NATIONAL OPEN UNIVERSITY OF NIGERIA

SCHOOL OF BUSINESS AND HUMAN RESOURCE MANAGEMENT

COURSE CODE: BHM717

COURSE TITLE: **Price Theory I**

COURSE GUIDE

BHM717
PRICE THEORY I

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CONTENTS PAGE

Introduction

Price theory 1 is a core course which carries two credits units. It is made available to all students who are taking the postgraduate diploma in the schools of Business and Human Resources Management. The course is a useful material to you in your academic pursuit as well as to your work place as managers or administrators.

What You Will Learn in This Course

The course is made up of five modules. Module 1 has 4 units, module 2 has 4 units, module 3 has 3 units, module 4 has 2 units and module 5 has 2 units, covering areas such as the basic concept of price theory, theory of consumer's behaviour, theory of production and costs, price and output determination in perfect competition monopoly and oligopoly, welfare economics and input-output analysis.

The course guide is meant to provide you with the necessary information about the course generally, the nature of the materials you will be using and how to make the best use of the materials towards ensuring adequate success in your programme. Also included in this course guide are information on how to make use of your time and information on how to tackle the tutor-marked assignment questions. There will be tutorial sessions during which your instructional facilitator will take you through your different areas at the same time exchange ideas with your fellow learners.

Course Content

The Course consists of the basis of price theory, the nature and scope of price theory, theory of elasticity of demand, the theoretical frame work for analysing both consumer and producer behaviour, consumers utility maximization under cardinalist and ordinalist approach, cost concept and production functions, profit maximization or course minimization in relation to perfect competition, monopoly and oligopoly, a special case of price discrimination and bilateral monopoly, the analysis of welfare economics, market failure and government intervention, inter-industry analysis of input-output model and a two sector analysis.

Course Aims

The main aim of this course is to educate you on the nature and scope of price theory, the objective and constraint function of different economic agents. The course also aims at making you have a greater appreciation

of the interplay of the forces of demand and supply in resource allocation. The aims of the course will be achieved by:

- Explaining the nature of price theory
- Discussing the differences between price theory and macro economics
- Analyzing the different approaches to the theory of consumer's behaviour
- Explaining theory of production
- Describing the necessary assumptions under which different market models operate
- Explaining the conditions of welfare economic and analyzing inter-industry economics.

Course Objectives

On completion of this course, you should be able to:

- Explain the nature and scope of price theory
- Describe the relationship between price elasticity of demand and marginal revenue of a firm
- Explain the differences between short run and long-run production functions.
- Analyse the various forms of cost concepts
- Explain price and output determination under perfect and imperfect market models.
- Discuss market failures and the role of government in resource allocations
- Explain the interdependence and interrelationship between different industries within an economy.

Course Materials

Major components of the course are:

- Course Guide
- Study units
- Textbooks
- Assignment Guide

Study Unit

There are different units of five models in this course, which should be studied carefully and in sequence. These are as follows:

Module 1

Unit 1 The Basic Concepts of Price Theory
Unit 2 Elasticity of Demand
Unit 3 Theory of Consumers Behaviour (Cardinalist Approach)
Unit 4 Indifference Curve Analysis (Ordinalist Approach)

Module 2

Unit 1 Theory of Production
Unit 2 Stages of Production
Unit 3 Cost Concepts
Unit 4 Cost Theory

Module 3

Unit 1 Perfect Competition (short-run Analysis)
Unit 2 Perfect Competition (Long-run Analysis)
Unit 3 Price and Output Determination under Monopoly

Module 4

Unit 1 Price Discrimination and Bilateral Monopoly
Unit 2 Oligopoly

Module 5

Unit 1 Welfare Economics
Unit 2 Input-output Analysis

Module 1 Unit 1 simply presents the general concepts of price theory. The second unit discusses elasticity of demand and it importance. The (3 and 4) units discuss the utility of a consumer from the cardinalist view point and consumers utility from the perspective of the ordinalist school of thought. Module 2 units (1 and 2) explain the meaning, types and stages of production in the short-run. Units (3 and 4) discuss the different cost concepts and theory of cost both in the short and long-runs. Module 3 unit (1 and 2) analyse the basic assumptions, price and output determination under perfect competition in both the short and

long-runs. Unit 3 explains price and output determination under monopoly. Module 4 unit 1 discusses the possibility and profitability of price discrimination and bilateral monopoly. Unit 2 explains oligopoly under non-collusive and collusive oligopolies. Module 5 and unit 1 examines the meaning of welfare economics and different criteria for welfare maximization. Unit 2 explains input-output model and how the model is set up.

Each study unit will take a minimum of two hours and it include the introduction, objectives, main contents, self assessment exercises, conclusion, summary, tutor marked assignment and references/further reading. Some of these exercises will necessitate consulting other materials such as the text books under the references and further readings. They are meant to give you additional information. You are advised to practice the self assessment exercise and tutor-marked assignment for greater understandings of the course. By so doing, the stated learning objective of the course will be achieved.

Assignment

There are many assignments in this course and you are expected to do all of them by following the schedule prescribed for them in terms of when to attempt them and submit same for grading by your tutor.

Tutor-Marked Assignment

In doing the tutor-marked assignment, you are to apply what you have learnt in the contents of the study units. These assignments which are many in number are expected to be turn in to your tutor for grading, the assignments constitute 30% of the total score for the course.

Final Examinations and Grading

At the end of the course, you will write the final examinations. It will attract the remaining 70%. This brings the total final score to 100%

Conclusion

The course, Price Theory I (BHM717) exposes you to the fundamentals of price theory. You will be taken through the theories that guide the consumer and producers behaviour on the successful completion of the course; you would have been armed with the materials necessary for efficient and effective management of scarce resources for improved welfare for you as an individual and the society as a whole.

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CONTENTS PAGE

MODULE 1

UNIT 1 THE BASIC CONCEPTS OF PRICE THEORY

CONTENTS

1.0 INTRODUCTION

Economics can be divided into two major fields. These are: Price theory or microeconomics. The second is macro economics. Price theory basically is a branch of economics that studies the interplay of demand and supply which create a multitude of individual prices, wage rates, profit margins and rental changes. In another word, micro economics is generally concerned with the study of individual economics units or agents such as: an individual consumer or household individual firms and single industry.

Price theory assumes that every economic agent as mentioned above is rational. That is to say consumers for example try to spend their income in a way that gives them as much pleasure as possible (utility maximization). In the same vein entrepreneurs seeks as much profit as they can extract from their investment, they do this by minimizing cost and risk as much as possible.

In contrast, macroeconomics is the study of economic aggregates such as the general price level, National income, economic growth, unemployment, money supply, international trade etc. While

microeconomics studies the minute segment of the economy, macro economics studies the entire economy and its relationship with other economies.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain the conceptions and scope of price theory
- analyse the theory of demand
- discuss the theory of supply
- explain the concept of market equilibrium

3.0 MAIN CONTENT

Elements and Scope of Price Theory

3.1 Price Theory

Price theory as we have mentioned in our introduction, is the field of economics that studies the smallest economic units, such as: (a) an individual consumer of a particular commodity or services (b) a single firm or industry. The consumer in this analysis is one out of millions of consuming units of the economy while the firm is one out of thousands of producing unit of the economy.

These two units of the economy have naturally different economic objectives. The consumer has as his/her objectives utility maximization that is to say lowest cost (price). The producer on the other hand, seeks to maximize profit. The entrepreneur can achieve this by promoting revenue growth and minimizing cost of production. The consumer achieves his/her objections, when prices are lower, from his/her limited income, this will enable the consumer to obtain more quantities of goods which implies higher utility. The producer on his/her part will achieve his/her objective only when prices are higher. Holding the cost of production constant, if prices increase and the producer sales higher quantities, he/she obtains higher revenue. This relationship is mathematically presented thus:

TR = Q x P where:
TR = Total Revenue
Q = Quantity sold
P = Price of the commodity sold

The higher the revenue over cost of production, the higher will be the residual between cost and revenue called profit. Profit is also define thus:p = TR – TC

Where: p = Profit
TR = Total Revenue
TC = Total Cost

However, the situation above indicates that the two economic agents have conflicting interests. This conflicts entails that there will be no buying or selling. This is so because; the consumer wants prices to fall while the producer wants prices to increase. If things remained this way, the consumer will not buy and at the same time will not consume his money income. The producer on his/her part cannot sell nor can he/she consume all that has been produced.

How do we reconcile the producer and the consumer? In this case, price becomes the 'incentive to action' and resistance to action: Price theory suggest that the two economic agents must agree on a price at which producers will be willing and capable of supplying a given quantity and the consumer will be willing and able to pay for a given quantity. This is the allocative role of price.

SELF-ASSESSMENT EXERCISE 1

Explain the area of concern of price theory

3.2 The Theory of Demand

Demand according to Akaahan (2004:5) refers to the quantity of a commodity per unit of time at a given price. It also means the desire or need backed by ability and willingness to buy a particular commodity over a specific time period. Mere desire to travel to the US is not the same as demand for USA visa, but the ability to back up the desire by paying for and processing visa and international passport qualifies an individual as someone who has desire of travelling to the United States of America. Again, assuming you wish and desire three pairs of shoes and on getting to the market you discover that you can only afford one pair. we can now say that the quantity of shoes you wish to buy exceeds the quantity demanded.

Therefore, the ability to buy is what separates desire, wish and needs from demand. In this case the consumer desires three pairs of shoes but only demands one pair. You should note that demands are one of the elements of price theory.

3.2.1 Factors Determinants of Demand

We know that there are several factors responsible for change in quantity demanded of a particular commodity but the traditional theory of demand concentrates on the following: the price of the commodity, price of other commodities be them substitutes or complimentaries, consumer's income, taste of consumer and government policies. These can be expressed in a demand function thus: Qd = f(P, Po, T,Y,G)

Where: Qd = Quantity demanded
P = Price of the commodity
Po = Price of other commodities
T = Taste of the consumer
Y = Consumers income
G = Government policies

Out of the factors identified above, only the first factor is responsible for a change in quantity demanded or what is known as movement along the same demand curve. The other factors are called a shift factor that is a movement from old demand curve to a new demand curve.

(i) Price of the commodity

The price of the commodity in question has an inverse relationship with quantity demanded. This relationship complies with the classical law of demand which states that holdings all other factors constant, the higher the price of a commodity, the lower the quantity that will be demanded for, and vice versa. The mathematical form of the relationship is expressed thus

Qd = a – p where
Qd = Quantity demanded
a = autonomous demand
P = Price of the commodity

In mathematics language, a function is a symbolic statement of relationship between the dependent and the independent variables. Therefore, in a simple form we can say the demand for a product depends largely on price of the commodity.

Table 1.1 Consumers Demand Schedule for Rice

(N)	(in bags)
10	10
12	8
14	6
15	4
17	2
19	1

If we assume that a=20 and P, varies from 10 to 19 Naira per bag as seen from the demand function and schedule respectively. We will have the demand function thus:

Qd = 20 – P for the first price,
Qd = 20 – 10 = 10
For the second and third prices we will have
Qd = 20 – 12 = 8
Qd = 20 – 14 = 6

If you substitute the various prices into the demand functions, we will have quantity of rice demanded varying from 10 to 1. If we plot the above information in a graph we will get the consumers demand curve.

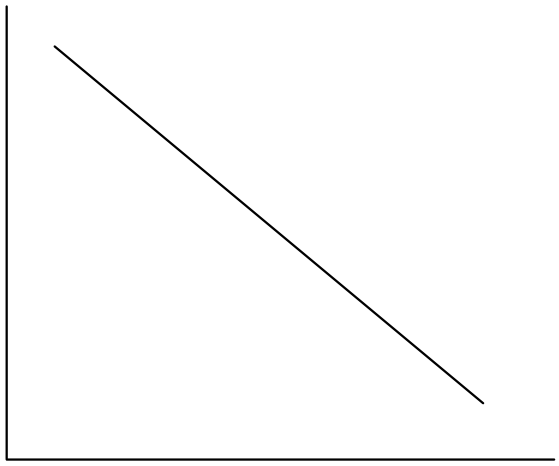


Figure.1.1: Consumer's Demand Curve

(ii) Prices of other commodities

The demand for a commodity also depends on the price of other commodities. These goods can either be substitutes to the good in

question or are complimentary goods to the good in question. Two goods are considered to be substitutes for each other if changes in the price of one commodity affect the demand for the other in the same direction. For example fish and beef are substitutes for each other and an increase in the price of beef while the price of fish remains constant will lead to an increase in the demand for fish and vice versa. On the other hand, if the price of fish falls, the demand for beef will fall. In the first instance, beef is expensive while fish is cheaper, in the second instance, fish is still cheaper and beef is expensive. In both cases the law of demand holds.

Two goods are said to be complimentary if an increase in the price of one causes a decrease in the demand for another and vice versa. When we use two or more goods simultaneously or together, such goods are said to be complimentary goods. For example GSM credit is a compliment to mobile handsets, petrol is a compliment to motor vehicles and trousers is a compliment to shirt etc. An increase in the price of GSM mobile handsets, holding the price of credit constant, the demand for credit will decrease. An increase in the price of handsets will allow only a few rich to possess handsets, only those few will need credit for their handsets, therefore demand for credit will fall. Note that there is a positive relationship between price and quantity demanded of substitute goods while for complementary goods, the relationship is inverse or negative.

(iii) Consumer's Taste and Preference

Test and preference of consumers generally depends on social class, customs, religious beliefs and values attached to a commodity, life style of a people, age grade and sex. The age grade for example, one would notice that youth generally attached value to goods like Jeans, T-shorts, hip hop music more than the older age grade. If you take lifestyle of a people for instance, the demand for kolanut and Baba riga is higher among the Hausas, the demand for red cap is higher among the Igbos while the demand for 'Pkwomo' is higher among the Yoruba. A change in these factors changes the demand for a particular good.

(iv) Consumer's Income

Disposable income is a major determinant of demand. The purchasing power of a consumer depends on his income. The higher your level of income the more money you will spend on goods and vice versa. Economists have identified three kinds of goods; (a) essential or normal goods, these are goods consume by almost all persons. The quantity demanded of such goods increase with increase in consumers' income only up to some limits, after which the demand for such goods becomes

income inelastic. For example an individual with an income as low as ₦10,000.00 may demand for 10 mudus of rice, when his income increased to ₦30,000.00 he may demand for one bag of rice. However, we should not expect that by the time he has an income of N1,000,000.000 he will increase the demand for rice beyond what the family can consume (b) Inferior goods; a good is termed inferior, if its demand decreases with increase in come. A decrease in income would lead to an increase in its consumption. In this case the demand curve is a backward bending curve. Example of such goods includes; Akara, junk food, local tourist attraction etc.

(v) Luxury Goods

These are goods consumed mostly by the rich, example of such goods are Gold, Jewelleries, cosmetics, summer holidays abroad etc. the demand for these goods will rise only beyond a certain level of the consumer's income. Take the case of a classroom teacher who earns ₦20,000 per month, it will be difficult for him/her to afford any of these goods but as his salary increases, he/she can afford these goods and his/her demand for these goods will increase.

(vi) Government Policy

This is another factor that affects demand. Government policy can promote or discourage the demand for a commodity. If Government intends to encourage the consumption of 'eba', it will grant subsidy to cassava farmers, this will reduce cost of production and increase the supply of cassava. On the other hand government can discourage the consumption of cigarette by taxing the tobacco companies heavily, by the time the tax margin is added to cost of production, the sale price would be high thereby marking cigarette expensive and those with low income will be discouraged.

3.3 The Theory of Supply

Supply refers to the quantity of goods and services a supplier is willing to offer for sale at a particular time at a given price. Various factors are responsible for change in supply of a commodity. These factors are price of the commodity, price of other commodities, prices of factors of production, state of technology, number of competitors, weather condition (agricultural goods) and government policies. From these factors we can have a supply function of the form:

QS = f (P, Po, T, C, W, G) These variable remain as defined above.

3.3.1 The Supply Curve

The supply curve is a graph which shows different quantities of goods supplied by a producer at different prices. The supply curve is a derivation of the law of supply. This law states that the lower the price, the lower the quantity of goods supplied, all things being equal and vice versa.

Table 1.2: The producers supply schedule

Price (N)	**Quantity supplied (in bags)**
4	2
5	5
6	8
7	11
8	14
9	17
10	20

From the supply schedule, we noticed that supply varies positively with price of the commodity. If given the same hypothetical figures, above, an estimate of the function, gives us say QS = -10 + 3P. Substituting the various prices of the commodity in our function, we shall get our supply schedule as shown in table 1.2 and supply curve as shown in figure 1.2

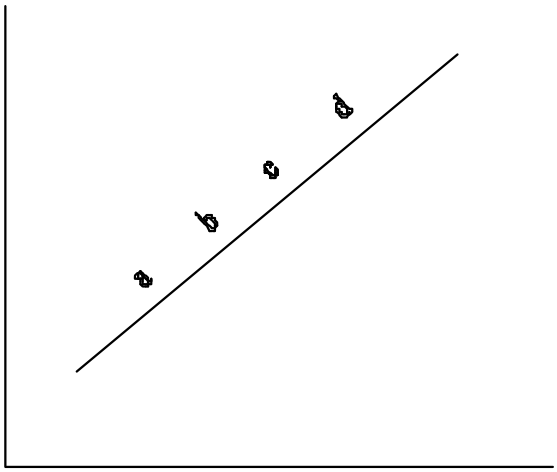


Figure 1.2: The Supply Curve

3.3.2 Change in Quantity supplied and Change in Supply

(i) A change in quantity supplied refers to a movement along the same supply curve due mainly to a change in the price of the commodity while the other factors are held constant. A movement from point 'a' through to point 'd' is caused by variation in price of the commodity.

(ii) Change in supply refers to a complete shift of supply curve from an old position to a new position. If the supply curve shifts, to right, it means the factor in question has encouraged the producer to offer more in the market and vice versa. Change in supply is caused by all other factors other than price of the commodity. If price of other commodities increase, producers will shift their resources to the production of that good whose price has appreciated and reduce or quit the production of the good whose price remains lower thereby increasing the supply of the former. For agricultural goods, bad weather can affect output hence supply and good weather can increase output/supply. State of technology is important. A firm using labour intensive technology will have lower output/supply while a firm using capital intensive technology is bound to record high output/supply. Also if cost of factors of production is high, producers will find it expensive to employ more capital labour land and the best entrepreneur to expand production thereby reducing supply. If on other hand prices of factor inputs are lower, productions will be encouraged.

3.4 Market Equilibrium

The relationship between buyers and sellers is known as the market. According to Wall (1995:43) a market is anywhere real or abstract where buyers and sellers trade goods and services. Equilibrium is achieved in the market when the quantity of goods producers are willing and able to supply is the same with that which consumers are willing and able to pay for. Here, it is the price that brings both buyers and sellers together. When supply and demand balance at a price, it is known as the equilibrium price (see figure 1.3).

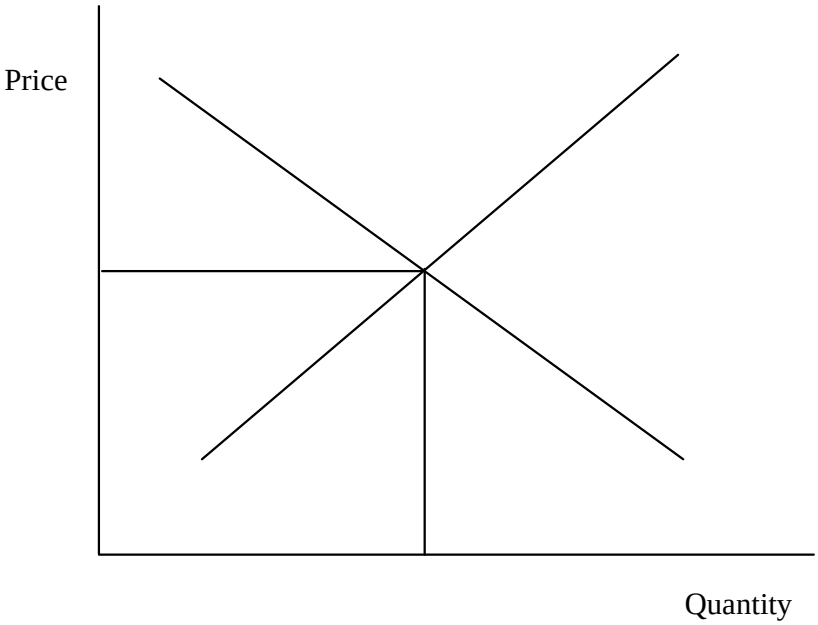


Figure 1.3: The equilibrium price and quantity

The graph in figure 1.3 shows that both consumer and producers agreed on quantity Qo at price Po, the two are at equilibrium at e. At this point we say the market has cleared.

3.4.1 Effect of Excess demand and Supply on Price

When demand exceeds supply, it will create scarcity, and the resultant effect is price increase. As demand increase and supply remains constant, consumers will struggle to grab a portion of the fixed supply thereby causing price to increase. If on the other hand supply exceeds demand, the suppliers will be struggling to sale their goods to the few buyer willing to buy and excess will be left over, If they must sell, prices must reduce so that consumers are motivated to clear the excess, if not there will be stock pile up of inventories which in turn will discourage production and employment.

Numerical Example

Given the demand and supply functions in our early example

Qd = 20 –P ..... (1)
Qs = -10 + 3P ..... (2)

At equilibrium Qd = Qs

20 – p = -10 + 3 P ..... (3)

Collecting like terms

20 +10 = 3P + P..... (4)
30 = 4P ..... (5)
P = 30/4
P = 7.5..... (6)

If you substitute the price value into the supply or demand function, you will get equilibrium quantity

Qd= Qs
20 – 7.5 = 10 + 3 (7.5)
12. 5 = -10 + 22.5
12.5 = 12.5

Therefore, the equilibrium quality is 12.5 bags and the equilibrium price is N7.50

SELF-ASSESSMENT EXERCISE 2

Discuss the concept of equilibrium market.

4.0 CONCLUSION

You have seen from the analyses that the basic concept of price theory is essential to the understanding market behaviour. The theory of demand and supply are basic elements of price theory. Therefore it has been argued that price play a great role in the efficient allocation of resources.

