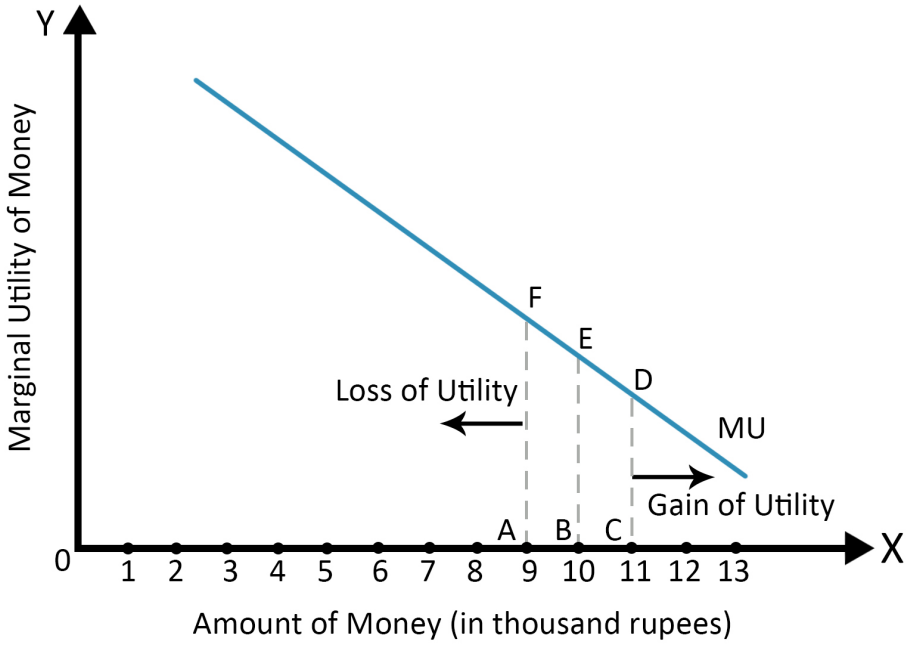


Fig 6.2.1 Non-participation in a Fair Game

In the figure, the X-axis measures the amount of money and the Y-axis measures the marginal utility of money. Suppose, an individual owns Rs. 10000. If she/ he participates in the fair game and wins the game, an additional Rs. 1000 will be added. The individual's stock of money increases to Rs. 11000. When the stock of the money increases, the marginal utility of each additional unit of money falls. The gain of marginal utility from winning the game is shown in the figure as BEDC.

If the individual loses the game, she/ he has to pay Rs. 1000. Then the stock of money falls to Rs. 9000. When the stock of money falls, the marginal utility of money increases. The loss of utility for Rs. 1000 is AFEB.

From the figure, it is clear that BEDC is lesser than AFEB. Hence, the gain of marginal utility from winning the game is lesser than the loss of marginal utility from losing the game. It is important to note that the money value is the same for winning and losing the game. However, the marginal utility of winning and losing the game is different. Therefore, a rational individual will not take part in a fair or 50-50 chance game. This is the explanation of the St. Petersburg Paradox by Bernoulli.

The same diminishing marginal utility can also be used to explain the reason for not participating in non-fair games or games at which the individual's expected value is higher than zero.

Suppose, if the prize for winning or getting a head is Rs. 1500, and losing or getting a tail is Rs. -1000, the expected value is Rs. 250 as mentioned earlier. The game is a non-fair game giving a favourable position to the individual. But, a rational individual may not participate in the game if the marginal utility of money is declining rapidly. The following figure explains this.

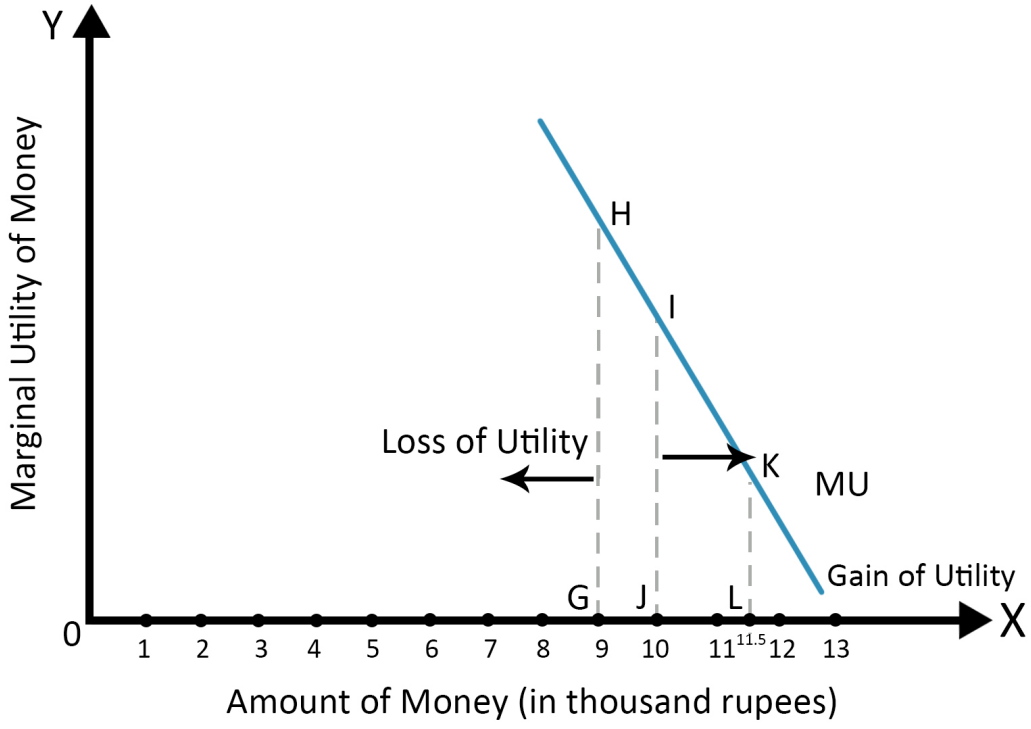


Fig 6.2.2 Non- Participation in Non-Fair Game

In figure 6.2.2, the X-axis measures the amount of money and Y-axis measures the marginal utility of money. Take the case of the same individual mentioned previously. This person possesses Rs. 10,000. If she/he participates in the non-fair game and wins the game, an additional Rs. 1500 will be added to the total amount of money. The individual's stock of money increases to Rs. 11500. When the stock of the money increases, the marginal utility of each additional unit of money falls. The gain of marginal utility from winning the game is shown in the figure as JIKL.

Similar to the case of the fair game, if the individual loses the game, she/he has to pay Rs. 1000. Then the stock of money falls to Rs. 9000 leading to an increase in the marginal utility of money. The loss of utility for Rs. 1000 is GHIJ.

Here, JIKL is lesser than GHIJ. That is the gain of marginal utility from winning the game is lesser than the loss of marginal utility from losing the game. The interesting case is that the gain in terms of money value, Rs. 1500, is higher than the loss, Rs. 1000. Still, the marginal utility from gain is lesser than the marginal utility from loss. The reason is the rapidly declining marginal utility of money. So, a rational individual will not take part even in a favourable game when the marginal utility of money is falling at an increasing rate.

Bernoulli's expected utility hypothesis gives importance to utility from the additional money gained or lost rather than the monetary value of money while taking decisions under uncertain scenarios. This is largely accepted in the economic realm. However, the cardinal measurement of utility used in the hypothesis is criticised today.

Neumann and Morgenstern put forward another approach to explain the behaviour of rational individuals in uncertain situations.

6.2.1.2 Neumann – Morgenstern Theorem

J. Von Neumann and O. Morgenstern explained their theory in, 'Theory of Games and Economic Behaviour'. They advocated the formation of a utility index by measuring the utility numerically from the outcomes of the game. According to Neumann and Morgenstern, the decisions of rational individuals in uncertain situations are based on the utility index.