5.0 SUMMARY

The unit has explained the meaning and scope of price theory. The concepts of demand and supply are considered along with their determinants. The interplay of demand and supply to determine the equilibrium price was analysed. The unit equally looked at the effects of excess demand and supply on price and finally numerical examples are given to justify the theoretical framework. In the next unit you will be introduced to the theory of elasticity.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the factors responsible for change in supply.
2. Discuss the likely effects of (a) increase in the cost of factors of production on supply (b) increase in demand for food in food prices.

7.0 REFERENCES/FURTHER READING

Akaahan, T. J. (2004). Principles of Microeconomics. Jos: Mono Press Ltd.

Varian, H. R. (1987). Intermediate Microeconomics A Modern Approach. New York: W. W. Norton and Company.

Wall, N. (1995) (ed). Nuffield Economies and Business Students Book. London: Longman Singapore Publishers P.E Ltd.

UNIT 2 ELASTICITY OF DEMAND

CONTENTS

1.0 INTRODUCTION

Elasticity of demand is defined as the extent to which quantity demanded of a community changes in responds to change in price of the commodity, prices of other commodities and income of the consumer. Akaaham (2004:19) defined elasticity of demand to mean the extent of responsiveness of demand to changes in its determinants. As we proceed, you will learn about types of elasticity of demand and the determinants of demand elasticity.

The concept of elasticity of demand was first introduced into the literature of economics by Alfred Marshall in 1890 in his book titled 'Principles of Economics' Since then the theory has found relevance among consumers, investors and the government.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain the concept of elasticity of demand
- describe the various types of elasticity
- analyse the determinants of price elasticity of demand
- explain the uses of elasticity principle.

3.0 MAIN CONTENT

3.1 Elasticity of Demand

Elasticity of demand is a concept in economics used to measure the degree of responsiveness or sensitiveness of demand for a commodity to the changes in its determinants under consideration. These determinants could be; price of commodity, prices of other commodities, income of the consumer and advertisement. Traditionally, only the first three determinants are considered by most writers. However, as most firms are emerging and growing into cartels, and many into monopolistic competitions, advertisement becomes necessary. To this end, the measurement of responsiveness of demand to change in advertisement has become very important as a sale strategy.

3.2 Types of Elasticity of Demand

3.2.1 Price Elasticity of Demand

Price elasticity of demand measures the degree of responsiveness of demand to changes in the commodity's own price. The coefficient of elasticity is measure by the formula:

$$\frac{\%\text{ change in quantity demanded}}{\%\text{ change in price}}$$

Or

$$\frac{Qx}{Qx} \div \frac{Px}{P} = \frac{Qx}{Qx} \cdot \frac{Px}{Px} = -\frac{Qx}{Px} \cdot \frac{Px}{Qx}$$

Where:
Qx = Original quantity demanded
Px = Original Price
Qx = Change in quantity demanded
Px = Change in price

The minus sign is generally inserted in the formula before the fraction with a view to making elasticity coefficient a non-negative value since negative values in elasticity concept has no place and makes the concept misleading.

Numerical example

Assuming the price of course material (BHM 717) was N100.00 last year, students bought 15 copies, this year the price increased to N120,00 and the students bought 13 copies calculate the price elasticity of demand.

Solution: $ep = \frac{Qx}{Qx} \div \frac{PX}{Px} = \frac{Qx}{Qx} \times \frac{Px}{Px}$

$Px = 120 - 100 = 20$

$Qx = 13 - 15 = -2 = -2 \div 20$

$ep = -2 \times \frac{100}{20} \times \frac{15}{100}$

$= -2 \times \frac{100}{15} \times \frac{20}{}$

Cp = 0.66 = Demand is price inelastic we can say that a 1% increase in price has brought about 66% increase in quality demand. Note: if the coefficient of elasticity is

ep = 1, we say demand is unitary price elastic
ep < 1 demand in price inelastic
ep > 1 demand is price elastic

In our example above, demand did not respond proportionately to change in price. The degree of respond is less.

3.2.2 Cross Elasticity of Demand

This measures the degree of responsiveness of demand for a commodity to change in the price of its substitutes or compliments or better put it, cross elasticity of demand is defined as the proportionate change in the quantity demanded of good x resulting from a proportionate change in the price of good y symbolically we have

$exy = \frac{Qx}{Qx} \div \frac{py}{Py} = \frac{Qx}{Py} \times \frac{Py}{Qx}$

The sign of cross elasticity coefficient will be negative if commodities x and y are compliments and positive if the two commodities are substitutes.

Numerical sample:

Assuming we have two goods x and y. if the price of good y increased from N8 to N11 and the quantity demanded of goods x increased from 10 to 15 bags.

i. Calculate the cross elasticity of demand
ii. Are the two goods substitutes or compliments?
iii. Give an example of the good in (ii)

Solution:

$$exy = \frac{15-10}{10} \Big/ \frac{11-8}{8} = \frac{5}{10} \times \frac{8}{3}$$

i. exy = 1.3 A 1% change in price of good y has brought about 130% increase in the demand for good x.
ii. The two goods are perfect substitutes
iii. An example is beef and fish

3.2.3 Income Elasticity of Demand

According to Koutsoyiannis (2003:49) Income elasticity of demand is the measure of proportionate change in the quantity demanded of a commodity resulting from a proportional change in income of the consumer.

The income elasticity is positive for normal goods. Some writers have used income elasticity to classify goods into 'luxuries' and 'necessities'.
A commodity is considered to be 'luxury' if its income elasticity is greater than unity. A commodity is considered to be necessity if its income elasticity is less than unity. Income elasticity is symbolically written thus:

$$ey = \frac{Q}{Q} \Big/ \frac{y}{y} = \frac{Q}{y} \times \frac{Y}{Q}$$

Numerical Example

If Mr Kunle earned N10,000 per month, after his promotion, his salary increased to N15,000 per months, as a result he increase the quantity of food stuff from 800 to 1000kgs.

i. Calculate the income elasticity of demand
ii. Is this food stuff a luxury or necessity

Solution: $ey = \frac{1000-800}{800} \Big/ \frac{15,000-10,000}{10,000} = \frac{200}{5000} \times \frac{10,000}{800}$

$$ey = \frac{2}{5} \times \frac{10}{8}$$

i. ey = 0.5 = Demand is income inelastic
ii. The good is a necessity

3.2.4 Advertising Elasticity of Demand

It has been discovered recently that a significant element of many firms costs is advertising. In order to ensure that it is money well spent, advertising elasticity of demand can be applied. Therefore, advertising elasticity of demand measures the degree of responsiveness of demand resulting from a change in advertising expenditure. The formula is

$$\frac{\%\text{ change in quantity demand}}{\%\text{ change in advertising expenditure}}$$

$$eAE \quad \frac{Q}{Q} \quad \frac{AE}{AE} = \frac{Q}{Q} \quad \frac{AE}{AE}$$

If the demand advert elasticity is greater than unity, then it implies that it is profitable to advertise. If the coefficient is less than unity, it implies that it is not profitable to advertise the product. In the first case, it is possible the good is still new in the market or the firm is facing stiff competition. In the second case, the firm could be a gigantic monopoly or consumers have developed 'brand loyalty' for the good.

Numerical Example

Dangote sugar expended N50,000 on advertisement and recorded a sales of 800,0000 tone of sugar. When the sales department increased the advertisement expenditure to N70,000, a sales of 1,2000,000 tone of sugar was recorded with price remaining unchanged.

i. Calculate the advert elasticity of demand
ii. Is Dangote a monopolist?

Solution

$$eEA = \frac{12{,}000{,}000 - 800{,}000}{800{,}000} \qquad \frac{70{,}000 - 50{,}000}{50{,}000}$$

$$= \frac{400{,}000}{20{,}000} \quad \frac{50{,}000}{800{,}000}$$

i. eEA = 1.25 demand is advert elastic
ii. The company is faced with other rival sugar companies, it has to sale itself properly to the public, Dangote is not a monopolist.

SELF-ASSESSMENT EXERCISE 1

Explain the term income elasticity of demand.

3.3 The Determinants of Price Elasticity of Demand

There are several factors responsible for price elasticity of demand. These are:

i. Availability of substitutes

If two goods are considered to be close substitutes, the greater will be the elasticity of demand.

For example if the tariff on MTN calls is increased, a little bit, subscribers are likely to migrate to other service providers like Glo, Zain, multilinks etc. On the other hand if the good are not substitutes, the elasticity of demand will be lower. For example, shoe and biro, a change in the price of one is not likely to affect the demand for the other significantly. Therefore, firms should be mindful of the kind of good they sale in their pricing policy.

ii. Nature of the commodity

As we have seen earlier on, commodities can be grouped as luxuries and necessities. Consumers respond quick to changes in the price of luxury goods. For example if the price or subscription fee for DSTV increases, many consumers will postpone watching DSTV and when the fee decreases, many consumers will subscribe. On the other hand, the consumption of necessary goods cannot be postponed and therefore, their demand is price inelastic. For example, an increase or decrease in the price food item will have little effect on demand hence a necessary good is price inelastic. Goods can also be grouped into durable and non durable goods. The demand for the former is price elastic, while the latter is price inelastic. For example, if the price of television set increases, consumers will prefer to repair old ones or buy 'Tokunbo' than buy a new one. If we take food items to be non durable and perishable, you would agree with me that their demand is price inelastic.

iii. The Proportion of Income Spent on the Product

If the proportion of disposable income spent on a commodity is high, its demand will be more elastic and if the proportion of income spent on a commodity is less, it demand will be inelastic. For sample, an increase in transport fare will make commuters to reduce the number of times they travel except it is very necessary to do so. On the other hand an increase in the price of goods like salt, sugar, water rates will leave the consumer consuming the same quantity. They will do same even if price fall for such goods.

iv. Range of alternative uses of a product

The wider the range of alternative uses of a product the higher the elasticity of demand. As the price of such commodity decreases, consumers will increase more than proportionate the demand for such a good to take advantage of its alternative uses. For instance, a decrease in the price of cassava will propel consumers to buy more to take advantage of other derivatives of cassava such as Gari, flour, starch etc.

v. Habit and Tradition

If you have already developed a habit in the consumption of particular goods, you will always be indifferent to change in its price. For example, an increase in the price of Kolanut, 'kwomo' and red cap will not decrease the demand for those goods by the Hausas, Yorubas and the Igbos respectively. Habit is a very strong socio/cultural factor. This is because there are certain goods some people still consume even if those goods have been declared to be unsafe for consumption.

3.3.1 Elasticity of Demand and Total Revenue

Total revenue as we had seen in unit one is the amount of money income accruing to a firm from the sales of its products at a particular time period. It is found by multiplying the total number of product sold by the price of that product. TR = P.Q. If the market demand for the good is linear, the total revenue curve will submit to the law of diminishing returns, first, it will slope upward reach a maximum point then start declining (See figure 2.1)

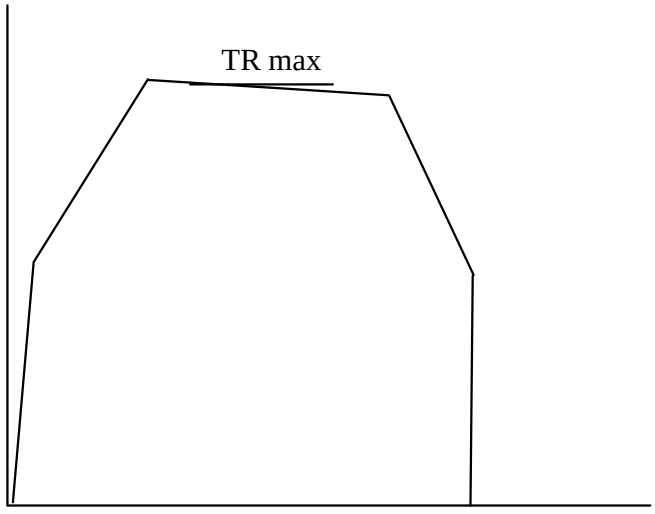


Figure 2.1:

Given the relationship between price elasticity and total revenue, if eP = 0, change in price will not cause any change in total revenue if ep<1. TR decreases when price decrease and when price increases TR increases. If ep > 1 then TR increases while price decreases and vice versa.

3.3.2 Price Elasticity and Marginal Revenue (Mr)

Marginal Revenue is defined as extra revenue accruable to a firm as a result of additional sales. It has been proven that there is a strong relationship between price elasticity of demand and marginal revenue. Note that marginal revenue is a function of total revenue. We had seen that:

TR = PQ

The MR = differentiating TR = PQ with respect to Q

$$MR = \frac{d(PQ)}{dQ} = \frac{dTR}{dQ} \quad \text{..... (1)}$$

$$MR = P\frac{dQ}{dQ} + Q\frac{dp}{dp} = P + Q\frac{dp}{dp} \quad \text{.... (2)}$$

find the L.C.M

Therefore, $\frac{Q}{P}\frac{dP}{dP} = \frac{1}{e}$ ..... (3)

$$MR = P\left[1 + \frac{Q}{P}\cdot\frac{dp}{dQ}\right] \quad \text{..... (4)}$$

Note that $\frac{Q}{P}\frac{dp}{dQ}$ is the reciprocal of elasticity

$$MR = P\left[1 + \frac{1}{e}\right]$$

Remember that price elasticity of demand has a negative sign which is generally ignored. However, if we recognize it, we will have

$$MR = P\left[1 + \frac{1}{-e}\right]$$

$$MR = P\left[1 - \frac{1}{e}\right]$$

This relationship suggests that the higher the value of (e) the higher will be MR and vice versa as price remains constant

3.4 Uses of Elasticity

i. The knowledge of elasticity of demand is important to the consumer because the information will enable the consumer to compare the proportion of his income spent on a commodity and the utility derived from the consumption of such commodity. If the proportion of income spent is greater than the utility derived then the welfare of the consumer has declined and vice versa.

ii. It is important for a firm to consider the price elasticity of demand for its goods before offering its price. Firms can either increase price because cost of production has increased or because the firm intends to increase revenue. Whether or not the price increment would be beneficial will all depend on price elasticity. If the demand for the commodity is price inelastic, revenue will be the highest but if demand for the commodity is price elastic revenue will be lowest.

iii. Elasticity is a useful tool in formulating government fiscal policy. Government can generate maximum revenue from tax on goods with inelastic demand. If taxes are imposed on goods with elastic demand revenue will be lowest because price will increase by the percentage of tax rate which in turn will reduce demand. Tax can equally be used to discourage the consumption of some goods.

iv. Elasticity is useful in economic analysis especially for specifying the relationship between dependent and independent variables. A good example is that of estimation of demand functions. This is mostly use in econometrics analysis.

4.0 CONCLUSION

The analysis above shows that elasticity of demand is an important tool of price theory. Theory of elasticity also helps us to determine whether a commodity is a luxury or necessity. The uses to which utility is put, is vital in decision making by the household, firm and government. It is equally useful in international trade in the area of export /import and currency devaluation.

5.0 SUMMARY

The unit has thrown light to the meaning of elasticity of demand. Types of demand elasticity and their determinants were equally considered. The unit looked at the relationship between revenue and price elasticity

of demand. Finally, usefulness of elasticity of demand was discussed. In the next unit we will be discussing the theory of consumers' behaviour.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the term advertising elasticity of demand and state the implication of an inelastic advertising elasticity of demand
2. Discuss the major determinants of elasticity of demand.

7.0 REFERENCES/FURTHER READING

Akaahan, T.J. (2004). Principles of Microeconomic. Jos: Mono express Ltd.

Bhatia, H. L. (2004). History of Economics Thought. New Delhi: Vikas Publishing House PVT Ltd.

Kontsoyiannis, A. (2003). Modern Micro Economics. London: Macmillan Press Ltd.

Varien, H. R. (1987). Intermediate Micro Economics. A Modern Approach. New York: ww. Norton and Company.

Wall, N. (1995) (ed). Nuffield Economics and Business, Students Book. London: Longman Publishers Pte Ltd.

UNIT 3 THE THEORY OF CONSUMERS BEHAVIOUR (CARDINALIST APPROACH)

CONTENTS

1.0 INTRODUCTION

The Theory of Consumer's Behaviour is the theory of demand which is an element of price theory. Traditional theory of demand recognized different determinants of demand, these include price of the commodity, price of other commodities, income of the consumer, taste, government policy etc. while the classical economists belief that price of a commodity is an important factor that determines the quantity of a good to be demanded for, the utilitarian school argued that price of the commodity is only a necessary factor but the sufficient factor is the degree of satisfaction the consumer will derive from the commodity.

This degree of satisfaction is called utility. They argued that there are some goods, even if their price decrease to N0.00k, consumers will not consume the commodities because they lack the ability to satisfy (utility). For example, cigarette has no utility to non-smokers, therefore, regardless of its price, a non smoker will not demand for it.

Utility is defined as the level of satisfaction a consumer derives from the consumption of a particular good or goods. The final degree of utility varies with the quantity of commodity and ultimately decreases as the quantity increases. The theory of consumers' behaviour has two approaches; the cardinalists and the ordinalists. In this unit we shall be discussing the cardinalist theory.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- describe the cardinalist approach to the theory of consumer's behaviour
- explain the assumption of the cardinal utility theory
- analyse total, and marginal utilities
- explain the relationship between demand and marginal utility.

3.0 MAIN CONTENT

The Cardinal Utility Theory

3.1 Assumptions of the Cardinal Utility Theory

The Neo-classical economists such like Jovons and Marshall, assumed that utility is cardinally measurable and quantifiable. That is to say, the level of satisfaction can be measured and assigned a cardinal number like 1, 3, 5, 6 etc or it can be measured in subjective units called utills. Other economists however argued that utility can be measured in monetary units, by the amount of naira a consumer is willing to give up for another unit of commodity.

For this theory to hold, the following assumptions are made:

i. Rationality: That every consumer is a rational being, given the consumers limited income, she/he aims at maximization of utility. He/she will spend first and larger proportion of his/her income on goods whose utility is high before considering those goods with lower utility.

ii. Cardinal utility: That the utility of each commodity is measurable. The most convenient measure is money. For example, if you are prepared to pay N100.00 for a pair of shoe, it implies that the utility derived is exactly worth N100.00. If utility derived is less than the price, a rational consumer will not buy the commodity.

iii. Constantly Marginal Utility of Money: This assumption is necessary if money is to be used as a measure of utility. The essential feature of a standard unit of measurement is that its own value be constant. If the marginal utility of money is not held constant as income varies, the measuring rod for utility becomes unrealistic and inappropriate for measurement.

iv. Diminishing Marginal Utility: This assumption states that as a consumer continue to add to the stock of a particular goods, the utility derived from each successive unit diminishes.

v. Utility is Additive: The cardinalists assumed that utility derived from different goods and services consumed by a consumer can be added together to obtain the total utility. The additivity of utility can be expressed through a utility function.
TU = f (xi, x2, x3, x4 ....xn)
However this assumption was late dropped.

vi. Utility maximization: That every consumer is rational and spends his money income in such a way that will maximize his utility. That is every consumer aims at getting the highest level of satisfaction from every naira spent.

SELF-ASSESSMENT EXERCISE 1

Analyse the statements that, "Price of a commodity is not a sufficient factor that determines quantity demand of a commodity".

3.2 The Concepts of Total and Marginal Utilities

i. Total utility is defined as the summation of utility derived from the consumption of successive units of a commodity by a consumer. For example, if the consumer consumes two loafs of bread and obtained 5 and 7 utills from the two loads respectively, his total utility from the two loaves will be TU= 12. Let us consider table 3.1. The table shows the relationship between quantities of goods consumed, total utility and marginal utility derived.

Table 3.1

Qx	Tu	Mu	Px
0	0	0	0
1	7	7	16
2	13	6	14
3	18	5	12
4	22	4	10
5	25	3	8
6	27	2	6
7	28	1	4
8	28	0	2
9	27	-1	1

The graph of the total utility is presented in figure 3.1

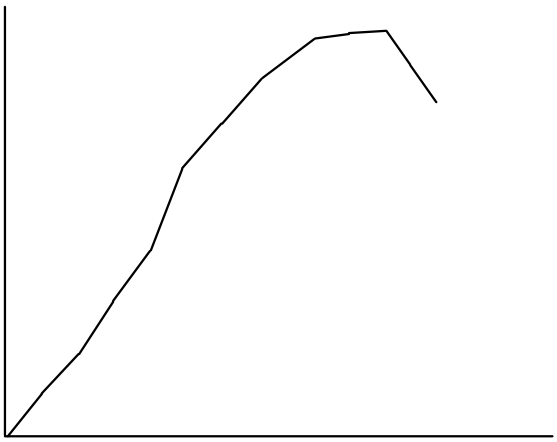


Figure. 3.1:

A total utility increase reaches a peak and start to decline

iii. Marginal Utility: This is the additional or extra utility derived as a result of consuming an extra unit of the commodity. The marginal utility of a commodity and its price are, all things being equal, the two determinants of the quantity demanded of a commodity. That is Mu is the basis of consumer's demand curve for a commodity, its price remaining the same. The law of diminishing MU states that as more units of a commodity is consume, the lesser the utility that will be derived from it, consumption of all other commodities remain constant. See Figure 3.2.

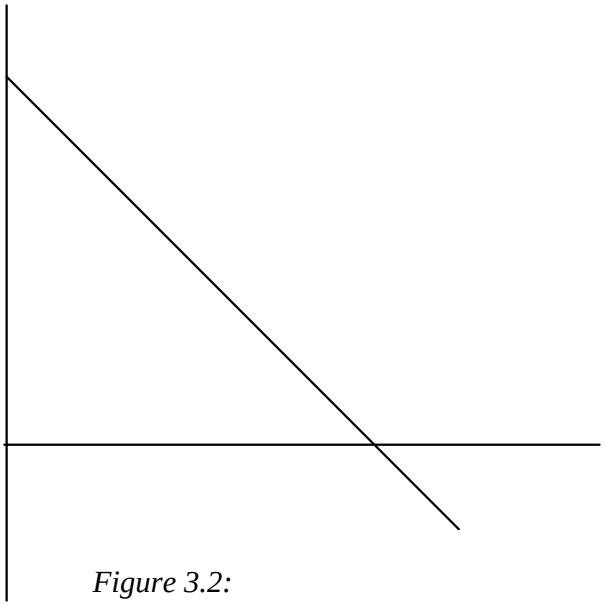


Figure 3.2:

When Tu is increasing, MU is decreasing but still positive, when Tu reaches a maximum, the corresponding Mu is zero, when TU is decreasing, Mu is negative. This suggests that total utility first increase at a fast rate, then increase at a diminishing rate, reaches a maximum and begins to decline thereafter. The cardinalist argued that a consumer should always compare the utility to be derived to the price he is to part with before demanding for such a commodity. If you discover that Mux > Px, the consumer will enjoy surplus therefore the consumer should increase the consumption of such a good.