Let us consider the assumptions of the Neumann- Morgenstern Theorem before explaining the N-M utility Index.

Assumptions of Neumann- Morgenstern Theorem

- Individuals have their own preferences of events. Events of a game are the outcomes of a game associated with a probability of occurrence of the respective outcomes.
- In the case of tossing a coin, getting a head with a 50 percent chance is an event. Similarly, getting a tail with another 50 percent chance is the second event in tossing the coin. Under N-M Theorem, an individual's preferences for each outcome are complete. That is, individuals have a specific preference for each event of a game.
- Individuals have the freedom to specify their preference for one event over another. Also, they can remain indifferent between events of a game. Suppose, under a game,

an individual has two events viz. a chance of winning a prize of Rs. 2000 for 100 percent surety, and a prize of Rs. 5000 for 70 percent chance of winning and 30 percent chance of failing it. The individual can compare the events and prefer one event or remain indifferent between the two events.

- The choices of individuals are consistent in the sense that if the person prefers one event over another, then she/he will not prefer another event when the originally preferred event is available.

Now, let us see the N-M Utility Index in detail.

Neumann – Morgenstern Utility Index

The N-M Utility index is calculated by measuring utility numerically for outcomes. For this, one should have an understanding of the outcomes of a game and the probability of occurrence of the outcomes.

Suppose a person wants to purchase a lottery ticket. The winning prize of the lottery is Rs. 10,000, and the consolation prize if she/he loses, is Rs. 100. So, the outcomes are Rs. 10,000 and Rs. 100. The probability of occurrence of the outcome of Rs. 10,000 is 70 percent, and Rs. 100 is 30 percent.

Here, we have outcomes and their probability. Then, the expected value is

$E(x) = P_1 \times W + (1- P_1) \times F$ ----------(2)

P_1 is the probability of occurrence of the first outcome, i.e., winning the lottery;

W is the winning outcome;

(1- P_1) is the probability of occurrence of the second outcome, i.e., losing the lottery.

Under the probability theorem, the total probability of occurrence of all the possible outcomes adds up to 100 per cent or 1. Since there are only two outcomes here, the probability of the occurrence of the second outcome can be written as (1- P_1);

F is the failing outcome.

Putting the numerical values in the equation (2)

$E(x) = .7 \times 10000 + .3 \times 100$

$= 7000+30$

$= 7030$

7030 is the expected monetary value of purchasing a lottery ticket.

In order to find out the expected utility, the expected monetary value must be converted to utility. Then, the equation (2) will be changed to

$E(u) = P_1 \times U \text{ of } W + (1-P_1) \times U \text{ of } F$-------(3)

Suppose the utility for Rs. 10000 is 1000 utils and Rs. 100 is 10 utils, then the expected utility will be

$E(u) = 0.7 \times 1000 + 0.3 \times 10$

$= 703$ utils

This is the expected utility of purchasing the lottery. Now, to generate the N-M utility index, we need to find out the expected utility of the expected sum of money.

In order to find out the utility of other sums of money, we need to find a certain sum of money. Certainty sum of money is sure or certain money. We use certain money to find utility because, with certain

money, an individual will be indifferent to other sums of money if she/he possesses the certain money.

In our example of purchasing the lottery ticket, if the individual is indifferent between Rs. 7000 as certain money and prizes of the lottery ticket, then the expected utility from purchasing the lottery will be equal to the utility of Rs. 7000.

Utility of 7000 = E (utility of lottery)

Utility of 7000 = P_1 × U of W + (1-P_1) × U of F

= 0.7 × 1000 + 0.3 × 10

= 703 utils

Therefore, the N-M utility index for a person wanting to purchase a lottery is

Money	**Expected Utility**
10000	1000
7000	703
100	10

Like this, the utility index of lottery tickets and other games can be calculated.