Mux < Px, the consumer will suffer welfare lose and should stop consuming the commodity.

Mux = Px, the utility derived is equals to the last Naira sacrificed. Therefore the consumer is in equilibrium.

3.3 Equilibrium of The Consumer

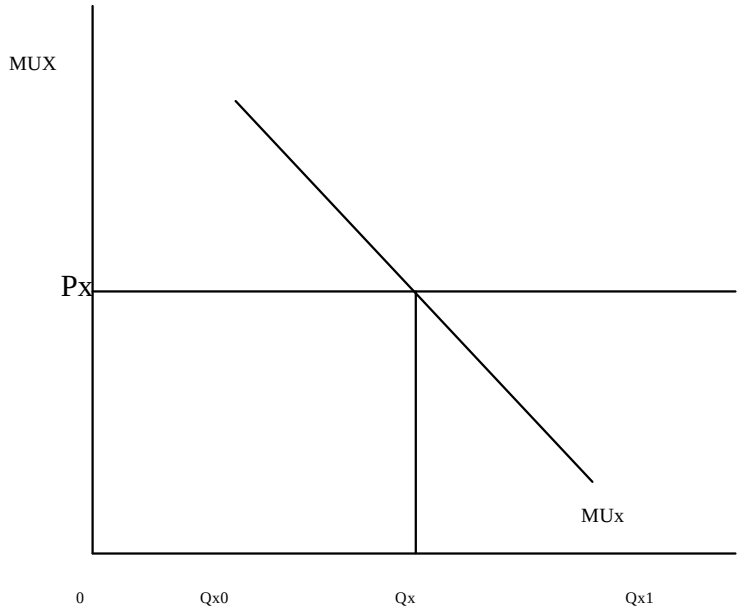
A consumer is in equilibrium when he maximizes his utility, given his income and the market prices. Let us start the analysis with a simple model of one commodity x. The consumer is at liberty to spend all his income on commodity x or retains his money. Either of the two will depend on the marginal utility of the commodity or that of money income.

If the marginal utility of the commodity is greater than Mu of money income, a utility maximizing consumer will give up his money income in exchange for commodity x and vice versa. Therefore, the consumer is in equilibrium when marginal utility of good x is equal to the price of good x. This can be expressed as:

MUX = Px

Two conditions necessary for this equilibrium are that:

i. Price of good x must be equal to MUx, and
ii. Mux must be diminishing (as shown in figure 3.3)



In the graph above Px line and Mux curve intersects at point E where Mux = Px. At this point the consumer is in equilibrium. Any point to the left of E, Mux > Px, any point to the right of E., Mux < Px Point E is called an equilibrium point because the consumer's utility is maximized. Any consumption beyond Qx Mux is falling while consumption before Qx, utility is not maximized because OQXo < OQx.

If we relax our assumption of a single commodity x and now **acknowledge the fact that variety is the spice of life and accommodate several commodities, the condition for equilibrium of the** consumer is the equality of the ratios of the marginal utility of individual commodities to their respective prices. That is:

$$\frac{Mux}{Px} = \frac{Muy}{Py} = \frac{Muk}{Pk} = \ldots\ldots\ldots = \frac{MuN}{PN}$$

This implies that the ratios of marginal utilities of individual commodities to their prices must be equal.

3.3.1 Derivation of the Demand of Consumer

According to Koutsoyiannis (2003:19) the derivation of demand is based on the axiom of diminishing marginal utility. If we marry the law of demand and diminishing marginal utility we will discover that Mux is an inverse function of quantity demanded and also Px and quantity demanded are inversely related. Remember also that both price and marginal utility are determinants of demand (Fig. 3.4 (i) and (ii).

Refer to table 3.1

At Q1 marginal utility and price of the commodity are highest, as quantity demand is increased, marginal utility decreased and consumers are willing to pay less. The higher the quantity demand, the lesser the Mu and the lower the price the consumer is willing to pay to maintain his utility. When you trace each utility to its corresponding price and joint all the points in graph II you get a demand curve derive from Mu curve.

SELF-ASSESSMENT EXERCISE 2

Discuss the relationship between marginal utility and quantity demand for goods.

3.4 Mathematical Derivation of Equilibrium of The Consumer

The utility function of a consumer for a single commodity, for example x is given as:

$$U = f(qx)$$

Where utility is measured in money units, If the consumer buys qx his expenditure is qx px. The consumer seeks to maximize the difference between his utility and his expenditure.

$$U - Px\ Qx$$

Lets take the partial derivative of the function with respect to qx and equate it to zero. Thus

$$\frac{du}{dqx} \quad \frac{d(Px\ qx)}{dqx} = 0$$

Rearranging we obtain

$$\frac{du}{dqx} = Px$$

Note: $\frac{du}{dqx} = Mux$

From there, we have

Mux = Px

This is the equilibrium of the consumer

3.4.1 Weaknesses of the Cardinal Utility Theory

i. The assumption that utility is measurable is unrealistic. It is not possible to measure utility objectively. This is because utility is a psychological issue. So it is not easy to quantify it.

ii. The assumption of constant utility of money is seriously misleading. The utility of money varies from individual to individual. The utility of N1,000 to a poor man is far higher than it is to a millionaire. Since the utility of money changes the basis upon which this assumption was made no longer exist.

iii. There are exceptions to the assumption of diminishing marginal utility. There are certain goods and services, that the more you posses the higher the utility, for sample, the quest for knowledge, people would always want to obtain more qualifications.

4.0 CONCLUSION

The above analysis shows that the theory of consumer's behaviour is an extension of the theory of demand. The cardinal school explains that price alone is not the major determinant of quality demanded of a commodity but the final degree of utility to be derived from the commodity. The law diminishing marginal utility draws our attention to the fact that marginal utility decreases as more quantities of a commodity are acquired by a consumer. The utility of the consumer is maximized when marginal utility of money income equals marginal utility of the commodity in question: Mux = Px.

5.0 SUMMARY

This unit has explained the approach of cardinalist school to the understanding of consumers' behaviour. The distinction between total and marginal utilities was discussed. An analysis of the assumption of the cardinal utility theory, the consumer's equilibrium and critique of the assumption were made in this unit. IN the next study unit, you will be taken through the discussion on the ordinal theory of consumer's behaviour (Indifference curve analysis).

6.0 TUTOR-MARKED ASSIGNMENT

1. With the help of a graph, discuss the conditions under which consumer attains equilibrium.
2. Explains the assumption of the cardinal school.

7.0 REFERENCES/FURTHER READING

Akaahan, T.J. (2004). Principles of Microeconomic. Jos: Mono express.

Bhatia, H. L. (2004). History of Economics Thought. New Delhi: Vikas Publishing House PVT Ltd.

Kontsoyiannis, A. (2003). Modern Micro Economics. London: Macmillan Press Ltd.

UNIT 4 INDIFFERENCE CURVE ANALYSIS

CONTENTS

1.0 INTRODUCTION

The indifference curve analysis is the analytical tool of the ordinal school. This school comprises of people like Francis Edgeworth, Irving Fisher, Vilfredo Pareo, Eugene Slutsky etc. The ordinal school opposed the idea that utility can be measured in cardinal terms and instead posits that goods are ordered in rank according to the consumer's preference. This preference is based on the utility derived from the goods. If good x has higher utility than good y, then goods x will be ranked higher than good y in order of preference.

The ordinalists use indifference curve as their tool of analysis. Indifference curve is defined as a graph that shows the locus of points indicating different combination of two goods that yield the same satisfaction to the consumer. The word indifference means, as the consumer moves along the same curve, he gets the same satisfaction, so the consumer is indifferent to whatever combination along the same curve.

In their measurement of utility, the ordinalists dropped the concept of diminishing marginal utility advocated by the cardinalist and in its place they introduced marginal rate of substitution.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain indifference curve and its assumptions
- explain the properties of indifference curve
- analyse the equilibrium of the consumer

- describe price and income consumption curves

3.0 MAIN CONTENT

Indifference Curve Analysis

3.1 Assumptions of Indifference Curve

The theory of indifference curve is based on the following assumptions:

i. **Rationality: The consumer is assumed to be rational, that the** consumer aims at maximizing his utility subject to his income and market prices. It is also assumed he has full knowledge of all relevant information (certainty).
ii. **Utility is Ordinal: It is assumed that the consumer can rank his** preferences (order the various goods) according to the satisfaction of each goods to the consumer. It is not necessary to assume that utility is cardinally measurable.
iii. **Diminishing Marginal Rate of Substitution: The consumer's** preferences are ranked in terms of indifference curve, this implies that as the consumer moves along an indifference curve he gives up some quantities of one commodity and add to the quantities of another good.
iv. **Total utility of the consumer depends on the quantities of** commodities consumed.
TU = f(q1, q2 ... x1, x2... qn)
v. **Consistency and Transitivity of choice. It is assumed that the** consumer is consistent in his choice, that is if in one period he/she chooses fish over bread, he will not choose bread over fish in another period if both goods are available to him/her. This assumption of consistency is written symbolically as:
If F > B, then B < F

Similarly, it is assumed that consumer's choices are characterized by transitivity, that is, if fish is preferred to bread, and bread is preferred to yam, then fish is preferred to yam. Symbolically the transitivity assumption is:

If F > B and B > Y, then F > Y

3.1.1 Indifference Curve and Indifference Map

An indifference curve is the locus of points showing different combinations of two goods that yields the same level of satisfaction to the consumer so that he is indifferent to any combination of the two

goods when it comes to choice making between them. In another words indifference curve is also known as Iso-utility curve or equal utility curve.

Indifference map is a graph which shows all the indifference curves which rank the preferences of the consumer. A combination of two good lying on a higher indifference curve yield higher utility and are preferred to those combinations on a lower indifference curve.

***Figures 4.1 and 4.2 show indifference curve and indifference map* respectively:**

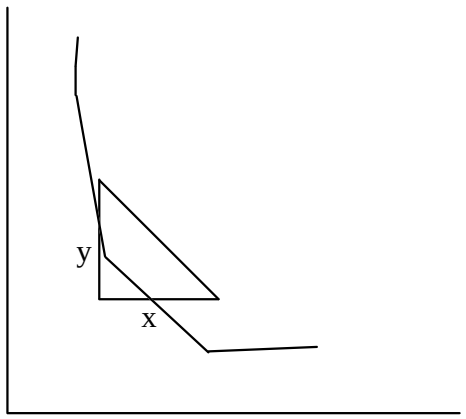


Figure 4.1

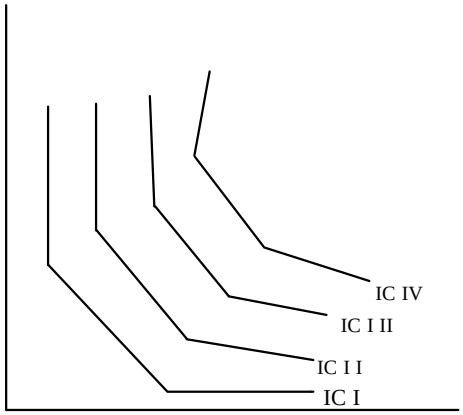


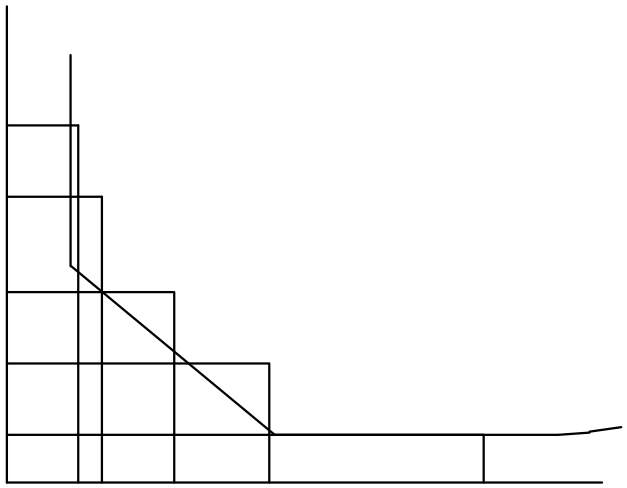
Figure 4.2:

Consider table 4.1 as containing the combination of two commodities available to a consumer

Table 4.1

Consumation	Bread	Fish
A	10	1
B	8	2
C	6	3
D	4	4
E	2	5

This table can be called an indifference schedule which shows different combination of bread and fish that gives the consumer equal satisfaction. Figure 4.1 can be reproduced using table 4.1



FISH

The slope of the indifference curve is negative. As the consumer moves from point A to B, he gives up two units of bread to gain one unit of fish. The curve shows that combination A gives the consumer equal satisfaction just as any combination. That is 10 loaves of bread and one fish gives the consumer equal satisfaction to combination D, where we have 4 loaves of bread and 4 fish. Therefore, the movement from A – E requires substitution of fish for bread. From A – B the marginal rate of substitution of fish for bread is:

$$\frac{18 - 10}{2-1} = \frac{-2}{1}$$

MRSF,B, measures the slope of the indifference curve which is =

$$\frac{dB}{df} = MRSFB = -2$$

Marginal rate of commodity substitution therefore is defined as the rate at which one commodity is substituted for another as the consumer moves along an indifference curve.

SELF-ASSESSMENT EXERCISE 1

Discuss the concepts indifference curve and indifference map.

3.1.2 Properties of Indifference Curves

i. An indifference curve has a negative slope, which implies that as the consumption of good x is increased that of good y must

increase, if the consumer is to stay on the same level of satisfaction.

ii. The further away from the origin an indifference curve lays, the higher the level of utility. That is the combinations of goods x and y on a higher indifference curve possess higher utility than those combination on a lower indifference curves. The former is preferred by a rational consumer.

iii. Indifference curved does not intersect. If they do the point of intersection will imply two levels of utility, which is not possible.

iv. Indifference curves are convex to the origin. This implies that the slope of an indifference curve decreases (in absolute terms) as we move along the curve from left to right. Remember that the marginal rate of substitution of the commodities is diminishing.

3.2 Budget Line

The budget line is also known as budget constraint. It is a line that shows the maximum combination of two goods a consumer can purchase with his income given the market prices. The total budget outlay of the consumer sets a limit to his/her maximizing behaviour. You were told that combination of goods on a higher indifference curve yield higher utility which is the desire of every consumer but the only obstacle to this ambition is the consumer's income. The income constraint, in the case of two commodities may be written as:

Y = Px Qx + Py Qy
Y = Income
Px = Price of goods x
Qx = Quantity of good x
Py = Price of good y
Qy = Quantity of good y

If the consumer decides to spend all his income on good y than the equation will be

Qy = $\frac{1}{Py} y - \frac{Px}{Py} Qx$

Since Qx = 0,

Qy = $\frac{Y}{Py}$

The same argument goes for good x see figure 4.4

A Y/Py

Line AB is called the budget line; the slope of the budget line is called the price ratio of the two goods. $\frac{OA}{OB} = \frac{Y/P_y}{Y/P_x} = \frac{P_x}{P_y}$

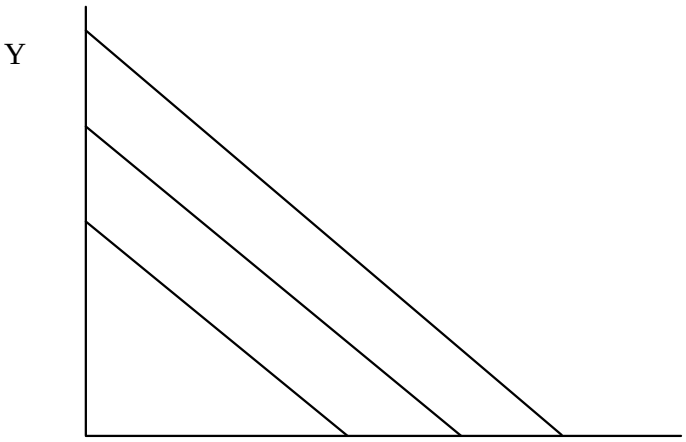
A consumer cannot spend above his income and it will be irrational to spend below his income.

3.2.1 Shift in The Budget Line

The budget line can expand outward or contract inward, as a result of an increase or decrease in the consumer's income. If the income of the consumer increases the budget will shift to the right indicating that the consumer can now consume more goods on a higher indifference curve.

The reverse is the case if the budget line shifts to left.

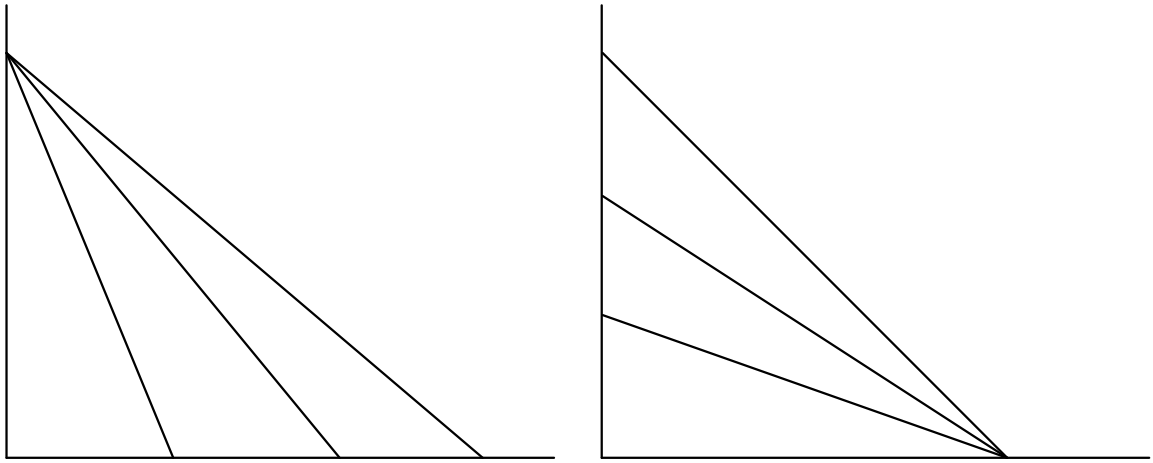
See figure 4.5



Line AB was the original budget line, with an increase in the income of the consumer, the budget line shift to the right to line CD. Moment to the left means reduction in the income of consumer indicated by line EF

3.2.2 Effects of A Change in Price

Since the slope of the budget line is called the price ratio. Change in price of a commodity affects the budget line. Let us consider figure 4.6 to depict a reduction in the price of good x.



Line AB was the initial budget line, as a result of a reduction in the price of goods X, the value of income appreciated and goods X becomes cheaper; this enables the consumer to buy more of goods X. Notice that income AD > AB and the quantity bought represented by OD' is greater OB. On the other hand if the price of goods X increases, real income will shrink therefore making goods X more expensive. This effect of an increase in price is represented by line AC. Increase in price has reduced the purchasing power of the consumer so he will buy lesser quantity, of goods X as OB > OC.

Figure 4.7 explains the effect of a change in price of good Y using the same analysis in figure 4.6, line AB is the initial budget line. Line DB indicates reduction in price of good y and line CB indicates increase in the price of good y.

3.3 Consumer's Equilibrium

The consumer is in equilibrium when she/he maximises his utility, given his income and market prices. Two conditions must be fulfilled for the consumer to be in equilibrium.

i. The marginal rate of substitution is equal to the ratio of commodity prices.

$$MRSx,y = \frac{Mux}{Muy} = \frac{Px}{Py}$$

This is called the necessary condition but not sufficient for an equilibrium. The second condition which is

i. the sufficient condition which requires that:
ii. the slope of the indifference curve decreases as we move along the curve from the left down to the right

Graphically, given the indifference map of the consumer and his budget line, the equilibrium defined by the point of tangency of the budget line with the highest possible indifference curve. See figure 4.9

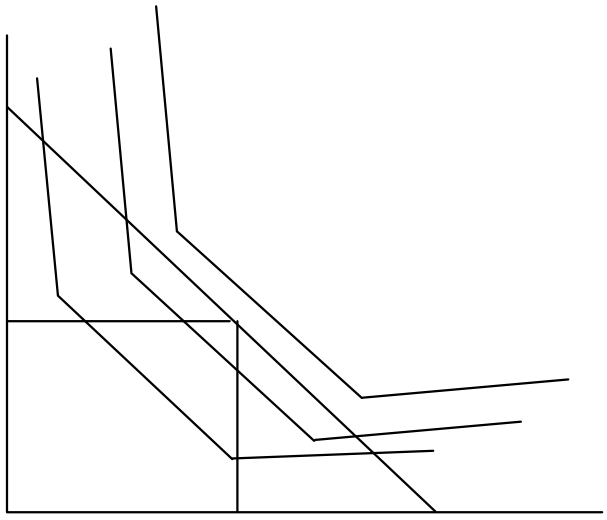


FIG. 4.9

At point e which is the point of tengency the slope of the budget line (Px/Py) and that of the indifference curve is (MRS= MUX/Muy) must be equal. The first condition is fulfilled on the graph at point e where indifference curve II is tangential to the budget line. The second condition is fulfilled by the convex shape of the indifference curves.

If the consumer were to operate on indifference I he/she would not have maximized utility because his income is higher and that would mean under utilization of income. Goods on a lower difference curve yield lower utility. The consumer would have wished to operate on indifference curve III because a higher indifference curve has higher combination and higher utility. However, his budget is below the

combination of goods on that indifference curve. He cannot afford the combinations on indifference curve III. He can only afford those on indifference curve II.

3.4 Derivation of Demand Curve

We had seen in figure 4.6 that a fall in the price of any of the commodities allows the consumer with more purchasing power as the budget line shifts to the right. Let us use the price consumption curve (PPC) to demonstrate how demand curve can be derived.