Neumann – Morgenstern Utility and Neoclassical Cardinal Measurement of Utility

Though both the N-M utility and Neoclassical cardinal measure of utility measure utility in terms of numbers or cardinally, they both differ in terms of base for measuring utility. In the case of the Neoclassical cardinal measure of utility, the utility is a measure of satisfaction that the consumers derive from consuming the good. However, in the case of N-M utility, it measures the utility of money in respect of various outcomes of risky or uncertain situations. So, the Neoclassical measure is used to understand the level of satisfaction of consumers whereas the N-M utility measure is used to predict the preference of an individual when she/he faces uncertain situations. So, the N-M utility theory does not measure the pleasure an individual receives from choosing different outcomes of an uncertain event.

Recap

- Tossing coins, purchasing lottery, gambling examples of uncertain situations
- St. Petersburg Paradox-why individuals do not take part in fair games
- Random games with an expected value equal to zero are fair games
- Random games with an expected value not equal to zero are non-fair games
- A solution to the St. Petersburg Paradox is given by Bernoulli
- Fair games depend on the expected utility from the outcomes of the game
- Expected utility more important than monetary value of outcome of game

- Rational individual compares addition in utility with loss of utility
- Marginal utility of money(MU_m) plays important role in Bernoulli's solution
- (MU_m) is less for winning the game than losing the game
- (MU_m) declines with increasing money stock from winning the game
- Individuals do not participate in fair or non-fair favourable games
- Neumann-Morgenstern Theorem mainly works by creating utility index
- N-M utility index measures monetary values of outcomes of games
- Expected utility probability times the utility of monetary values of outcomes
- N-M utility is based on a certain or sure sum of money
- Approaches to measuring utility cardinally- N-M utility and Neoclassical

Objective Questions

1. What is the St. Petersburg Paradox?
2. What are fair games?
3. How does a non-fair game be converted to a fair game?
4. What is the expected value of a game?
5. Who propounded the solution for the St. Petersburg Paradox?
6. What is the important factor that determines the decision of an individual regarding participation in uncertain games?
7. How does a rational individual arrive at the decision to participate in uncertain situations?
8. What is the reason for non-participation in fair games?
9. How does the marginal utility of money change with changes in the stock of money?
10. What is the Neumann-Morgenstern utility index?

11. What is the expected utility of a game?

12. What is the mathematical equation for expected utility?

13. What is a certain or sure sum of money?

14. What is the difference between the Neumann-Morgenstern Utility and Neoclassical Cardinal measurement of Utility?

Answers

1. St. Petersburg Paradox refers to the question of why individuals do not take part in games which are considered to be fair.

2. Fair games are random games with an expected value equal to zero.

3. Non-fair games can be converted to fair games by charging an entry fee to participate in games which is equal to the expected value of the non-fair game.

4. Expected value is probability times the monetary value of the outcome.

5. Bernoulli

6. A decision to participate in a fair game depends on the expected utility from the outcomes of the game.

7. A rational individual arrives at the decision regarding participation in uncertain games by comparing the addition in utility from winning the game with the loss of utility from the failure in game.

8. The marginal utility of money declines with increasing money stock from winning the game.

9. Marginal utility of money falls when the stock of the money increases, and increases when the stock of the money decreases.

10. N-M utility index is a measure of utilities of various monetary values of outcomes of games.

11. Expected utility of a game is probability times the utility of monetary value of outcomes.

12. $E(u) = P_1 \times U$ of $W + (1-P_1) \times U$ of F

13. Certain or sure sum of money is that money which if it is sure to individuals, she/he will be indifferent to the monetary values of outcomes of a game.

14. N-M utility measures the utility of money in respect of various outcomes of a risky situation whereas the neoclassical cardinal utility measures the satisfaction that consumers derive from consuming the good.

Assignments

1. Explain St.Petersburg Paradox.
2. Elucidate Bernoulli's solution with graphical representation.
3. Describe the Neumann-Morgenstern Utility Index.
4. Explain the assumptions of Neumann- Morgenstern Utility Theorem?