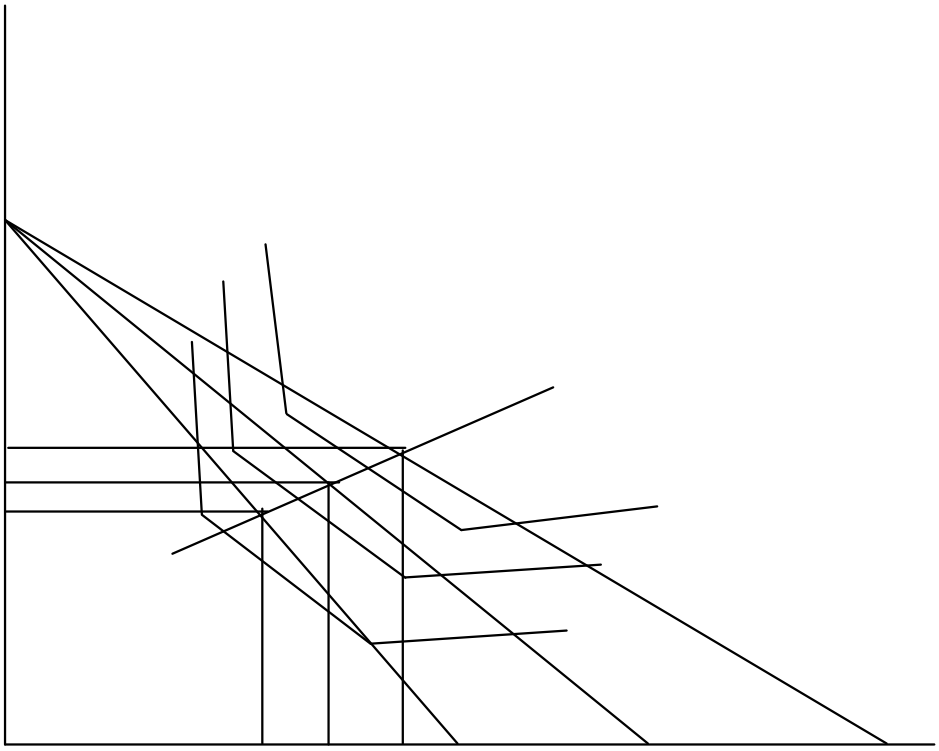


Fig 4.10

As the price of x falls, the budget line shift to the right from its initial position AB to AC. The consumer is able to purchase more of goods x and y (X2Y2) a new equilibrium is attained at e2 when the indifference curve is tangential to the new price line AC. If the price of x falls further a new budget line will occur to the right allowing the consumer to buy more of goods x and y, and a new equilibrium is attained at e3 when we join the points of tengencies from e1-e3 we form the price consumption curve.

Remember that as the price of good x falls, the quantity demand increases from x1 – x3. From here we can plot the demand curve from quantity-price pairs defined by the PCC. See figure 4.11

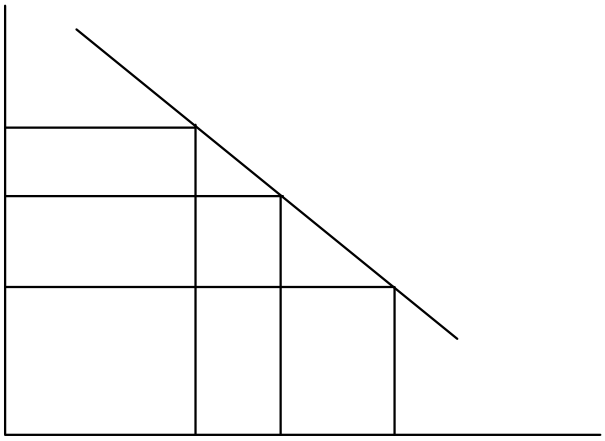


Figure 4.11:

The demand curve for a normal good is downward sloping. P1 represents the first price before the price of X fall, at price P2 X2 is demanded for P3 is the lowest price represented by line AD this price allowed the consumer to buy X3. The price change has two effects. (a) Substitution effect and (b) income effect. The substitution effect allows the consumer to substitute good x for y and the income effect allow the consumer to operate on a higher budget line, implying an increase in purchasing power. This is known as Slutsky decomposition of price effects.

3.4.1 Income Consumption Curve and the Engel's Curve

When the income of the consumer changes the budget line will shift in response to the change in the income. The income consumption curve shows the locus of all tengency points between the indifference curves and budget lines when income varies holding price constant. If these points of tengencies are joining together we have the income consumption curve. Therefore we can define the ICC as the locus of points representing various combinations of two goods purchased by a consumer as his income changes, all other things remained the same.
Figure 4.12

Angel curve is a function showing the relationship between quantity purchased of a commodity and the level of income. It is named after the German statistician Earnest Engel (1821-1896) who pioneered the study of this relationship.

SELF-ASSESSMENT EXERCISE 2

Discuss the conditions that must be fulfilled before a consumer can attain equilibrium.

4.0 CONCLUSION

This unit analyses the theory of consumer's behaviour using the indifference curve approach. It has been seen that some of the shortcomings of the cardinal approach is that commodities can be ranked on the basis of their ability to satisfy the consumer. As a result, the assumption of cardinal measurement was dropped. All the combination of goods x and y on an indifference curve gives the consumer equal satisfaction. The only constraint to the maximizing ambition of the consumer is his income and market prices. The indifference curve reveals the preference of the consumer.

5.0 SUMMARY

In this unit, we have so far discussed the meaning of indifference curve and its underlying assumptions. The role of the price line or budget line was highlighted. The necessary and sufficient condition under which the consumer attains equilibrium was analysed and explanation was made on the logical derivation of the demand curve using the price consumption curves. In the next unit you will be taken through the discussion on the theory of production.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss the effect of a change in the prices of a commodity on real income and quantity demanded.
2. Explain the basic properties of an indifference curve.

7.0 REFERENCES/FURTHER READING

Akaaha, T. J. (2004). Principles of Microeconomics Jos: Mono Expressions Ltd.

Koutsoyiannis, A. (2003). Modern Microeconomics. London: Macmillan Press Ltd.

MODULE 2

UNIT 1 THEORY OF PRODUCTION

CONTENTS

1.0 INTRODUCTION

In this unit we shall be discussing the supply side of price theory. The supply of a product depends upon its cost of production, which in turn depends upon (i) the physical relationship between inputs and output and (ii) the prices of factor inputs. The physical relationship between inputs and output plays an important role in determining cost of production. It is the general description of this physical relation between input and output which forms the subject matter of the theory of production. In other words, the theory of production relates to the physical laws governing production of goods.

2.0 OBJECTIVES

At the end of this unit, you should to be able to:

- discuss the concept of production
- explain the various types of production
- analyse short-run production
- describe the importance of the theory of production.

3.0 MAIN CONTENT

Theory of Production

3.1 The Meaning of Production

According to Ahuja (2005:353) the act of production involves the transformation of inputs into output. The word production in economics is not merely confined to effecting physical transformation in the matter; it includes creation or addition of value. Therefore, production in economics also covers the rendering of services such as transporting, financing, marketing, teaching, entertaining, broadcasting, driving, singing etc. The relationship between inputs and outputs of a firm has been called the 'production function' Thus the theory of production is the study of production function. The production function of a firm can be studied by holding the quantities of some factors fixes, while varying the amount of other factors (Short-run analysis). It can also be studied by varying the amounts of all factors (Long-run analysis) The former requires the application of the law of variable proportion, which will be discuss later.

3.2 Types of Production

We have three types of production or you can call it types of utility creation.

i. **Primary production: This type of production is concerned with** the extraction of raw material or natural resources from the soil or sea. For example, the extraction of crude oil, tin mining, farming, fishing/hunting and timber extraction. Most of the activities here do not require sophisticated skills; manual labour is okay except for a few; like crude oil extraction.

ii. **Secondary Production: This type of production deals with the** processing of the produce of primary production. It deals with the conversion of raw materials extracted from the soil or sea into finished products. For example, textile materials, semovita, cars, shoes, hydro electricity/solar energy, iron/steel computer, bulldozer etc. People who are engaged in these activities are said to be engaged in manufacturing or construction industry. A society with a developed secondary production is likely to be more developed with wider employment opportunity than a society characterized by only primary production.

iii. **Tertiary Production: This type of production is concerned with** rendering of services. The services could be direct or indirect. Those engaged in direct services are workers who render services

personally to others. For example Teachers, doctors, engineers, footballer, lawyers, pilot etc. While those engaged in producing indirect services are workers like the police, soldiers, clergy men etc. The inter relationship between the three types of production is that the primary sector extracts, the raw materials, supplies these to the secondary sector which transforms these raw materials into finished goods while the tertiary sector provides supportive services that brings comfort to those in the other sectors. In addition, the tertiary sector undertakes the distribution of finished products to the consumer and raw materials to manufacturers.

SELF-ASSESSMENT EXERCISE 1

Discuss the various types of production.

3.3 Short Run Production Function

You can recall from your elementary economics, that four factors of production were identified. These are land, labour, capital and entrepreneurship. At this level we will be dealing with only two of them; either labour and land or labour and capital. However entrepreneurship is important but it will be treated as a specialized form of labour. Capital in this case will be in the form of fixed or durable capital whose supply quality is therefore the same as land in the short run.

Short run production means the period during production that is so limited such that it cannot permit the entrepreneur time to adjust to certain basic market signals like increase/decrease in price output and demand. In the short run the entrepreneur cannot alter the size of certain factors of production. For example assuming a conference is organized and held in a town and the demand for bread increased more than double as a result of increase in population it will not be possible for the manufacturer to change his plant size from a smaller to a bigger one to enable him take advantage of increase in demand.

Therefore, one of the basic features of a short run production function is that some factor inputs are allowed to vary while others are held constant or fixed. In our above example, labour is a variable factor while the plant or machine for baking the bread is fixed. If there is an increase in demand for bread, the manufacturer can only increase labour by either hiring more, increase the working hours to increase the output of bread but he cannot immediately buy a bigger plant or machine. On the other hand if demand decreases, he will not reduce the installed capacity of the machine, nor can he convert it into other uses other than baking bread in the short run.

3.3.1 The law of Variable Proportion

The law of variable proportion otherwise called the law of diminishing returns is only applied in short run. In the long run all factors are variable factors. The law of variable proportion states that: An increase in some inputs relative to other fixed inputs within a given state of technology, cause output to increase, but after a point the extra output resulting from the same additions of extra inputs will become less and less. In other words, the law states that as more variable inputs are added on a fixed input in the process of production, first output will increase, reached a peak and begin to decline.

The law is based on the following assumptions (i) that the state of technology is given and unchanged. If there is improvement in technology, then marginal and average products rise instead of diminishing (ii) there must be some inputs whose quantity is kept fixed. It is only in this way that we can alter the factor proportions and know its effect on output.

3.4 The Importance of The Theory of Production

The theory of production plays a double role in the price theory. First it provides a basis for the analysis of relationship between costs and output. Cost governs supply of a product which, together with demand, determines the price of a product. The higher the cost of production, the lower will be quantity produced and supplied relative to demand and the higher will be the price of the commodity and vice versa. Secondly, the theory of production provides a basis for the theory of firms demand for factors of production. Demand for factor of production or inputs, together with the supply of them determine their prices.

The theory of production has great relevance for the theory of firm, since the theory of firm is concerned with what level of output it will produce so as to maximize its profits. In order to fix this profit, maximizing output, besides the demand conditions (average and marginal revenues) the firm will be guided by the marginal and average cost of production. In addition to the prices of factor inputs, the changes in marginal and average cost of production as a result of increase in output are determined by the physical relationship between inputs and output.

Demand for factors of production depends upon the marginal revenue productivity of the factors (that is extra revenue realized from the sale of extra output produced by an extra factor input), and therefore, the

demand curves for factors of production are derived, given the price for output, from their marginal productivity curves. T he theory of production explains the forces which determine the marginal productivity of the factor inputs.

The theory of production is also relevant to the macro-theory of distribution. The distributive shares of the various factors, for instance, aggregate shares of wages, rents and profits in National income, depend upon the elasticity of substitution between factors which is an important concept of the theory of production. The Neo – classical school argued that if a factor of production can easily be replaced by another factor, the smaller will be its share (price), the more rigid a factor is, that is if a factor cannot be substituted easily, the higher will be its share in the national income.

SELF-ASSESSMENT EXERCISE 2

Analyse the relevance of theory of production to an entrepreneur.

4.0 CONCLUSION

The analysis above explains the concept of production as an important segment of price theory. Studying the theory of production is very important in the determination of output of a firm and also in the determination of prices of factors of production. The types of production is an essential determinant of the stages of economic development, as developing countries are characterize by primary production while the developed countries are characterized by secondary and tertiary production with less of the primary production.

5.0 SUMMARY

This unit analysed and discussed the meaning of production and the types of production. The unit equally explained short run production function and its implication on output. The law of variable proportion has been discussed and its underlying assumptions. Finally, the unit ended with a brief analysis of the relevance of the theory of production.
In the next unit you shall be introduced to stages of production, total, marginal and average products.

6.0 TUTOR-MARKED ASSIGNMENT

1. Examine the advantages associated with secondary production to a nation as Nigeria

2. Discuss with giving example, the concept “shortrun production functions.

7.0 REFERENCES/FURTHER READING

Ahuja, H. L. (2008). Advance Economic Theory. Microeconomics *Analysis, New Delhi: S. Chand and Company Ltd.*

Koutsoyiannis, A. (2003). Modern microeconomics, London: Macmillan Press Ltd.

UNIT 2 STAGES OF PRODUCTION

CONTENTS

1.0 INTRODUCTION

Short run production function exhibits three returns to variable factor. These are increasing return, constant return and diminishing return. Increasing returns occurs when a large proportion of fixed factor is combined with a small proportion of variable factor and output increase at a faster rate. Constant return to scale occurs when the same proportions of fixed and variable factors are employed such as increase in output is in equal proportion with increase in variable input: Diminishing return occurs when the proportion of variable factor is more than the proportion of fixed factor employed such that output is less than the proportion of variable factor employed.

These returns to scale are grouped into three stages of production. In this unit therefore we will look at the implication of holding a factor constant and varying other factors on total, marginal and average outputs.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- identify and discuss total, marginal and average products
- explain the stages of production
- analyse the concept of Returns to variable factor
- describe the applicability of the law of diminishing return.

3.0 MAIN CONTENT

Stages of Production

3.1 The Concept of Total, Marginal and Average Products

3.1.1 Total Physical Product (TP)

In the short run, total product of a factor is the amount of total output produced by a given amount of a variable factor, keeping the quantity of other factors such as capital and land fixed. As the amount of variable factor increases, the total output increases. The rate of increase in total product varies at different levels of employment of variable factor. Therefore, the production function is expressed thus:

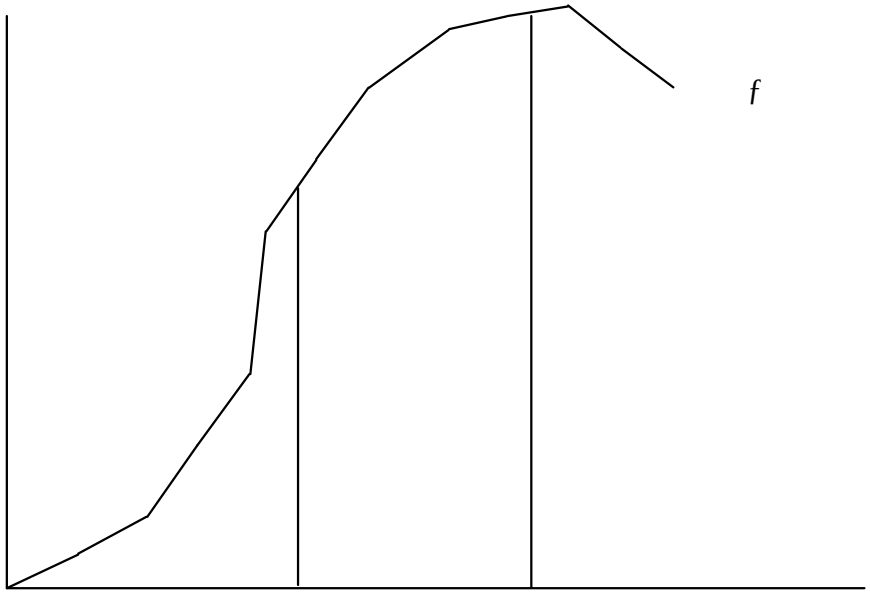
TP = f (KiL)
Where K = Fixed amount of capital employed
L = Amount of labour employed.

Since capital is held constant the production function can be expressed as

Tp = f (L)

Such that variation in total product is determined by labour only, see figure 6.1 below.

Figure 6.1: Total Product



From fig. 6.1, the total product curve rises at an increasing rate, see point (0-a) after point 'a' total product curve starts rising at a decreasing rate as employment of variable factors increased point (a-b). Any employment of labour beyond L2, the total product curve starts to decline.

3.1.2 Average Product (APL)

The average product of a variable factor (labour) is the total product (TP) divided by the amount of labour employed with a given quantity of fixed capital used to produce the commodity. The expression for the average product is:

$$APL = \frac{TP}{L} \text{ or } \underline{APL} = \frac{Q}{L}$$

Where TP and L are as defined above, and
Q = total product.

3.1.3 Marginal Product MPL

Marginal product of labour is defined as the additional output produced as a result of additional variable factor employed. In another word, it can be seen as change in total output put due to change in variable factor employed. The marginal product of labour is given by:

$$\frac{TP}{L} = MPL \text{ or } MPL = \frac{Q}{L}$$

Where Q = total product
= change

3.2 Three Stages of The Law of Variable Proportion

The three stages of production are derived from the law of variable proportion. These stages express the relationship between total, marginal and average products on one hand and variation in variable factor on the hand. You can recall that from the beginning of this course, we said the objective of the producer is profit maximization therefore he has to set his profit maximizing output such that at that output the gap between total revenue and total cost is highest and he/she is not under utilizing any factor input. Let us use table 6.1 and figure 6.2 to illustrate the stages of production.

Table 6.1:

Labour	**Total Product**	**Marginal product**	**Average product**
1	8	8	8
2	17	8	8.5
3	27	10	9
4	36	9	9
5	43	6	8.6
6	48	5	8
7	50	2	7.1
8	50	0	6.3
9	49	-1	5.4
10	47	-2	4.7

From table 6.1 TP increased at an increasing rate up to the third labourer, after which it started increasing at a diminishing rate. This is clearly revealed in column 3 where the MPL of the third labourer is the highest, 10. From the 4th – 8th labourer total product has been increasing at a slower rate as shown by the MPL where the marginal product continues to decline from 10-0. Employment beyond point 8, such as 9-10 TP declines and MP becomes negative. The average product on the other hand is highest when L = 3, when L = 4 AP remained constant at 9 after that it continue to decline but remained positive.

Marginal product is the most essential variable to the entrepreneur when making cost/benefit analysis. For example, how relevant is 8th labour, if his/her MP is zero. This implies that his employment has not added any value to total product.

Employing the 8th labour has only added to cost of production by the amount of wage he/she is to be paid, but he has not added to total output. The 9th and 10th labourer have no business being employed, their employment has caused TP to decline and MP becomes negative.

Figure 6.2:

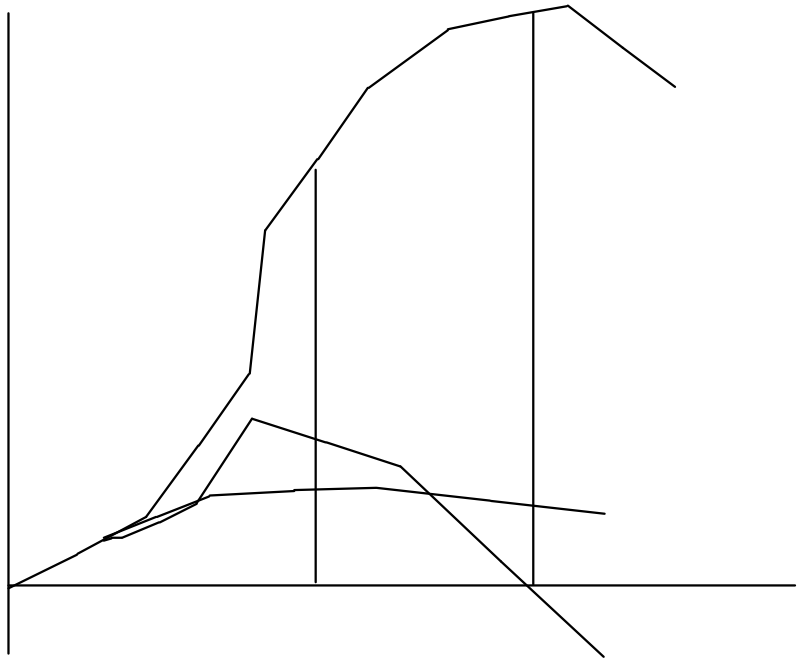


Figure 6.2:

Stage 1 is the stage of increasing return. At this point the slope of the TP curve is very steep; output is increasing at an increasing rate. Though output is increasing, a rational producer should employ more labour to produce beyond stage 1. This is because maximum output has not been attained.

Stage 2, this is the stage of diminishing returns. You can see the TP is still increasing but at a diminishing rate until it reaches it maximum where the second stage ends. This stage is called the stage of diminishing returns because at this stage, both the MP and AP are falling continuously but are still positive. At the end of stage II, TP is maximum, MP is zero and AP is above MP. This is the rational stage of production because TP is highest and fixed factor and variable factor are employed in equal proportions.

Stage 3: is called stage of negative returning. In this stage TP starts to decline. As a result MP is negative. The quantity of variable factor is too much in relation to the fixed factor. It may be noted that stage I and III are completely symmetrical. In stage I fixed factor is too much relative to the variable factor. Therefore the marginal products of fixed factor is negative. In stage III, variable factor is too much relative to fixed factor, therefore, marginal product of variable factor is negative.
Therefore, it is very clear from above that a rational producer will never be found producing in stages I and III. These stages are called stages of

economic absurdity or economic nonsense. Stage II is the most appropriate for production. At any point in stage II, the producer will decide what quantity to produce depending upon the prices of factor.

SELF-ASSESSMENT EXERCISE 1

Explain the reasons why a rational producer will not produce in stages I and III.

3.3 Mathematical Determination of Marginal and Average Products

It is useful to determine marginal and average products from the short=run production function. Assuming Dangote Plc has the following short run production function. You are to determine the marginal and average product of labour.

$TP = 6L2 - 0.4L3$ ..... (1)

It is easier to identify the function, as a short run production function because there is no fixed factor.

To determine the MPL you take the first derivative of the TP function with respect to labour. From the TP function

$MPL = \frac{dTP}{dL} = 2 \times 6L - 3 \times 0.4L2$ ..... (2)

$dL = 12L - 1.2L2$

$MPL = 12: 1.2L2$ ..... (3)

To determine the amount of labour for which TP is maximum, equate the MPL function in equation (3) to zero. Recall that when MPL = 0, TPL is maximum.

From equation (3) find the value of labour for which TP is maximum.

$12 L - 1.2 L2 = 0$ ..... (4)

$1.2L2 \frac{- 12}{L}$

$1.2L = 12$ ..... (5)

$L = 10$ ..... (6)

At 10 units of labour TP is maximum. To prove this substitute the value of L in equation (6) in to equation (1)

$TP = 6L2 - 0.4L3$

$TP = 6 (10)2 - 0.4L3$ ..... (7)

TP = 600 – 400..... (8)
TP = 200 ..... (9)

To determine the APL, you divide the TP function by L

APL = TP 6L2 0.4L3 .....
(10)
L L

APL = 6L – 0.4L2 .....
(12)

From here you determine the value; : for which APL is maximum. Recall again that when APL is maximum, MPL = APL, to get L you take the first derivative of the APL function in equation (12).

dAP = 6 – 0.8L = 0 .....
(13)
dL

0.8L = 6 .....
(14)

L = 6
0.8

L = 7.5 ..... (15)

When APL is maximum MPL = APL go back to equations 4 and 12 to find the equilibrium between APL and MPL by substitution 7.5 into equation 4 and 12.

MPL = APL

12L – 1.2 L2 = 6: - 0.4L2

12 (7.5) – 1.2 (7.5)2 = 6 (7.5) – 0.4 (7.5)2
90 – 1.2 (56.25) = 45 – 0.4 (56.25)
90 – 67.5 = 45 – 22.5
MPL = 22.5 = APL = 22.5

You can also calculate the unit of labour for which MPL is maximum. Use equation three takes its first derivative.

dMPL = 12 – 2.4L
dL

L = 5
Substitute L = 5 into equation (3)
12 (5) – 1.2 (5)2

60 – 1.2 (25)
60 – 30
MPL = 30
MPL is maximum when L = 5

All these can be captured on a graph

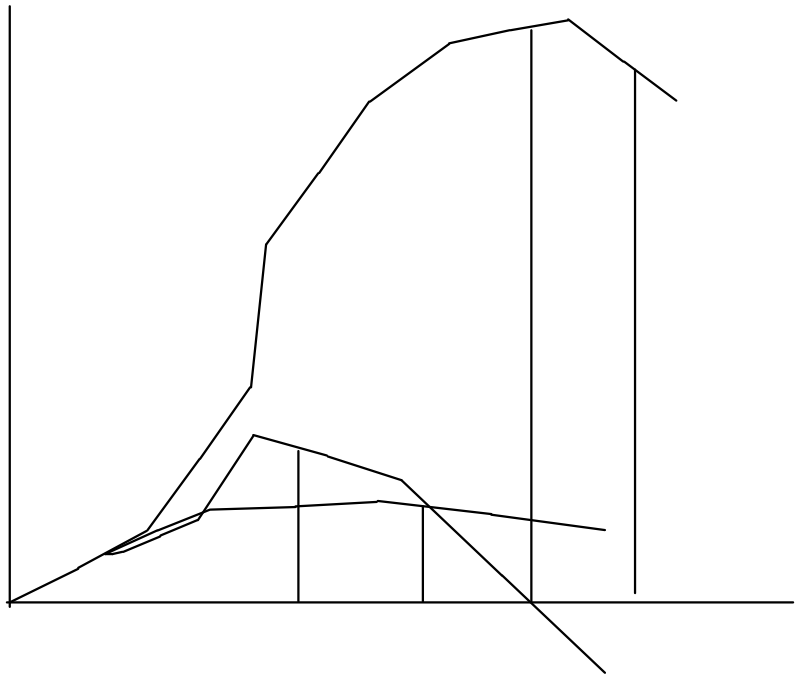


Figure 6.3:

Observed that an employment beyond 10 units of labour, TP is decling. For example, if you substitute 12 into the equation and solve for Tp you will arrive at 173. Thus conforms to the necessary conditions, which says, the second derivation of the TP function must be negative.

$\frac{drP}{dL2} = 0 = 12L - 1.2L2 = 0$

$\frac{d2TP}{dL2} = -2.4L$

SELF-ASSESSMENT EXERCISE 2

Given the following production function:

TP = 12L2 – 2L3

a. Determine the level of employment (L) that will produce the maximum output.
b. What unit of labour will produce MPL = APL?

3.4 The Applicability of The Law of Diminishing Return

The law of diminishing returns has vast general applicability. This law applies as much to industries as to agriculture. The occurrence of diminishing marginal physical returns after a point has been confirmed by the overwhelming empirical evidence. Imagine if diminishing returns did not occur we could grow sufficient amount of food even in a flower pot by using more dozens of labour and capital. If we argue that constant return could be obtained by applying more labour on a given piece of land, then as the population increased we could use more labour on that land to get proportionate increase in agricultural output. If we agree with this, then the world and especially developing nations like India, Nigeria, Niger Chad and Indonesia, etc would not have to face problems of food shortage and over population.

Professor Lipsay is right when he says 'indeed, were the hypothesis of diminishing returns incorrect there would need to be no fear that present population explosion with its attendant food crisis, the world food production could be expanded in proportion to the increase in population merely by keeping the same proportion of the population on farms. As it is, diminishing returns means an inexorable decline in the MP of each additional labourer and an expanding population is applied with static technique, to a fixed world supply of agricultural land.

You should not misinterpret the laws to mean that there is no hope for mankind. Law of diminishing returns, as stated above, has a great provision that technical knowledge, equipment etc remain the same. In the present developed counties, though population has increased, agricultural productivity has greatly increased too instead of diminishing. This is because these nations have made impressive progress in technology resulting in new and superior machinery, manpower and fertilizer. Developing countries do not have this advantage due to their static technology.

As demonstrated above, we can suspend the operation of diminishing returns by continually improving the technique of production. In conclusion, unless there is continued and rapidly accelerating improvement in the techniques of production, the population explosion

must bring with it declining living standard in many countries and the eventual widespread famine.

4.0 CONCLUSION

The analyses above shows that in a short run production function some factors are held constant while some are varied. As a result of continuous application of variable factors on a fixed factor, output exhibits increasing diminishing and negative returns. However, diminishing returns can be eliminated both in industries and agriculture if we improve our techniques of production, expand/replace machines with larger installed capacity.

5.0 SUMMARY

This unit has thrown light on stages of production. The response of Total Average and marginal products in relation to employment of variable factor (labour) was discussed. The unit equally explained the mathematical derivation of TP, MP and AP and we concluded with an analysis of the applicability of diminishing returns. In the next unit our discussions shall centre on cost theory.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss the three stages of production using a suitable graph.
2. Explain with reason(s) why diminishing returns is inevitable in developing countries agricultural output.

7.0 REFERENCES/FURTHER READING

Ahuja, H. L (2008). Advance Economic Theory. Microeconomics *Analysis. New Delhi: S. Chand and Company Ltd.*

Koutsoyiannis, A. (2003). Modern Microeconomics. London: Macmillan Press Ltd.

UNIT 3 BASIC CONCEPTS OF PRICE THEORY

CONTENTS

1.0 INTRODUCTION

In the proceeding unit, we discussed the nature of production function underlying the production process of goods. The production function, along with the price of factors and the state of technology determine to an appreciable degree the supply of goods. In this unit we shall be concerned with explanation of different cost concepts and other terminologies that are associated with efficient resource allocation by the entrepreneur. In a layman's language cost is defined as the out of pocket expenses incurred by a producer or buyer of a commodity. To the producer, cost is the prices of factor of production multiplied by the quantity of factors inputs, hired in the process of production. This definition is from the accounting perspective. From the view point of an economist, cost is defined as accounting cost plus opportunity cost. We shall be discussing these and the concept of efficiency in this unit.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain the differences between accounting and economic costs
- describe the concept of opportunity cost
- analyse private versus social costs
- explain the differences between technical and economic efficiencies.

3.0 MAIN CONTENT

Cost Concepts

3.1 Accounting versus Economic Costs

It is necessary for the proper understanding of the price theory to know the various concepts of cost that are often employed. When an entrepreneur undertakes an act of production, he has to pay prices for the factors which he employed for production. He will pay wages, to the labourers, rent for hiring building, interest on capital, pay for fuel and raw materials. All these are included in his cost of production. An accountant will take into account only the payment and charges made by the entrepreneur to the outside suppliers of various production factors.

But the economist's view of cost is a little different from this. Assuming an entrepreneur has an amount of money as his take off capital, which he starts the business with, an economist will consider this option, if the entrepreneur had invested this money elsewhere it would have earned a certain amount of interest or dividends. The entrepreneur has many options opened to him. He could have saved the money in a fixed deposit account, invested in shares or bonds or speculate in the commodity market. Further, an entrepreneur devotes time to his own business and contributes his entrepreneur and managerial ability to it. If the entrepreneur had not set up his business he would have sold out his services to others for some positive amount of money.

Thus, the economist include in his cost of production (i) the normal return on money capital invested by the entrepreneur himself in his own business, which he could have earned if he had invested elsewhere. This is infact the opportunity cost of his money capital (ii) the wages or salary he could have earned if he had sold his services to others, as a manager or consultant (iii) the rent he could have received if he had rented the buildings/premises to other business men. All these are lose opportunities to him in monetary terms. The accountant does not include these items in cost of production.

The accounting costs or contractual cash payments which the firm makes to other factor owners for purchasing or hiring the various factors are also known as explicit cost. Economic view point is called implicit costs or imputed cost. Therefore,

Economic cost = Accounting costs + implicit costs
Or Economic profits = Total revenue - Economic costs
Economic profits = Total revenue – (explicit +implicit costs).

If the entrepreneur does not get any profit from his own business, he will fall back on the other options we identified above. He can withdraw his money from the business and put it into alternative use that is more beneficial, he can also offer his managerial services to other businesses instead of his own that he is not getting any profit from and he can also convert his building/premises to other uses other than the initial business.

3.2 Opportunity Cost

The concept of opportunity cost occupies a very important place in modern economic analysis. The opportunity cost of any goods is the next best alternative good that is sacrificed. The resources which are used for the manufacture of armaments may also be used for the production of cars or other automobiles. Therefore, the opportunity cost of production of armaments is the output of cars and other automobiles forgone or sacrificed which could have been produced with the same amount of resources that have gone into making of arms. To take another example, a farmer who is producing yam, can also produce cassava with the same factors and plot of farm. Therefore, the opportunity cost of tubers of yam is the quantity of cassava given up. Thus the opportunity cost of anything is the next best alternative that could be produced instead by the same resources or by factors having the same monetary value.

What is worthy of mention is that the relative prices of goods tend to reflect their opportunity cost. According to Ahuja (2008:445), resources will remain employed in the production of particular goods when they are being paid at least the money rewards that are sufficient to induce them to stay in the industry. For example, an economics lecturer will remain in the classroom as long as the university is able to pay him/her equal to the value he/she is able to obtain and create elsewhere. If a factor of production is paid less than what it could have earned elsewhere, the factor is likely to transfer it services to that better alternative.

3.3 Private versus Social Cost

The sum of explicit costs incurred by a firm to produce a good constitutes the firm's private cost. It is this private cost that the firm takes into account while making decision regarding price and output of the commodity it produces. However, in addition to private costs, the production of a commodity by a firm brings with it benefits or losses to others which the firm do not take into account while taking decisions regarding price and output of the commodity. Remember it is the social costs of crude oil exploitation in the Niger Delta region, which has

causes serious problem to both the oil companies and the Federal Government of Nigeria.

The oil companies, in the process of extracting oil from the ground, pay prices for the purchase of drilling machines, labour, electricity and the tools needed for extracting oil. These payments constitute private costs to the oil companies. But in the production process, the noise of heavy machines, oil spillage, environmental degradation and water pollution that could cause damage to people and aquatic animals that live in the same location constitute social cost. If social welfare is to be maximized, it is the total cost and not just the private cost that has to be minimized.

SELF-ASSESSMENT EXERCISE 1

Explain with good example(s) the concept of social cost.

3.4 Technical Efficiency versus Economic Efficiency

It is very important to make clear the notion of economic efficiency in the use of resources as it is intimately related to the cost of productions. In our study of production, we take it for granted that resources are used by producer with technical efficiency. By technical efficiency we mean that the maximum possible output is obtained from a given set of inputs. From this definition, it is clear that any producer that operates at stages I and III in our stages of production in unit 6 is not operating with technical efficiency, this is because in stage I the highest output has not been attained while in stage III output has deviated from the highest possible output. Therefore, the producer is technically efficient only in stage II where output is highest given the factor inputs. In a nutshell, technical efficiency means the optimal allocation/combination of resources that result in the highest possible output for a firm.

You can see from this definition that most Nigerian corporations such as Power Holdings Company of Nigeria Plc, the Nigerian Police etc are technically, inefficient, given the huge investment and installed capacity, they have performed decimally. On the other hand, economists examine the question that with, the given prices of various resources or factor inputs, which production process or factor combination a producer will employ for producing a given level of output of a commodity which minimizes the cost of production. Economic efficiency therefore implies the use of production process or resources combination which ensure the minimization of cost incurred on using resources to produce a given level of output. Thus, while engineers are primarily concerned with getting maximum physical output from a given amount of physical

inputs, economists are essentially concerned with maximizing the value of output from a given level of cost (that is value of inputs used).

Economic efficiency is achieved when a Naira worth of input yields the largest possible value of output. In our analysis of production, it was assumed that technical or physical efficiency of resources had already been attained. The major concern to the economist is the economic efficiency. If a production process is economically inefficient, then cost is likely to be greater than revenue which will amount to net losses. If it is sustained over time, the business will fold up. For a country like Nigeria, with abundant human resources and cheap labour, it will be economically efficient to use labour intensive process of production than capital intensive process. The former will minimize cost than the later.

For a firm to be globally competitive, it needs to be both technically and economically efficient. Technical efficiency will propel increase output while economic efficiency induces reduction in cost, the combine effect is that net profit will be highest.

SELF-ASSESSMENT EXERCISE 2

Analysis the differences between technical efficiency and economic efficiency.

4.0 CONCLUSION

We have seen the different concepts of cost in this unit. The units throw light on the difference between accounting cost and economic cost. Economic cost is broader as it encompasses the accounting cost and opportunity cost. The concept of opportunity cost is important, as it reveals the best alternative foregone, such that if earnings are poor in the present employment, resources can be demobilized and channelled to the best option. A company that does not only takes care of its private cost but considers its social cost is likely to enjoy a friendly environment than those concerned mainly with their private cost. A firm will grow and endure over time, if its operation is technically and economically efficient.

5.0 SUMMARY

In this unit we discussed cost concepts. The concept of accounting and economic costs was also explained. Analysis of the concept of private and social costs was undertaken alongside opportunity cost. The unit ended with a discussion on the differences between technical efficiency and economic efficiency. In the next unit you will be examining the theory of cost.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain with reason(s) why firms should pay attention to social cost in their operation.
2. Discuss the differences between explicit and implicit cost, give relevant samples.

7.0 REFERENCES/FURTHER READING

Ahuja, H.L. (2008). Advanced Economic Theory, Microeconomic *Analysis. New Delhi: S. Chand and Company Ltd.*

Akaahan, T. J. (2004). Principles of Microeconomics. Jos: Mono Expressions Ltd.

UNIT 4 COST THEORY

CONTENTS

1.0 INTRODUCTION

The short run cost are those expenses over a period of time during which the firm is unable to vary all its inputs. In the short run, some inputs are fixed while some are variable. Capital equipment, building managerial capability is examples of fixed factors in the short run. Factors like labour, fuel, raw material vary in the short-run. However, in the long-run a firm is at liberty to adjust its use of all inputs to produce output in the least costly way or in responds to market signals. In the long run a firm has enough time to increase its plants size, purchase additional equipment and retrain its managers or reduce the holdings of its equipment and purchase a machine with a lower production capacity.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain short run cost of production
- explain the relationship between various cost curves
- analyse long-run cost of production
- describe the concept of economies of scale.

3.0 MAIN CONTENT

Cost Theory

3.1 Short Run Costs

There are some inputs which can be readily adjusted with the changes in the output level. Thus a firm can readily employ more workers, if it has to increase output. Likewise, it can secure and use more raw materials, more chemicals without much delay if it has to expand production. Labour raw materials, chemicals, etc; are the factors which can be readily varied with the change in output as such they are called variable factor. On the other hand, there are factors such as capital equipment, factory building, top management personnel which cannot be readily varied with change in output.

The short-run cost function is a multivariate function and it is determined by many factors. It can be symbolically expressed as:

C = (Q, T, K, Pf)
Where C = Total output
Q = Output
T = State of technology
K = Capital factor
Pf = Prices of factors

In the short run all other determinants of costs other than output (Q) are held constant, so that its short-run cost function can be written as
C = f (Q)
This implies that total cost is a function of output, all things being equal.
Total cost is defined according to Akaahan (2004:66) as the total cost that must be incurred to produce a given quantity of output. Total cost can be decomposed into total fixed cost (TFC) and total variable cost (TVC). That is
TC = TFC + TVC

Total Fixed Cost. These are the cost incurred by the firm that do not depend on how much output it produces. It is also known as overhead costs and includes charges such as contractual rent, insurance fee, maintenance costs, property taxes interest on borrowed fund, minimum administration charges such as manager's salary. The amount of fixed cost cannot be altered in the short-run.

Total Variable Cost: These are costs which are incurred on the employment of variable factors of production whose amount can be

altered in the short-run. Thus the TVC change with changes in output in the shortrun. If output is to be increased more workers, raw materials, fuel, electricity must be increased hence the bill the firm must pay. If the firm intends to reduce output all these factors must be reduce, which in turn will reduce TVC.

Marginal Cost: The Marginal cost of production measures the change in total cost that occurs as a result of a unit charge in output. That is MC = $\frac{TC}{Q}$

Average Total Cost: This is obtained by dividing the total cost by the level of output produced. The ATC can be decomposed into two. These are Average fixed cost and average variable cost ATC = AFC + AVC.

Average Fixed Cost: This is total fixed cost divided by the level of output. Since the TFC is constant in the short run, the greater the output, the lower will be AFC per unit of output

AFC = $\frac{TFC}{Q}$

Average Variable Cost: AVC is Total Variable costs divided by output. That is AVC = $\frac{TVC}{Q}$

3.1.3 Graphical Presentation of Short-Run Cost Curves

The graph can only be derived from a hypothetical short-run cost table. See table 8.1 below.