Suggested Readings

1. Hal R Varian(2010) *Intermediate Microeconomics: A Modern Approach*, 8th Edition, W.W Norton and Company/ Affiliated east- West Press (India).
2. Pindyck, R.S., Rubinfeld, D. L., and Mehta, P. L. (2013). *Microeconomics* (Seventh edition).Pearson Education Prentice Hall.

References

1. Nicholson Walter and Christopher Synder (2019), *Microeconomic Theory-Basic Principles and Extensions*, Cengage Learning.
2. Salvatore, D. (2003), *Microeconomics -Theory and Applications* (Fourth Edition), Oxford University Press.

Model Question Paper
Set-1

SREENARAYANAGURU OPEN UNIVERSITY

QP CODE: ……

Reg. No : .....
Name : …….....

B. A. Economics Examination- Semester I
Discipline Core - 1- B21EC01DC- Microeconomics-I
(CBCS - UG)
2022-23 - Admission Onwards

Time: 3 Hours Max Marks: 70

Section A - Objective Type Questions.

Answer any 10 questions. Each question carries 1 mark (10 X 1=10 marks)

1. The Planning Commission was replaced by …….. on January 1, 2015.
2. Identify the branch of economics that deals with pricing of goods and services.
3. Which is the central problem that solves the 'functional distribution'?
4. Value of elasticity varies from …….to ……..
5. At what point does a consumer attain equilibrium in the case of a single commodity case?
6. Why is the indifference curve convex to the origin?
7. A good with a horizontal demand curve has a demand with……..elasticity.

8. What is variability?

9. …… games with an expected value equal to zero are fair games.

10. The …..decreases as we move down along an isoquant.

11. What is the profit maximising condition under perfect competition?

12. Write the mathematical form of a production function.

13. Represent the supply function mathematically.

14. The price elasticity of supply will be --------- when the supply curve is horizontal to X-axis, and will be -------- when the supply curve is vertical to X-axis.

15. Revealed preference theory was put forward by……..

Section B- Very Short Questions.

Answer any 10 questions. Each question carries 2 marks (10X2=20 marks)

16. Distinguish between partial and general equilibrium analysis.

17. During COVID 19 pandemic, even with an increase in demand for masks in the short run supply could not be increased. Why?

18. What is inductive method?

19. What is a budget line? Explain the causes for change in the budget line.

20. Point out the differences between Bandwagon and Snob effect.

21. Define consumer surplus?

22. Write down the mathematical equation for expected utility.

23. What do you think is the most important factor that determines the decision of an individual to participate in uncertain games?

24. Two isoquants cannot cut each other. Do you agree with this statement? Why?

25. What is the Marginal Productivity of Labour in a Cobb- Douglas Production function?

26. Point out two differences between homogenous and non-homogeneous production functions.

27. What is expansion path? What does an optimal expansion path show?

28. Define TR, AR,MR using the mathematical equations.

29. What are the factors affecting the price elasticity of supply?

30. Distinguish between supply of a commodity and quantity supplied of a commodity?

Section C- Short Answer

Answer any 5 questions. Each question carries 4 marks.(5X4=20 marks)

31. Draw and explain the production possibility curve (PPC) for an economy that produces milk and guns. What will happen to the PPC curve if a disease kills half of the economy's cows?

32. A 10 percent increase in the quantity demanded of apples results from a 5 percent decline in its price. Find out the price elasticity of demand for apples.

33. Given a consumer's money income (M), the prices of two goods X and Y are Px and Py respectively.

- Indicate the quantity of Y the consumer would purchase if she spent all her income on Y.
- Indicate the quantity of commodity X if she spent all her income on commodity X
- Find the slope of the budget line in terms of Px and Py and express mathematically the equation of the budget line.

34. Write down the differences between price consumption curve and income consumption curve.

35. Distinguish between the Neumann-Morgenstern Utility and Neoclassical Cardinal

measurement of Utility?