Table 8.1: A hypothetical Short-run costs of a firm

Output	TFC	TVC	TC	MC	AFC	AVC	ATC		
0	70		0	70	-	0	0	0	
1	70		15	85	15	70	15	85	
2	70		23	93	8	35	11.5	46.5	
3	70		30	100	7	23.3	10	33.3	
4	70		39	109	9	17.5	9.8	27.3	
5	70		50	120	11	14	10	24	
6	70		65	135	15	11.6	10.8	22.5	
7	70		80	150	15	10	11.4	21.4	
8	70		100	170	20	8.8	12.5	21.2	
9	70		125	195	25	7.8	13.9	21.7	
10	70		150	220	25	7.0	15	22.0	
11	70		176	246	26	6.4	16	22.4	
12	70		208	278	32	5.8	17.3	23.2	
13	70		242	312	34	5.4	18.6	24	

The table above is splited into two in a graph form, the total will be graphed separately, while the second graph will contain from MC-ATC

Figure 8.1: Showing TC, TVC and TFC

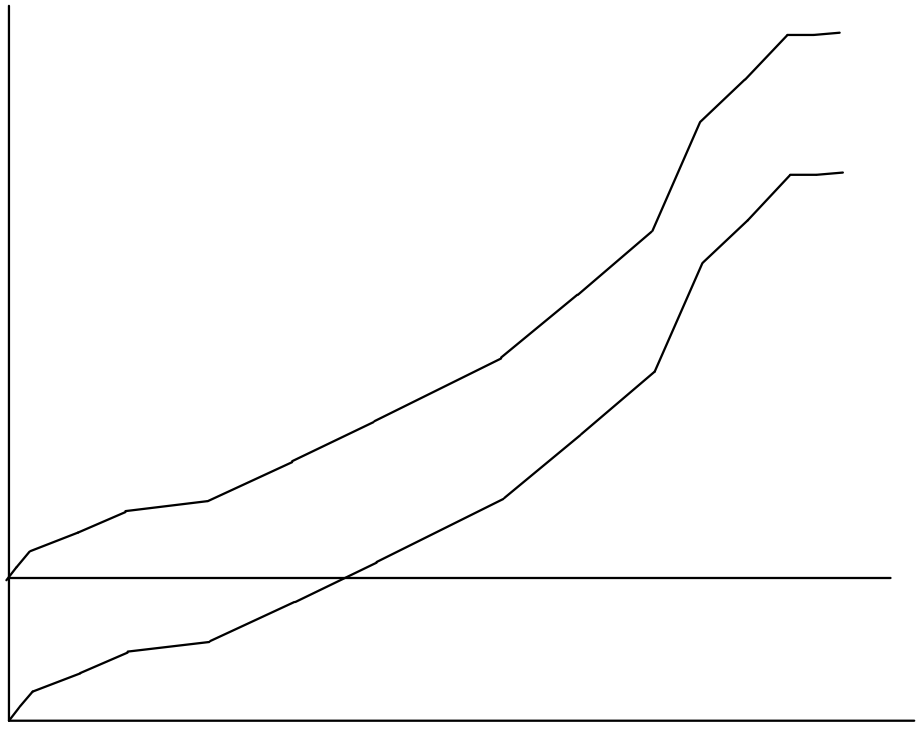
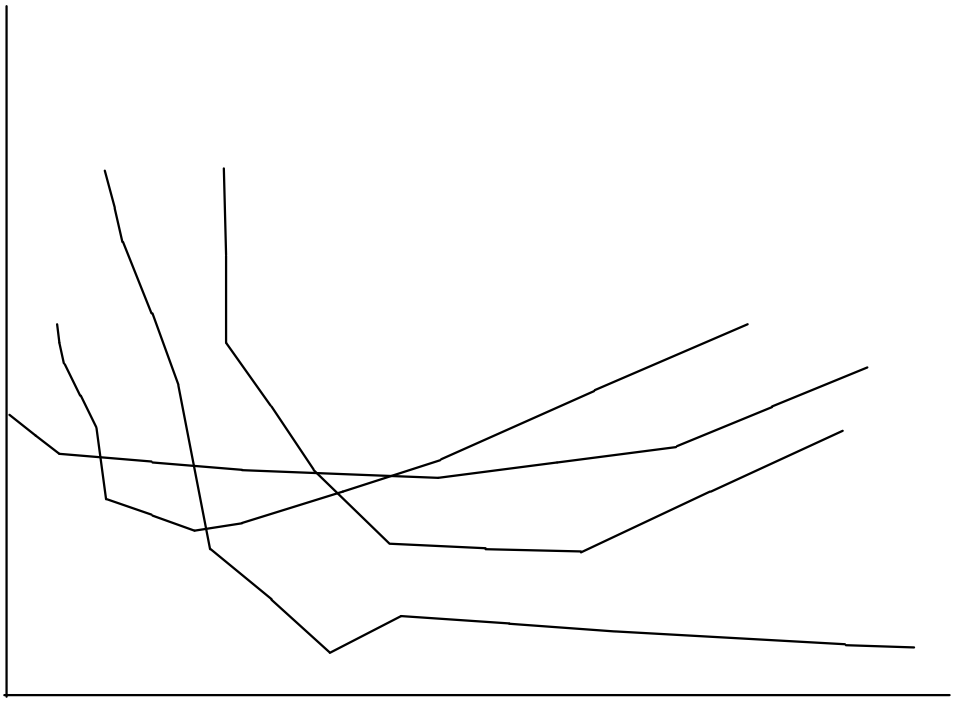


Figure 8.2: Showing MC, AFC, AVC and ACT



3.2 The Relationship between Output and All the Cost Curves

3.2.1 The relationship between output, TFC, TVC and TC

From figure 8.1, you can see that the TFC curve remain the same for all level of output from 0-13. Therefore, it takes a horizontal shape. The TVC curve first increases at a decreasing rates. As more output is produced, more variable factor is needed on a fixed factor, as such TVC continue to increase as long as output is increased. The TC curve has the same behaviour to that of TVC the only reason why TC is higher than TVC is because TVC must be added to TFC to get TC since TFC is constant throughout, the shape of TC is determined by TVC.

3.2.2 The relationship between Output, MC, ATC & AVC

The traditional theory of cost relies heavily on per unit cost curve shown on figure 8.2, the MC, ATC and AVC are all u-shape. Notice that all the curves in Fig 8.2 with the exception of AFC, started at a higher level, then begin to decrease, reach a point of minimum and begin to increase again. This is following the law of diminishing returns. At a lower level of production/employment MC, ATC and AVC are highest because of the influence of TFC that is incurred even when output is zero. As more

output is produced, ATC, MC and AVC are on the decline, this is the equivalent of stage 1 in our stages of production. As the optimal output is produce, ATC and AVC are minimal, corresponding to stage II. If output is increase beyond such point, MC, ATC and AVC start increasing corresponding to stage III.

A downward trend in the MC curve shows increasing marginal productivity of variable input which is mainly because of internal economies resulting from increase in production. The MC is U-shaped with the cost of additional units of output, first falling, reach a minimum and then rises. Note: when output is low, MC is high, MP is low, when output is increasing at decreasing rate, MC is minimum and MP is maximum. When output is decreasing, MC is rising and MP is negative. It is the same analogy for the AVC and AP, this means that the MC and MP are inversely related just as AVC and AP are inversely related.

We know that $MC = \frac{TC}{Q}$

Note that the MC is independent of fixed cost and it is directly attributed to the change in total variable cost. So, $MC = \frac{TVC}{Q}$

Let's assume that the price of labour = w such that TVC = W.DL ..... (1)

$MC = W\,L = W.\frac{L, w}{Q}$ is held constant in the short run

Also $MP = \frac{Q}{L}$

$I = \frac{L}{Q}$ This is the reciprocal of MP
MP

Substitute $\frac{1}{MP}$ for $\frac{L}{Q}$ in equation (1)

$MC = W.\frac{I}{MP} = W\frac{}{MP}$

This marginal is equals to the reciprocal of marginal product of the variable factor multiplied by the price of variable factor.

Total product (Q) = AP. L
Average Variable Cost $AVC = \frac{TVC}{Q}$

Since TVC is equal to the amount of variable factor (L) employed multiplied by the price per unit (w) of the variable factor (TVC=L.W.)

Therefore,

$$AVC = \frac{L.W}{Q}$$

Since $Q = AP.L$

$$AVC = \frac{L.W}{AP..L}$$

$$AVC = \frac{W}{AP}$$

$$AVC = W\,(1)\,\frac{}{AP}$$

Thus given the price of variable factor w, AVC is equal to the reciprocal of average product (1) multipled by the constant w.

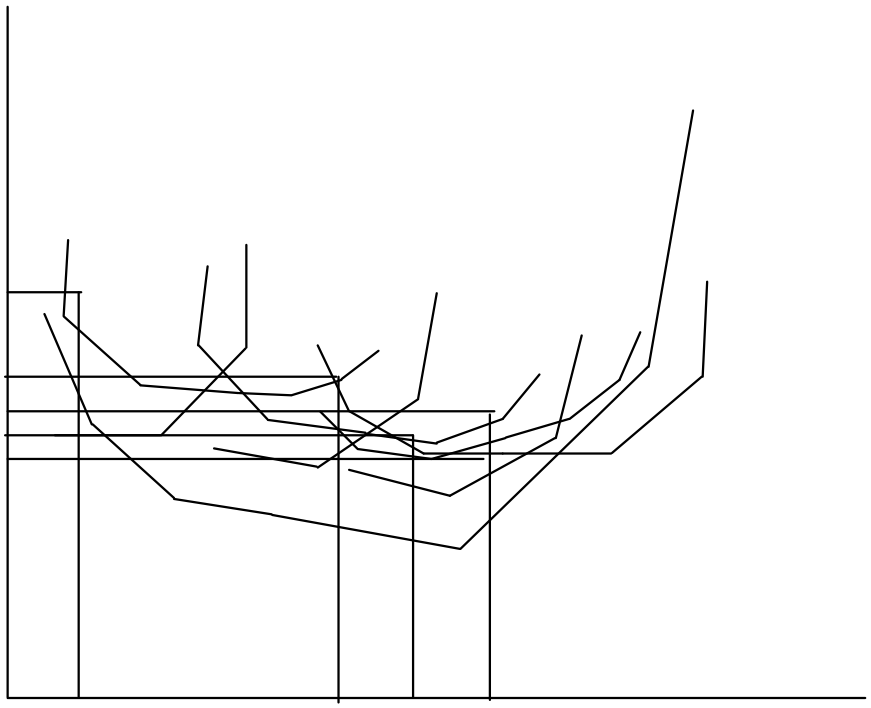
AP

In the theory of production, MP cuts AP from above where AP is maximum. The MC cuts the AVC from below, where AVC is minimum.

3.3 The Long Run Cost of Production

In the long-run all factors are assumed to be come variable. The long-run cost curve is a planning curve, in the sense that it is a guide to future expansion of his output. According to Koutsoyiannus (2003:111) the long-run average cost curve (LAC) is derived from short run cost curves. Each point on LAC corresponds to a point on a short-run cost curve, which is tangent to the LAC at the point. Let us demonstrate this.

Assuming the state of technology of a firm at a particular time is represented by three method of production, each with a different plant method of production, each with a different plant size a small plant, medium plant and large plant. The small plant operates with the cost denoted by the curve SAC1 the medium has SAC2 and the larger size has a cost curve represented by SAC3. If the firm plans to produce output xi, it will choose the small plant. If it plans to produce x2 the medium plant size will be preferred. It is wishes to produce x3 the large size plant will be chosen. What determines the choice of a plant size is the demand for the firms products. Consider figure 8.3



If the firm starts with a small plant and its demand gradually increases, it will produce at a lower cost up to level xi, beyond that point cost starts to increase. If the demand reaches x", the firm can continue to produce with the smaller plant or it can install the medium size plant. The decision at this point depends not on cost but on the firm's expectations about its future demand. If the firm expects that demand will expand further than xi" it will install the medium plant, because with this plant outputs larger than x1" are produce at a lower cost. If it expects demand to stay constant at this level, the firm will not install the large plants, given that it involves a larger investment which is profitably only if demand expand beyond X2". For example, the level of output X3 is produced at cost C3 with the large plant while it cost C2 if it produce with the medium size plant (C'2 > C3).

If we assume that there is a very large number (infinite number) of plants, we obtain a continuous curve, which is the planning LAC curve of the firm. Each plant of this curve shows the minimum (Optimal) cost for producing the corresponding level of output. The LAC curve is the locus of points denoting the least cost of producing the corresponding output.

The long-run marginal cost is derived from the short-run marginal cost curve but does not 'envelop' them. The LRMC is formed from the

points of intersection of the SRMC curves with the vertical lines. The LMC curve takes a U-shape and it is equal to the LATC at its minimum point. When LATC is decreasing the LMC is below it, even though the LMC reaches its minimum point before the LAC, both are equal at the minimum point of the LAC.

SELF-ASSESSMENT EXERCISE 1

Explain the behaviour of a firm in the long-run.

3.4 Economies of Scale

Apart from the different cost concepts discussed above, firms face different costs depending on their size and location. Economies of scale are divided into two: Internal economies and external economies.

3.4.1 Internal Economies

Internal economies of scale refers to the benefits that accrue to a firm as a result of expansion in its size. A firm that mass produce a particular commodity is likely to have the following advantages. (i) reduction in per unit cost of production, (ii) low price of raw material as a result of bulk purchase (iii) Cheaper credit as a result of corporate integrity (iv) lower sales expenses due to customer's development of brand loyalty etc,. These are some of the advantages bigger firms can get over smaller firms. However, a gigantic firm can suffer some disadvantages as a result of its size. These include:

i. Financial fraud as a result of complex financial records, such that fraud is not easily dictated as in a one man business.
ii. Beaurcratic bottle neck can hinder quick decision that is advantageous to the firm.
iii. Huge waste, if there is error in production, before it is dictated; much resource would have been wasted.
iv. Lack of commitment and truancy can lower productivity and efficiency.

Because of the large size of the firm, it will be difficult to check punctuality and dedication as in the smaller businesses. These disadvantages are term internal diseconomies of large scale production.

3.4.2 External Economies

External economies of scale, are the advantages a firm stand to enjoy as a result of being located close to other firms. For example, a firm could be located close to four other firms if one of the firms constructs a

motorable road that passes through the premises other firms, the firm under consideration, such a firm would not need to construct its own road. Assuming too that the firm is located close to military barracks, the firm may not spend much on security. Another example is a situation where the finished products of one of the firms is the raw material to the firm under consideration, the firm may not pay much in terms of transportation of raw materials. Another firm could install streets/security light that are enjoy by other firms because of their proximity to each other. However, the firm can suffer external economies of scale, for example, fire outbreak in one firm can engulf other firms. If the firms are linked by one road, assuming there is demonstration by workers of one firm, the gate may be closed to workers of other firms. You imagine also situation where two firms, one producing fertilizer and the other a fast food restaurant are located in the same area, the fast food is likely to lose customers as a result of air pollution arising from the production chemical fertilizer. All these are disadvantages that could add to cost of production. Internal and external economies can help reduce cost while internal and external diseconomies could result in increase cost of production.

SELF-ASSESSMENT EXERCISE 2

Discuss the relationship between cost of production and internal economies of scale.

4.0 CONCLUSION

This unit explains the theory of cost both in the short and in the long run. The short run analyses the implication of increase employment of some factors while others are held constant on the cost curve. In the long-run all factors are allowed to vary, therefore, there is a positive relation between output and factor inputs employed. There is an inverse relationship between MC and MP on one hand and AVC and AP on the other. This suggests the operation of the law of diminishing returns in the short-run cost theory. Economies of scale can also influence the cost of structure of a firm.

5.0 SUMMARY

The theory of cost in both the short and long runs were highlighted and discussed. Different cost curves have been analysed in this unit. These include the TFC, TVC, TC, AFC, AVC, ATC, and MC. The long-run period was explained to be a decision period and finally, a discussion of internal and external economies was carried out. In the next unit you shall be taken through marketing under perfect competition.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain short-run production.
2. Analyse carefully how the u-shaped of AVC and MC is related to the stages of production in the short-run.

7.0 REFERENCES/FURTHER READING

Ahuja, H.L. (2008). Advanced Economic Theory: Microeconomic *Analysis. New Delhi; S. Chand and Company Ltd.*

Akaahan, T. J. (2004). Principles of Microeconomics. Jos: Mono Expression Ltd.

Koutsoyiannis, A. (2003). Microeconomics London: Macmillan Press Ltd.

MODULE 3

Unit 1 Perfect Competition
Unit 2 Long-Run Analysis of Perfect Competition
Unit 3 Price and Output Determination under Monopoly

UNIT 1 PERFECT COMPETITION

CONTENTS

1.0 INTRODUCTION

Perfect competition is one out of several other product market structures studied under price theory. Others are monopoly, monopolistic competition and oligopoly. In this unit we will be concerned with perfect competition as a type of product market. The phrase, "perfect competition presupposes the existence of many competing firms producing and selling similar goods to a large number of consumers. Perfect competition is characterized by the following basic features. Large number of sellers and buyers, product homogeneity free entry to and exit from the market, profit maximization, free flow of information, perfect mobility of factor of production and absence of government interference. These shall be explained as you are taken through this unit.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain the meaning/assumption of perfect competition
- analyse the nature of demand curve faced by a perfect competitor

- explain the short run equilibrium condition of perfect competition
- describe the short-run supply curve of perfect competition.

3.0 MAIN CONTENT

3.1 PERFECT COMPETITION

Perfect competition, as is generally understood is said to prevail when the following conditions are found in the market.

i. Large number of sellers and buyers. This condition ensures that no single firm or consumer is so significant such that his/her supply or demand can influence the entire market to the point of altering the prevailing market price. The buyers are many and the sellers are many producing and selling similar product. No buyer has any reason to prefer the products of firm A to that of firm B or C.

ii. Product Homogeneity: The goods produced are identical, no branding, and no product differentiation. This implies that the product is indistinguishable from each other. The goods in the market are perfect substitutes for one another. In this case, the control over price is completely eliminated only when all firms are producing homogenous product.

iii. Free entry and exit. In this market, there are no restrictions to entry or exit. When firms in the industry are making excess profit, the profit will attract new entrants into the industry and when profits are no longer attractive, firms are free to leave the industry and take their investment elsewhere, where they feel they can get better returns on their investment. The assumptions of free entry and exist ensures that that are always many sellers in the market. If this freedom is curtailed, few firms will come together, create monopoly and have control over price.

iv. Profit Maximization: The only goal of all the firms both in the short and long run is profit maximization. No other goals are pursued.

v. Free flow of information: It is assumed that both buyers and sellers have perfect knowledge with regards to current and future change in price, cost and output in the industry. Information is freely disseminated, ignorance and uncertainty is not a possibility in this market.

vi. Perfect Mobility of Factors of Production. That factor of production is free to move from one employment to another. For

example, an accountant can easily move to position of an admin officer if he feels as to change, or a building that was initially meant to be an administrative block can easily be converted into a factory.

vii. No Government Intervention: It is assumed that government does not intervene in the activities of perfect competitive firms either through imposing tariff, granting subsidy or price control. Therefore, perfect competition is regulated through the invisible hands (forces of demand and supply).

3.2 The Demand Curve of Perfect Competition

The first three conditions ensure that a single price must prevail under perfect competition and the demand curve faced by an individual firm under perfect competition is perfectly elastic at the ruling price in the market. Perfectly elastic demand curve signifies that the firm does not exercise any control over the price of the product but can sell any amount of the product as it wishes at the ruling price. It is in view of this that the perfect competition is called a 'price taker'.

***Figure 9.1: Shows the demand curve of a perfectly competitive* firm**

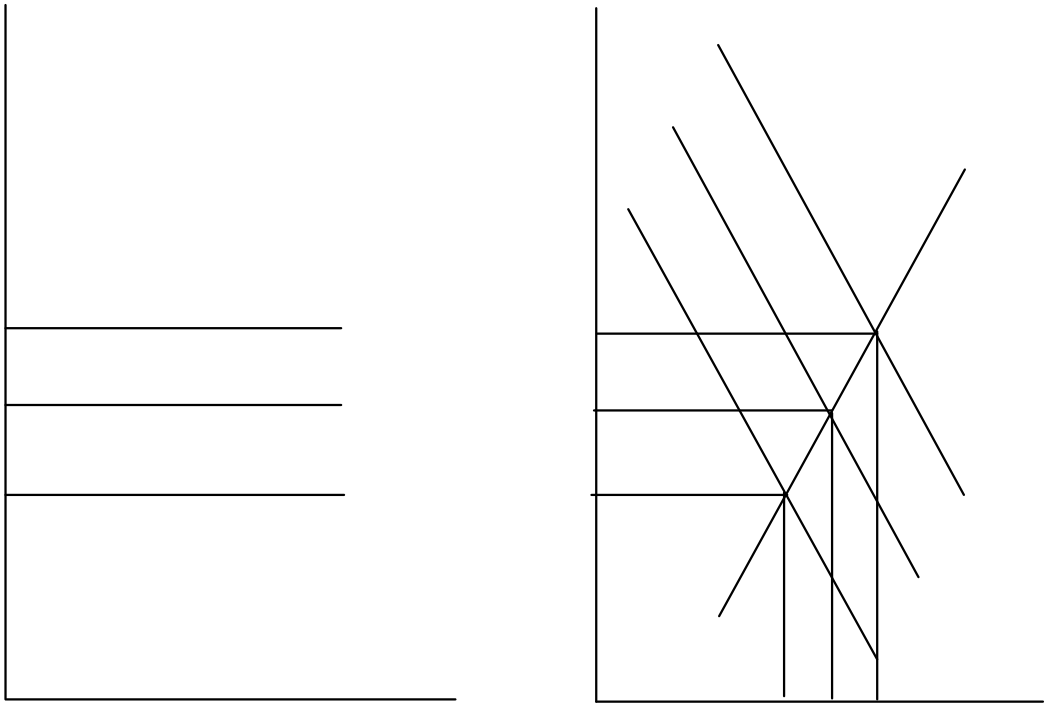


Figure 9.1:

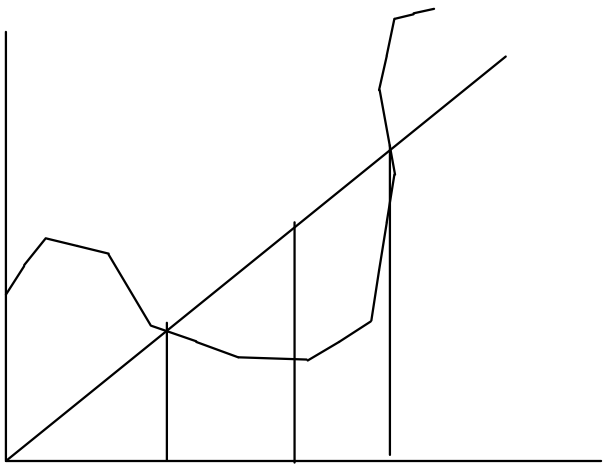
The demand curve is equally the marginal revenue, average revenue and the price line. P is fixed through the interplay of demand and supply, as such, no single firm can sale above Oe, if any firm does, it will lose all its customers to other rival firms. This implies that the demand curve will fall to zero. At the ruling price OP, the firm can sell any quantity it desires; therefore, the firm has no incentive to even lower price to attract more customers. Once the price in the market is established a firm accepts the price as given and adjust its output at the level which gives it maximum profit.

In Fig. 9.1b, the DD and supply curves intersect at point e and determined price OP. Since the firm has no influence over the price, it will take the price OP as given and therefore, average- marginal revenue curve facing the firm will be horizontal at the level as shown on fig. 9.1.b when the market forces produced a new price say a rise in price to OP" the average marginal revenue line will be above OP to OP". If demand decreases and price falls, to P1, the firm's average marginal revenue curve will shift below OP to OP". At each point of intersection between DD and SS, a new equilibrium is form such as point e' = SS = DD' and e"=SS=DD".

3.3 Short Run Equilibrium of Perfect Competition

Economists have developed two approaches to determine the equilibrium level of a firm in the short run. These are: (a) Total revenue and total cost approach and (b) Marginal revenue and marginal cost approach.

The total revenue and total cost approach involves comparing total revenue with total cost of the firm. The firm is in equilibrium when it produces the output that maximizes the difference between total revenue and total cost. This is shown graphically in (Fig. 9.2).



Since the firm is a price taker, the TR curve is a straight line through the origin, implying that price is constant and that total revenue varies proportionally with increase quality of goods sold. The slopes of the TR is the marginal revenue (MR). Which is constant and equal to the prevailing market price because all units are sold at the same price. The line of the TC curve starts above zero reflecting TFC and continue to increase gradually as TVC is added. After Q2, TC starts to increase. Q2 is the optimal output sold at that output, the gap between TR and TC is highest. AT Q1 and Q3 the firm incurred losses. Therefore profit is maximized at Q2. The shape of TC curve is U-shape reflections the law of variable proportion.

Marginal cost and Marginal Revenue Approach

This is the alternative approach which is based on MC and MR, which uses price as explicit variable and shows clearly the behavioural rules that leads to profit maximization. In figure 9.3, we show the marginal and average cost curves of the firm together with its demand curve which is also it marginal revenue curve. You were told above that MR = AR = DD under perfect competition.

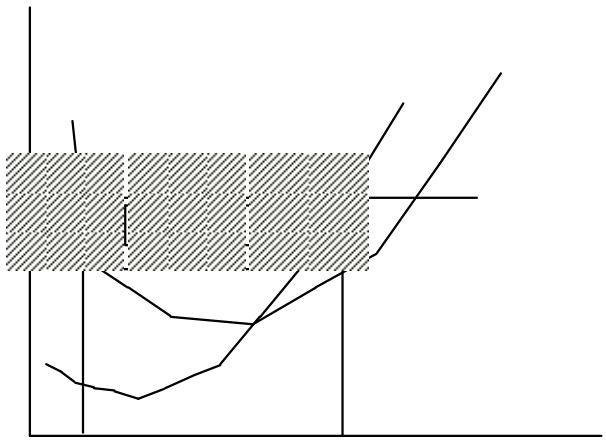


Figure 9.3:

The SMC curve cuts the ATC curve at it minimum from below; the two curves are U-shape, reflecting the low variable proportion in the short run. For this firm to produce OQe output, the firm incurred cost equal to the area AVQeO, the firm received revenue equal to the area PeQeO. The difference between revenue and cost is the shaded area PeVA which

is the profit. For a firm to attain equilibrium two conditions must be fulfilled. The first being that, MR = MC, this condition is satisfied at par e. The second condition is that at the point of intersection between MR and MC, the MC curve must be rising. The first condition is called the necessary condition while the second condition is called the sufficient condition for equilibrium.

From figure 9.3 any point to the left Qe, maximum revenue is not reached but MR > MC. To the right of Qe each additional output induces more cost than revenue. But exactly at Qe marginal revenue equals marginal cost, profit is maximized. The conditions are summarized thus:

(a) If MC < MR such as point e', the level of total profits has not been maximized. Therefore, it pays the firm to expand output beyond Qe'
(b) If MC > MR such as any point beyond Qe', total profit is being reduced and it is beneficial. For the firm to cut down its production.
(c) If MC = MR, such as point Qe the firm maximizes it short run profits.

The perfected competitive firm can also make just normal profit or make losses. These possibilities are explained in figure 9.4 a and b.

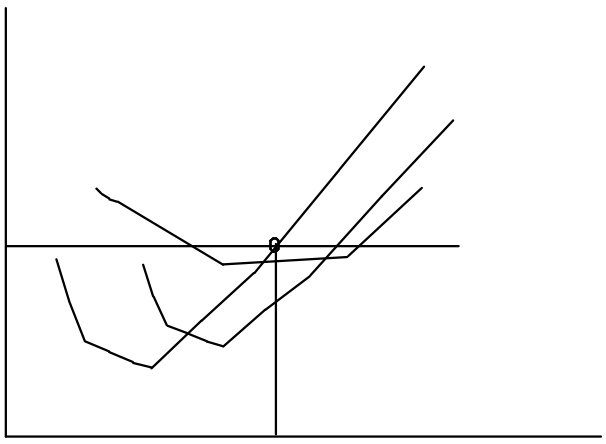


Figure 9.4:

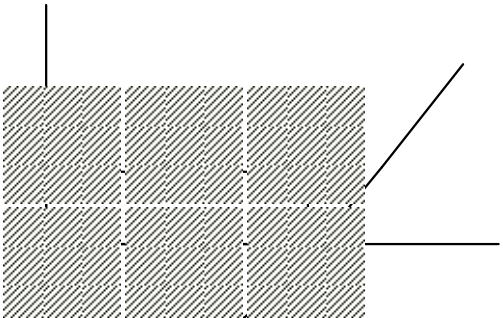


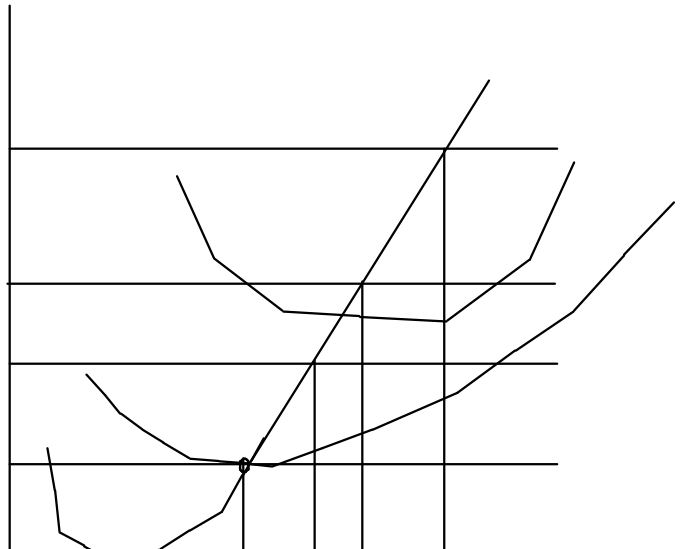
Figure 9.4a above shows that the firm is making just normal profits in the short run. The firm is in equilibrium at point R as it produces OQe at that MR = MC. Cost of production is measured by PRQeo while revenue is measure by the same PRQeo, this means that just normal profits are earned. In figure 9.4b, the firm is in equilibrium at point k, where MR = MC, but the price line and marginal revenue curve is not covering the SATC curve. The firm is covering Smc, but the SATC is paid by the management of the firm not from revenue accruing to the firm. As you can see revenue is measured by PKQeo while cost of production is represented by AUQeo losses = PKQe – AUQeo = AUKP the shaded area. If the firms' SAVC is constantly exposed that is if the firm cannot cover its SAVC, it will better for the firm to fold up.

SELF-ASSESSMENT EXERCISE 1

With the aid of a suitable graph, explain how a firm makes abnormal profit in the short run in a perfectly competitive market.

3.4 Short Run Supply Curve of Perfect Competition

We have seen above that the firm under perfect competition produces that amount of the goods at which marginal cost equals price or marginal revenue. Recalled too, that the price for perfectly competitive firm is given and constant. The price line is a horizontal straight line. The horizontal coordinate of a point on the rising MC curve measures the quantity of goods the firm will produce at that price. The short run marginal cost curve of the firm therefore, indicates the quantities which the firm will produce in the short-run at different price. See figure 9.5



This at the price OP, the firm will produce and offer for sale OQ quantity of the goods, at price OP, the firm will supply OQ1, price OP equals marginal cost at point A and point B for price OP1. Similarly, at price OP2, the firm produces OQ2 and OP2 equal MC at point C. Likewise, at price OP3 the firm will produce and supply OQ2. It is thus clear that short-run marginal cost curve of the firm is infact the short-run supply curve of the competitive firm. The firm will not produce any output at a price below P at any output below OQ, the firm will not cover its SAVC. Therefore, only the part of MC curve which lays above the average variable cost forms the short-run supply curve of the competition firm (from A – D) is the supply curve.

3.4.1 Mathematical Derivation of the Equilibrium of the firm

The firm's objective is profit maximization

p = TR – TC

Where p = profit

TR = Total Revenue

TC = Total cost

Both TR and TC are function of output (Q) given the price level.

The first order condition for the maximization of a function is that, its first derivation with respect of Q be equal to zero. Differentiating the total profit functions with respect to Q equal to zero, we have

$$\frac{dp(Q)}{dQ} = \frac{dTR(Q)}{dQ} - \frac{dTC(Q)}{dQ} = 0 \quad \ldots\ldots (1)$$

Or

$$\frac{dTR(Q)}{dQ} - \frac{dTC(Q)}{dQ} = 0 \quad \ldots\ldots\ldots\ldots (2)$$

Note: $\frac{dTR(Q)}{dQ} = MR$ and

$$\frac{dTC(Q)}{dQ} = MC$$

Therefore the first order condition for profit maximization is satisfied when MR = MC or MR – MC = 0 in equation 1 and 2 respectively

The second order condition for maximization of profits requires that the second derivation of the profit function with respect to Q be negative or less than zero.

$$\frac{d2p(Q)}{dQ2} = \frac{d2TR(Q)}{dQ2} - \frac{d2TC(Q)}{dQ2} < 0$$

Or

$$\frac{d2TR(Q)}{dQ2} < \frac{d2TC(Q)}{dQ2}$$

This implies that the slope of the MR must be less than the slope of the MC.

SELF-ASSESSMENT EXERCISE 2

Discuss the two conditions required for profit maximization in the short-run.

4.0 CONCLUSION

A perfectly competitive market is identified by some basic assumption, which includes many buyers and seller, free entry and exit, product homogeneity free flow of information etc. T he demand curve facing a competitive market is a horizontal straight line, which suggests that the perfect competitor is a 'price taker'. The price is set by the forces of demand and supply, and the firm at that price can sell any out of output. Two conditions must be satisfied to equilibrium to take place. First, MC = MR and secondly at the point of the intersection between MC and MR, the MC curve must be rising. In the short –run, the marginal cost curve is also the firms supply curve.

5.0 SUMMARY

This unit discussed and explained the concept of perfect competition and all the underlying assumption. The demand curve facing the competitive market was also explained. The short –run equilibrium conditions were highlighted and discussed. The unit equally analysed the short run supply curve of the competitive firm. The discussion of this unit ended with the mathematical derivation of the first and second order conditions of profit maximization of the firm. In the next unit, we shall be discussing long-run equilibrium of a perfectly competitive firm.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the basic assumptions underlying the existence of perfect competition.
2. Discuss the likely implication(s) of violating the first three assumptions on the demand curve faced by a perfect competitor.

7.0 REFERENCES/FURTHER READING

Akaahan, T. J. (2004). Principles of Microeconomics. Jos: Mono Expression Ltd.

Ahuja, H.L. (2008). Advanced Economic Theory: Microeconomic Analysis. New Delhi: S. Chand and Company Ltd.

Koutsoyiannis, A. (2003). Microeconomics. London: Macmillan Press Ltd.

UNIT 2 LONG-RUN ANALYSIS OF PERFECT COMPETITION

CONTENTS

1.0 INTRODUCTION

The long-run is a period of time which is sufficiently long to allow the firms to make changes in all factors input. In the long-run, all inputs are variable and none is held constant. The firms, in the long-run can increase their output by changing their capital equipment, they may expand their old plants or replace the old lower capacity plants with new higher-capacity plants or add new plants. In addition, new firms can enter the industry to compete with existing firms or old firms may reduce their output by reducing their capital equipment or sell out a party of the capital equipment in the long-run. Also, some firms may decide to quit the industry in the long-run.

Therefore, the L – R equilibrium refers to the situation when free and full adjustment in capital equipment as well as in the number of firms has been allowed to take place. In the L-R, it is basically the long-run average and marginal cost curves which are relevant for decision about equilibrium output in the L-R.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- analyse the conditions for L-R equilibrium in a competitive market
- explain zero economic profit in the L-R
- describe economic efficiency under perfect competition

- analyse numerical problems on competition market model.

3.0 MAIN CONTENT

LONG-RUN ANALYSIS OF PERFECT COMPETITION

3.1 Conditions for Equilibrium in Long-Run Competitive Market

As explained in our introductory note, for the firm to be in L-R equilibrium, besides marginal cost being equal to price, the price most also be equal to average cost. This is because if price is greater or less than the average cost, there will be the possibility of new firms to enter the market or old firm leaving the market respectively. If P > LAC, the firm will earn more than normal profit. These supernatural profits will attract more firm into the market. As new firms enter the industry the supply of goods will increase by the amount contributed by the new firms plus those of the old firms. The consequence is that increase in supply over demand will force price to decline and the cost of production will increase as a result of more intensive competition for factors of productions. As firms continue to enter price will continue to decline until P = LAC, such that all firms will earn only normal profits.

On the other hand, if P< LAC, the firms would make losses. These losses will induce some firm to quit the industry. As a result, the output of the industry will fall which will in turn raise price of the output. It is expected that cost will decline as a result of fall in the demand for factor input. Firms will continue to leave the industry until supply is less than demand and price equals LAC. So that the remaining firms will only earn normal profits. It therefore, logically follows that for a perfectly competitive firm to be in long-run equilibrium, the following two conditions must be fulfilled.

i. Price = Marginal cost; P = LMC
ii. Price = Average cost; P = LAC

If price is equal to both marginal cost and average cost, we have a double condition of long-run competitive equilibrium. Price = Marginal cost = Average cost. From our cost theory we know that MC = AC at the point where AC curve is minimum, therefore, the condition for long-run equilibrium of a firm can be expressed as: Price = marginal cost = minimum average cost

Figure 10.1: Represents long run equilibrium of the firm under perfect condition.

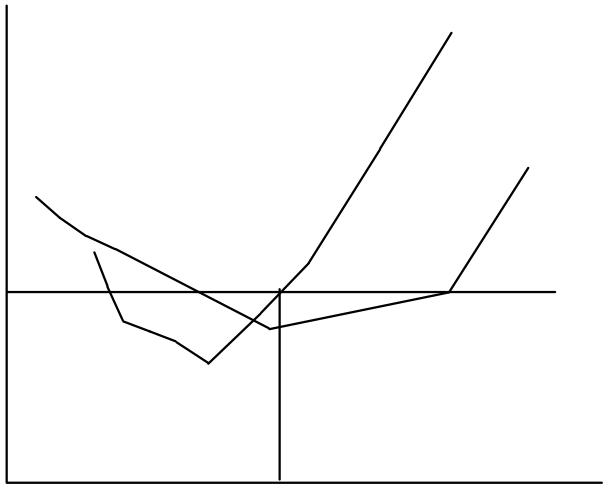


Figure 10.1:

If the price were to be above OP, the price line and marginal revenue would have lie somewhere above the minimum point of the LAC, the gap between the minimum LAC and price line will constitute abnormal profit. The excess profit will be wiped out by the influx of more firms and increase in cost of product. This will force price back to OP = Minimum ALC = LMC. If price falls below OP, it will imply that the price line which is equally the revenue line will lie below both the LMC and LAC. Since revenue is not covering cost, the result will be excess loses which in turn will lead to mass exodus of firm out of the industry. The exodus will lead to reduction in cost of production and output. A lower supply relative to demand will push back price to OP such that only normal profit will be earned. Operating at the minimum point of the LAC curve signifies that the firm is of optimum size, that is it is producing output at the lowest possible cost.

3.2 Long Run Survival of Firm with Zero Economic Profits

How do firms survive in the long-run earning zero economic profit? To explain this, we should remember the distinction between economic profits and accounting profits. We were told that accounting profits are measured by the difference between revenue and explicit cost (TR – TC = p). Whereas economic profits take into account the opportunity costs of self-owned factors employed by the entrepreneur in the firm and the managerial services rendered by the entrepreneur (wages of management) which are called normal profits.

Therefore, when we say firms earn zero economic profits, it means that they are earning a fair rate of return on capital invested and normal profits for the managerial services performed, which are included in the average cost of production. Thus, in the long-run competitive equilibrium, all factors including capital invested by the entrepreneur and their managerial services are rewarded equal to their alternative earnings elsewhere (opportunity cost). Let us look at it this way, assuming alternative earnings were to be higher than payments for capital invested by the managers and their services, they would disinvest in that industry and withdraw their managerial services, and invest their capital/services where earnings are higher. But where earnings are more than opportunity cost, the firm will earn economic profit (excess profits). The goal of the firm is to earn positive economic profits. It is the desire for the positive economic profits that motivates the entrepreneur to innovate and develop new ideas for commercial use so that they can lower cost of production or raise the demand for their goods. Figure 10.2 shows the L-R equilibrium of a competitive firm with zero economic profits.

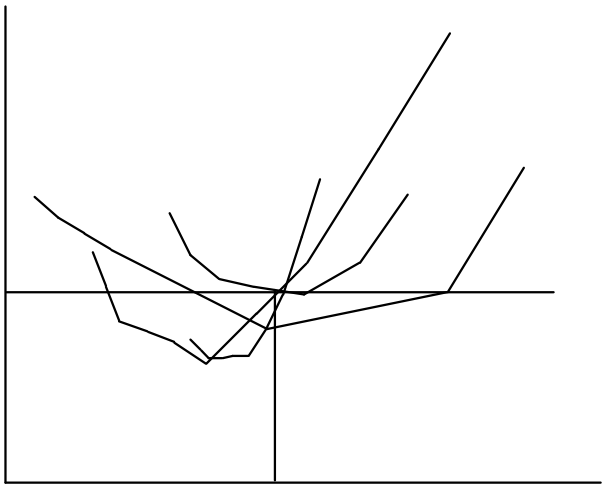


Figure 10.2:

It should be noted that zero economic profit is known as normal profits.
Firms survive and stay in the competitive industry because they earn normal profits where

P = SMC = SAC = MR = AR and
P = LMC = LAC = MR = AR

And there is no incentives for entrepreneur elsewhere than to stay.

In the long-run all necessary adjustments have been made, some firms have left the industry some other have entered. Excess losses and abnormal profits have been eliminated and normal profits or zero economic profits restored at point e as quantity Qe is produced.

SELF-ASSESSMENT EXERCISE 1

Discuss how firms in competitive industry arrived at zero economic profits.

3.3 Allocative Efficiency under Competitive Equilibrium

According to Ahuja, (2008:573) allocative efficiency implies the mutually beneficial exchange between consumers and producer of goods in a given society. This implies that both the consumer and producer are better off in participation in the exchange. It is belief that under conditions of perfectly competitive market, optimum production and exchange of goods takes place which ensures the achievement of maximum social welfare. This is demonstrated using the concept of producer and consumers surplus. Consumer surplus is defined as the gain in utility to a consumer over and above the market price the consumer really pays to obtain the goods from the producer/seller. On the other hand, producer surplus is measured by the excess revenue obtained by the producer over and above the sum of marginal cost (that is supply price) incurred by the producer in producing the quantity offered for sell. The consumer surplus is measure by the area under the demand curve, while the producer surplus is measure by the area under the price line.

Thus in figure 10.3 where the demand curve of the consumer and supply curve of the producer through their intersection at point E determined the market price OP and quantity OQ of the good produced and exchanged between them.

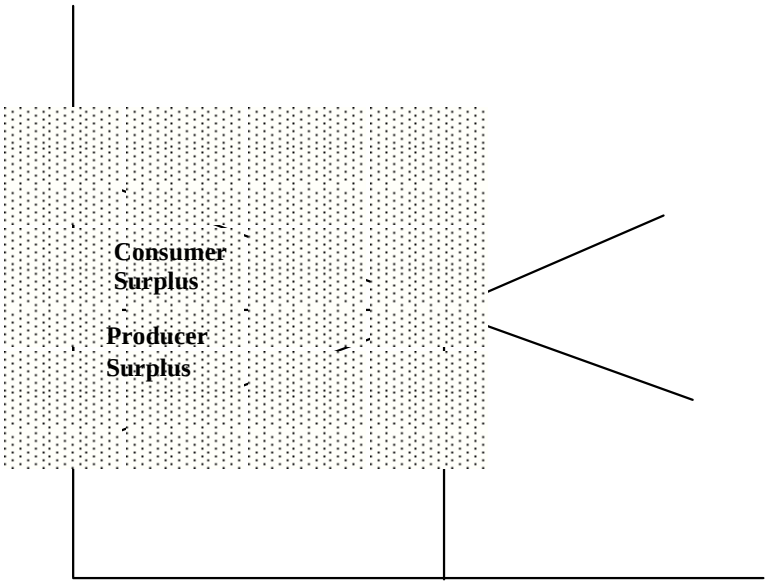


Fig. 10.3:

The consumer was willing to an amount represents by his DD curve but ended up paying OP, this leaves him with a surplus of equal to the area DPE, on the other hand the producer was willing to accept a price equal to his MC or supply cost but discover that consumers offered OP, his producer surplus equals the area PES. This measures excess revenue obtained by the producer over and above the sum of marginal cost or supply price incurred by the producer as he produces OQe

It follows from above, that both the consumer and producer gain from the exchange and production of goods. From the society's point of view, the total gain is the sum at consumer's surplus and producer's surplus. This is the areas DPE plus PES is known as the total economic surplus. It is called economic surplus because when consumers pay less and gain higher level utility, it implies increase in standard of living, more income will be save for investment. As producers earn above their supply, price more profits are obtained, the combine implications are that there will be increase in employment, investment more revenue to government through personal income tax and corporate tax and ultimately economic growth and development.

Another way of looking at the total economic surplus is to consider as the total benefits obtained from the consumption and producing OQe over and above the total variable cost of producing OQe. Thus the total benefit obtained by consuming OQe is the whole area ODEQe the area under the DD curve, while the area OSEQe is the sum of total cost of producing OQe. Therefore, the area DES measures the total surplus

which measures the net social benefit from producing and consuming OQe. The net social welfare is maximized only if there are no other alternative ways of producing and consuming this good to yield higher social surplus. If we discover that there are better ways through which this goods can be produced and consumed and higher surplus obtained then the output OQe determined by competitive equilibrium would not be efficient. This is because it would imply that there is an alternative that will make consumers and producers better off collectively than the present dispensation. If there is no alternative then resource allocation is economically efficient.

SELF-ASSESSMENT EXERCISE 2

Explain the process through which economic surplus is arrived at in a competitive market.

3.4 Numerical Problems under Competitive Market

We had seen the derivation of equilibrium of a competitive market in unit 9. We would like to apply the derivation in this section using numerical examples.