36. Individuals do not take part in uncertain games which are considered to be fair. Justify this statement.

37. Do the following production functions exhibit increasing, constant or decreasing returns to scale?

a. q=3L+2K

b. Q=L^1/2K^½

What happens to the marginal product of each individual factor as that factor is increased and the other is held constant?

38. Returns to Scale in production is applicable only in the long run.Do you agree? Why?

39.The shape of AFC curve is different from other Average and Marginal cost Curves. Justify this statement via derivation of Average and Marginal cost Curves.

40. Assess the relation between price elasticity of supply and supply function using a numerical example.

Section D- Long Answer/Essay Question

Answer any 2 questions. Each question carries 10 marks.(2X10=20 marks)

41. Suppose the indifference curves of two goods x and y are convex to the origin. a. Draw an indifference curve and state its properties.b. What is MRS_{xy}? Is MRS_{xy} increasing, decreasing or constant as the consumer substitutes x and y along an indifference curve?

42. Describe how the demand curve is derived from the price consumption curve.

43. Write down the mathematical form of the Cobb Douglas Production Function.Show it graphically. Explain the logic of the shape of the Cobb Douglas Production Function

44. Write briefly on Total Costs in short run. Explain how Average and Marginal Cost are calculated from Total Costs mathematically. On the basis of the mathematical calculation, fill in the below table.

Amount of Output	Total Fixed Costs (rs)	Total Variable Costs(rs)	Total Costs (rs)	Average Fixed Cost, AFC(rs)	Average Variable Cost, AVC(rs)	Average Total Cost, ATC (rs)	Marginal Cost, MC (rs)
0	50	0	50				
1	50	40					
2	50	50					
3	50	65					
4	50	100					
5	50	165					

Model Question Paper
Set-2

SREENARAYANAGURU OPEN UNIVERSITY

QP CODE: …… Reg. No : .....

Name : …….....

B. A. Economics Examination- Semester I

Discipline Core - 1- B21EC01DC- Microeconomics-I

(CBCS - UG)
2022-23 - Admission Onwards

Time: 3 Hours Max Marks: 70

Section A - Objective Type Questions.

Answer any 10 questions. Each question carries 1 mark (10 X 1=10 marks)

1.Tea and coffee are substitutes. The demand for tea …… when the price of coffee goes down.
2. Which branch of economics studies the relationship between quantity of money and inflation?
3.Who is the economist who made the distinction between risk and uncertainty?
4.State the elasticity of demand for necessities and luxury goods.
5.Define supply function.
6.The process of transforming inputs to output is called …….
7.Name the book that is associated with the origin of macroeconomics?
8.The expansion path generated by the Cobb Douglas Production Function is ……
9.The curvature of the utility function shows the consumers attitude towards ……
10.State the equation for price and cross elasticity of demand.
11.Define the problem of choice in economics.
12.Why does the demand curve slope downward?
13. Identify the branch of economics that deals with pricing of goods and services.
14. …….shows the relationship between quantity of inputs used to make a good and the quantity of output of that good.
15.Supply is a ------- variable in terms of time dimension.

Section B- Very Short Questions.

Answer any 10 questions. Each question carries 2 marks(10X2=20 marks)

16.What will be the shape of indifference curves when the consumer consumes tennis balls

and tennis rackets together? Explain diagrammatically.
17.What does α indicate in a CES production function?
18. What is the price elasticity of supply? Give its mathematical form.
19. One of your friends always buys lottery tickets. What will be the shape of his utility function?
20.Isoquants have a convex shape. Why?
21.How does profit determine the willingness to supply for a firm?
22.Write an example for a positive statement in economics.
23.What is expansion and contraction of demand?
24.How is the government's role in a free market economy different from that of a controlled economy?
25.What is microdynamics?
26. State how marginal utility and total utility are related to each other.
27. Imagine that you got two new job offers .If the expected value is the same in both the jobs, how can you choose the less risky job?
28.What are the three central problems any economy has to face?
29.Two isoquants cannot cut each other. Do you agree with this statement?Why?
30.Differentiate between internal and external economies of scale.

Section C- Short Answer
Answer any 5 questions. Each question carries 4 marks.(5X4=20 marks)

31. Long –run cost curve is also known as the Envelope curve. Why?
32. Illustrate the utility function for a risk averse individual.
33. What are the determinants of demand?
34. Scarcity is the cause for all economic problems. Do you agree with this statement? Give reasons
35. Define Price Consumption curve. Draw a price consumption curve for normal goods
36. How can individuals who invest in stock markets reduce risk?
37. Derive price elasticity of demand diagrammatically from a linear demand function.
38. Analyse the relationship between TP, AP and MP. Represent with suitable diagrams.
39.In the real world how can you apply the Law of Variable Proportions.
40. Write a short note on: a) implicit cost b) explicit cost c) opportunity cost.

Section D- Long Answer/Essay Question
Answer any 2 questions. Each question carries 10 marks.(2X10=20 marks)

41.(a)Examine the relationship between the cardinal utility approach and the indifference curve approach to consumer demand theory. (b) Which of these two approaches is preferable.Why?

42.A firm can have a production function that exhibits increasing returns to scale,constant returns to scale and decreasing returns to scale as output increases. Is this statement true? Explain with diagrams.

43. How would you explain the movement along the supply curve and shift in supply curve graphically?

44. Suppose a soda bottle factory is producing bottles in the short run. The producer has observed the following levels of production corresponding to different number of workers

Number of Workers	Number of Bottles
1	10
2	18
3	24
4	28
5	30
6	28
7	25

From the above information calculate the marginal and average product of labour for the production function

a. Does this production function show diminishing returns to labour? Explain
b. What might cause the Marginal product of labour to become negative?

സർവ്വകലാശാലാഗീതം

വിദ്യയാൽ സ്വതന്ത്രരാകണം
വിശ്വപൗരരായി മാറണം
ഗ്രഹപ്രസാദമായ് വിളങ്ങണം
ഗുരുപ്രകാശമേ നയിക്കണേ

കൂരിരുട്ടിൽ നിന്നു ഞങ്ങളെ
സൂര്യവീഥിയിൽ തെളിക്കണം
സ്നേഹദീപ്തിയായ് വിളങ്ങണം
നീതിവൈജയന്തി പാറണം

ശാസ്ത്രവ്യാപ്തിയെന്നുമേകണം
ജാതിഭേദമാകെ മാറണം
ബോധരശ്മിയിൽ തിളങ്ങുവാൻ
ജ്ഞാനകേന്ദ്രമേ ജ്വലിക്കണേ

കുരീപ്പുഴ ശ്രീകുമാർ

SREENARAYANAGURU OPEN UNIVERSITY

Regional Centres

Kozhikode
Govt. Arts and Science College
Meenchantha, Kozhikode,
Kerala, Pin: 673002
Ph: 04952920228
email: rckdirector@sgou.ac.in

Thalassery
Govt. Brennen College
Dharmadam, Thalassery,
Kannur, Pin: 670106
Ph: 04902990494
email: rctdirector@sgou.ac.in

Tripunithura
Govt. College
Tripunithura, Ernakulam,
Kerala, Pin: 682301
Ph: 04842927436
email: rcedirector@sgou.ac.in

Pattambi
Sree Neelakanta Govt. Sanskrit College
Pattambi, Palakkad,
Kerala, Pin: 679303
Ph: 04662912009
email: rcpdirector@sgou.ac.in

Microeconomics 1

COURSE CODE: B21EC01DC

Sreenarayanaguru Open University
Kollam, Kerala Pin- 691601, email: info@sgou.ac.in, www.sgou.ac.in Ph: +91 474 2966841

ISBN 978-81-963059-2-5