Example 1: A perfectly competitive firm is faced with the following cost function. TC = 2 + 4Q + Q2 and the price charged by the firm is N12.00k per unit.

i. Determine whether the firm operates in the short or long-run
ii. What output maximizes profits for the firm
iii. What is the maximum profit

Solution

i. The firm is operating in the long-run because the cost function has a fixed cost element represent by 2
ii. TR = P x Q
TR = 12 x Q = 12Q

Using the TR-TC approach

$$p = TR - TC$$
$$p = 12Q - (2+4Q+Q2)$$
$$12Q - 2 - 4Q - Q2$$
$$= 8Q - 2 - Q2$$

Profit will be maximized at the output level at which the first derivatives of the profits function with respect to output equal zero

$\frac{dp}{dq} = 8 - 2q = 0$

$8 = 2q$

$Q = 4$

Profit is maximized at Q = 4.

iii. $p = 12q - (2 + 4q + Q2)$

$p = 12(4) - (2+4(4) + 42)$

$p = 48 - 2 - 16 - 16$

$p = 48 - 34$

N14.00k

Example 2. Use the MC – MR approach for the question in 1 answer question ii – iii

Solution:

ii. $TR = P \times Q = 12Q$

$TC = 2 + 4Q + Q2$

To get the marginal revenue differentiate the TR with respect to Q

$\frac{dTR}{dQ} = 12$

To get the marginal cost differentiate the TC with respect to Q

$\frac{dTC}{dQ} = 4 + 2Q$

To determine the profit maximizing output MR – MC. Therefore,

$12 = 4 + 2Q$

$2Q = 12 - 4$

$2Q = 8$

$Q = 4$

iii. Substitute Q = 4 in the profit function

$p = 12 (4) -2 - 4 (4) - (4) 2$

$48 - 34$ p = N14.00k

Example 3: A firms total variable cost is given by the following

TVC = 75Q – 10Q2 + Q3. Assuming the market price is N45.00 is it advisable for the firm to produce the goods?

Solution

A firm produces a products only if the price of the product is equal or greater than the minimum average variable cost, AVC.

$$AVC = \frac{TVC}{Q} = \frac{75Q - 10Q2 + Q3}{Q}$$

$$AVC = 75 - 10Q + Q2$$

AVC is minimized at output level at which change in average variable cost as result an additional unit of output equals zero.

$$\text{Minimum AVC} = \frac{d(AVC)}{dQ} = 0$$

When we take the first derivation of AVC with respect to output (Q) we have

$$\frac{d(AVC)}{dQ} = -10 + 2Q$$

$$2Q = 10$$

$$Q = 5$$

AVC is minimum when output 5. Therefore minimum

$$AVC = 75 - 10(5) + (5)2$$

$$AVC = 75 - 50 + 25$$

$$100 - 50$$

Minimum AVC = 50

Since under perfect competition P = MR = AR it follows that the firm will be making losses because Min AVC > P = MR, the firm should not produce

N50 > N45.

4.0 CONCLUSION

The long-run competitive firm is characterized by free entry and exit. When all necessary adjustment are made by both new and old firms, decision about long-run equilibrium is based on the long-run average and marginal cost curves. The conditions necessary to establish a stable equilibrium in the long-run are: price equals long-run marginal cost and price must also equal - long-run average cost. The output in the L-R is produced at the minimum point of the LAC, which implies that the firm

is operating with optimal plant size. As a result, allocative efficiency is guaranteed under long-run perfect competition.

5.0 SUMMARY

This unit explained the meanings and condition under which long run equilibrium is attained. An analysis of the survival of competitive firm's earnings zero economic profits in the long-run is undertaken. The unit equally discussed consumers and producers surplus under allocative efficiency in competitive equilibrium. Finally, the unit ended with the analysis of numerical problem under perfect competition. In the next unit, you will be taken through a discussion on monopoly as a market model.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the conditions under which equilibrium is achieved in the long-run by a perfectly competitive firm.
2. Assuming the cost function faced by coca-cola plc is given as TC = 1000 + 2Q + 0.01Q2 and the price charged per bottle is N10.

Using the MC-MR approach, determine

i. The output that maximizes profit
ii. The maximum profit
iii. From the cost function differentiate between the total fixed cost and total variable cost.

7.0 REFERENCES/FURTHER READING

Ahuja, H. J. (2008). Advanced Economic Theory Microeconomic *Analysis. New Delhi: S. Chand and company Ltd.*

Akaahan, T.J. (2004). Principles of Microeconomic. Jos: Mono Expression Ltd.

Kontsoyiannis, A. (2003). Modern Micro Economics. London: Macmillan Press Ltd.

UNIT 3 LONG-RUN ANALYSIS OF PERFECT COMPETITION

CONTENTS

1.0 INTRODUCTION

Monopoly is a market model that exists when there is only one sole producer of a commodity or a single seller of a commodity with no close substitutes for his product. The monopolist has many buyers of his product. Unlike the perfect competition, there are strong barriers to entry into the industry of monopoly. Being the only producer/seller of a commodity without close substitutes, the monopolist is called 'price giver' and quantity adjuster. This implies that the monopolist has control over the output and can also influence the price of his commodity through adjustments in output. As a result, the monopolist has a downward sloping demand curve.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain the meanings and causes of monopoly
- describe the Demand and Revenue curve faced by monopoly
- analyse price and output equilibrium under monopoly
- explain the long-run equilibrium condition under monopoly.

3.0 MAIN CONTENT

Price & Output Determination under Short-Run Monopoly

3.1 Meaning and Causes of Monopoly

Monopoly is said to exist when one firm is the sole producer or seller of product which has no close substitutes. A firm under monopoly is equally an industry. In perfect competition many firm come together to form an industry, here, a firm is an industry. Monopoly means absence of all competitions. Given the demand curve, the monopolist can either set his price and sell the corresponding output or he sell the output defined by the point of intersection between marginal revenue and marginal cost, but he cannot influence the two at the same time. Being the only producer in the industry, the firm's demand curve is the industry's demand curve. From above, it follows that for the monopoly to exist, the following three conditions are necessary.

i. There is a single producer or seller of a product
ii. There are no close substitutes for the product
iii. Strong barriers to the entry into the industry exist

3.1.1 Causes of Monopoly

There are several factors responsible for the emergence of monopoly. These factors serve as barriers to the entry of new firms. We explain below some of the important factors that serve as barriers to the entry of new firms and therefore constitute sources of monopoly.

1. **Patent or copyright: A firm may possess a patent or copyright** which prevents others to produce the same product or use a particular production process. Generally, when firms introduce new products, they get patent rights from the government so that others cannot produce them. This is expected to serve as an encouragement to the firm for its invention, innovation help the firm to record its investment before other firms can come in.

2. **Control over Essential Raw Material: Control over essential** raw materials is a source of monopoly. For example, organization of petroleum exporting countries (OPEC) exercises monopoly power in the world over the supply of petroleum product.

3. **Grant of Franchise by Government. Another reason for** monopoly is the grant of franchise by government to a firm. A firm can be granted exclusive legal right to produce and distribute

a given produce in a particular region. For example the government of Nigeria has granted the exclusive right to Power Holdings Company of Nigeria (PHCN) to distribute electricity in Nigeria. Until deregulation of telecommunication industry, the franchise was granted to Nigerian Telecommunication (NITEL) Ltd to supply telephone services in Nigeria.

4. **Economies of Scale (Natural Monopoly): Another important** source of monopoly is significant economies of scale over a wide range of initial output. When a firm has grown so big and enjoys economies of scale, long-run average cost of production keeps on falling over a wide range of output and it reaches a minimum at an output rate that is large enough for a single firm to meet the entire market demand at a price that is profitable. Even if more than a firm exist, each firm must be producing at a higher than minimum level of cost per unit. In this case each of firm will change a price that is below the minimum LAC. This leads to price warfare and who survives in this economic warfare emerges as a monopoly.

5. **Advertising and Brand Loyalties. Strong loyalties to the brands** of the established firms and their heavy advertising campaigns to promote their brand are a factor that promotes monopoly. For example, strong loyalty of consumer to coca-cola made it difficult for other competitors to enter into the industry until Pepsi-Cola another soft drink giant came and broke the monopoly of Coca-cola. Besides, if well – established firms are expecting new potential competitors, they cut prices of their products so that potential competitors find it on unprofitable to enter the industry.

3.2 Revenue and Demand Curve of Monopoly

The demand curve of the consumer for a product under monopoly slopes downward, therefore the monopolist faces a downward sloping demand curve. If the monopolist wants to increase sales, he must lower the price. He can also raise the price if he is prepared to sacrifice some sales. A perfect competitor merely adjusts the quantity of output he has to produce, price is given and constant. But the monopolist encounters a more complicated problem. He cannot merely adjust quantity for a given price because each quantity change by the monopolist, will bring about a change in the price at which product can be sold consider figure 11.1

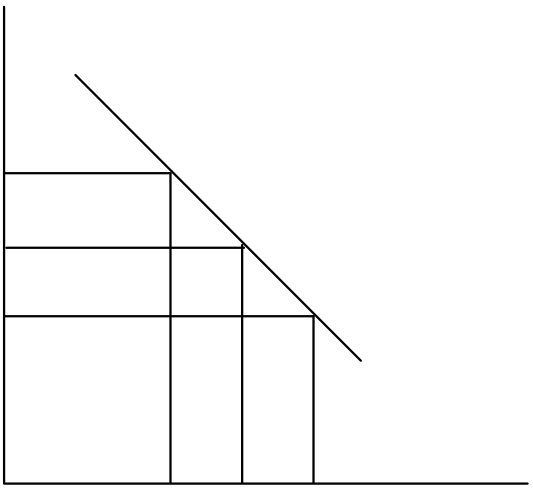


FIG.11.1: The Demand Curve Facing a Monopolist

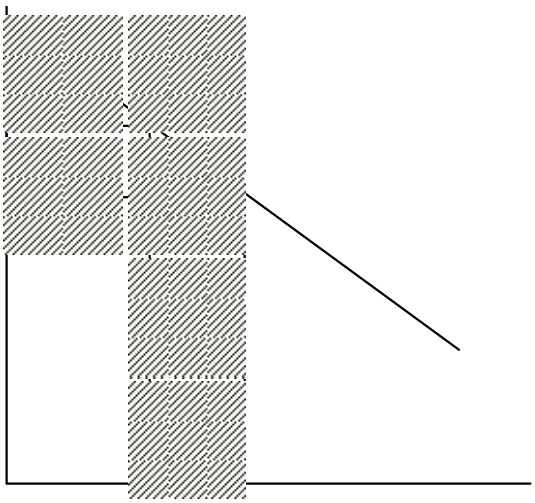


FIG. 11.2: Relationship Between Price and

This demand curve is represented by DD. At price OPo quantity demanded is OC. If he wanted to reduce sale volume, then price has to increase such as OP1 and quantity OA will be demanded for. Assuming he wishes to increase sales, price will be reduced to OP, so that quantity OB is demanded for.

Therefore, every quantity change by the monopolist entails a change in price at which the product can be sold. Thus, the problem faced by a monopolist is to choose the price quantity combination which is optimum for him or which yields him the maximum profits.

3.2.1 Marginal Revenue and Price under monopoly

Under monopoly, the downward sloping demand curve is equally the monopolist's average revenue curve. The relationship between price and marginal revenue is expressed thus:

$$MR = \frac{DTR}{Q} = \frac{(P.Q)}{Q}$$

TR stands for change in total revenue. From Fig 11.2 above where price falls from OPo to OP' the quantity demanded increased from Oqo to OQ'. The change in total revenue [TR or (PQ)] is equals to the gain in revenue from extra unit sold that is P' Q. Following the decline in price and loss in revenue incurred on all intra marginal units due to fall in price equals Q P. Thus, for some values of P and Q, the total change in revenue can be obtained as:

$$TR = P\,Q + Q.\,P$$

Dividing both sides by Q we have

$$\frac{TR}{Q} = P + Q.\frac{P}{Q}$$

$$MR = P + Q\frac{P}{Q}$$

Since the demand curve facing the monopolist is downward sloping, P is negative whereas Q is positive. The term Q P/ Q will be negative. It follows from the expression above that marginal revenue is less than price and lie below the demand and average revenue curve. Consider figure 11.3.

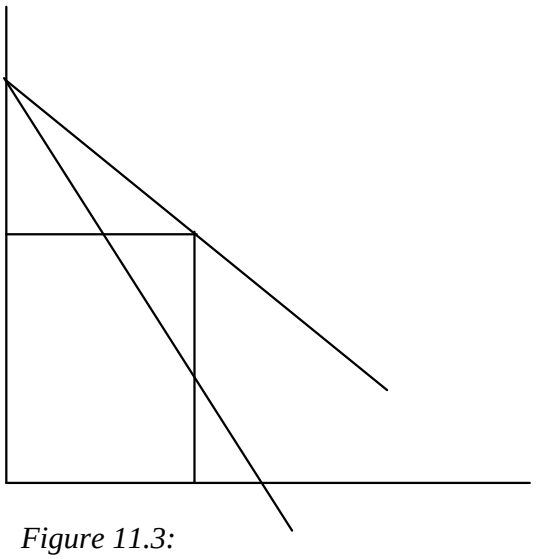


Figure 11.3:

The demand curve of the monopolist will be his average revenue curve which slopes downward throughout its length. We had see that MR < Price when the DD curve slopes down ward. Therefore, the marginal revenue curve will be below the average revenue curve. When the monopolist sells more, the price of his products falls, MR therefore, must be less than price. As seen from the figure 11.2, at quantity OQ, average revenue (or price) in QV or Opo and marginal revenue is Qs which is less than QV.

The monopolist has a clearly distinguished demand curve for his product which is identical with the consumer's demand curve for the product in question. Unlike other marketers, the monopolist does not consider the repercussion of a price change in upon other firms.

SELF-ASSESSMENT EXERCISE 1

Explain the nature of demand curve faced by a monopolist.

3.3 Short Run Price and Output Equilibrium of Monopoly

Like the perfectly competitive firm, the monopolist objective is profit maximization. Although, a perfect competitor faces a horinzontal demand curve where DD = P = MR = AQ. A monopolist faces a downward slopings demand curve or average revenue and his marginal revenue curve lies below the average revenue curve or demand curve. It is the difference in demand condition between the two that makes the difference in the result of their equilibrium even though they have the same motive; profit maximization. See figure 11.4 short run equilibrium

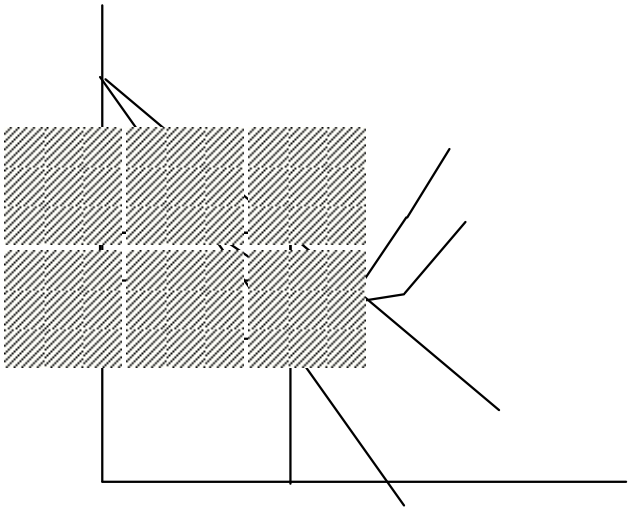


Figure 11.4:

The monopolist will continue to produce only if MR > MC. The reason being that, it is profitable to produce additional output if it adds more to revenue than to cost. Any output between O-Q, MR > MC, but maximum profit is not attainable at that range. Also any output to the right of Q, MC>MR, hence it is not rational to produce beyond Q. Therefore, the monopolist is in equilibrium where MR = MC. Output OQ is the equilibrium output, as MR intersects MC at point E. From the graph above, output OQ is sold at price OPA or QS, this implies that the monopoly will produce OQ and change OPA price. The average cost of producing OQ is QR while the average revenue is QS. Profit per unit or average profit is measured by RS. Total economic profits is PASRPO It is obtained by multiplying OQ by RS. If we use the TR-TC approach, we have TR = OPASQ, TC = OPoRQ, p = TR – TC = OPASQ – OpoRQ

p PASRPO

3.3.1 Price and Marginal Cost under Monopoly

Under monopoly, price is higher than marginal cost (P>MC). But under perfect competition, price equals marginal cost (P=MC). The demand curve of the monopoly is also his average revenue curve. The monopolist is in equilibrium when MR = MC, though, MR is less than price or (AR). From figure 11.4, at equilibrium, output OQ, MC = MR but lie below AR or price (QS = OPA). Therefore, price is greater than marginal cost, though, a relationship exist between price and marginal cost which is expressed thus:

Price = MR

Where e = elasticity

But at equilibrium

MR = MC

Since will be more than unity for a given value of elasticity, it logically follows that under monopoly P> MC

The extent to which price differs from MC will depend upon the value of elasticity (e) on the average revenue curve at the point corresponding to equilibrium. The precise extent to which P >MC will be given by the expression . The smaller the value of (e) the greater the expression, hence the greater will be price over marginal cost. Therefore, monopoly price is the function of MC of production and elasticity of demand. What we can deduce is that, the more inelastic the demand for monopoly product, the higher is the price he will charged, and vice versa. Since the monopolist has no close substitutes it is clear that the price elasticity of demand for his product is relatively inelastic hence, price is greater than marginal cost.

For example, assuming the price elasticity of demand for a monopolist product is e = 2, prove that price is greater than marginal cost, given that P = N12.00k.

Solution

P = MR At equilibrium MR = MC therefore

P = MC P = P = 2MC or ..... (1)

MC = MC = ½ P ..... (2)

From equation (1) 12 = 2MC MC =

MC = 6 From equation (2)
MC = ½ (12) MC = 6

Therefore, 12 > 6 P > MC

3.4 Long Run Equilibrium under Monopoly

In the long-run, the monopolist will make adjustment in the size of his plant. The long-run average cost curve and its corresponding long-run marginal cost curve portrays the alternative plants size to that of the short-run. The monopolist in the L-R will choose that plant size which is most appropriate for a particular level of demand. He will be in equilibrium at the level of output where his marginal revenue curve cuts the long-run marginal cost curve. Fixing output at which MR = L-R MC shows that the plant size has been adjusted away from initial MR = SMC. It is natural that the plant size chosen in the L-R is the most optimum for the demand facing the product of the monopolist. From figure 11.5, in the L-R marginal revenue is also equal to short-run marginal cost curve. Though this SMC curve is of the plant which has been selected in the long-run, keeping in view the given demand for the product. Thus, while in the short-run MR = SMC of a given existing plant, in the L-R MR = LMC as well as to the SMC of that plant which is appropriate for a given demand for the product in the L-R

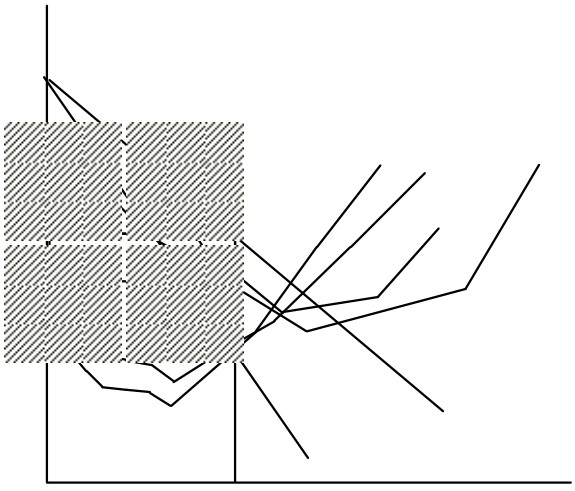


Figure 11.5:

It is important to understand that in the L-R, the firm will operate at a point on the LAC curve at which the SAC is target to it at point (R). This is so, because it is only at the tangency point (R) that SMC of the optimum plant equals the LMC at point (e). Figure 11.5 portrays the long-run equilibrium of the monopoly. His equilibrium output is OQ at which LMC = MR. Given the level of demand as indicated by positions of AR and MR curves, he would chose the plant size whose short-run average and marginal curves are SAC and SMC. He will be charging Qs or OP1 and will be making profits equals PISRP. It therefore, follows that the monopolist profit maximization in the L-R must fulfil the condition below. That at equilibrium

MR = LMC = SMC

SAC = LAC

P > $\underline{L}$ A C

Remember that a firm under monopoly is equally the whole industry, such that there is no entry or exit or much adjustment for the monopoly in the long-run. Therefore, the deviation between the plant size in the short-run is not much different from that of the long-run. Imagine a monopoly that came into existence through economies of scale, he would have started operations as a monopolist with a large plant size such that the plant size in both short and long-run may not differ significantly, hence, the three conditions above hold. (MR = LMC = SMC, SAC = LAC).

SELF-ASSESSMENT EXERCISE 2

Explain why the short run marginal and average cost curves are still relevant in the long-run under monopoly.

4.0 CONCLUSION

Monopoly is a market structure where there is only one producer or distributor of a good exist without close substitutes and there are barriers to entry in the industry. Monopoly emerges through any or some combinations of these factors; patent right, control over essential raw materials, granting of franchise by government, economies of scale and brand loyalty. The demand curve of the monopolist is downward slopings, which means he is a price giver and quantity adjuster. Monopoly price is always higher than marginal cost in the short-run but in the long-run, price is greater or equal long-run average cost (P > LAC).

5.0 SUMMARY

A discussion on the meaning and cause of monopoly has been undertaken in this unit. The nature of demand curve of a monopolist is found to be downward sloping with the price above marginal revenue. The monopolist is in short-run equilibrium where SMC = MR. Unlike perfect competition, monopolist price is greater than MC. The Long-run equilibrium of the monopolist has been analysed, it is observed that the SMC and SAC are still relevant in the determination of long-run equilibrium of the monopolist.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss the differences between monopoly and perfect competition.
2. Assuming a monopolist charges N17.00 for his product, given that the price elasticity of demand for his product is e=2.5 prove that price is greater than marginal cost and also determine the value of MC.

7.0 REFERENCES/FURTHER READING

Ahuja, H. J. (2008). Advanced Economic Theory Microeconomic *Analysis. New Delhi: S. Chand and Company Ltd.*

Kontsoyiannis, A. (2003). Modern Micro Economics. London: Macmillan Press Ltd.

MODULE 4

UNIT 1 PRICE DISCRIMINATION AND BILATERAL MONOPOLY

CONTENT

1.0 INTRODUCTION

This unit deals with the other aspect of monopoly, these include price discriminatory monopoly bilateral monopoly and mathematical analysis of price and output under monopoly. However, price discrimination refers to a marketing strategy adopted by a monopolist in which the monopolist sales the same product at different prices to different buyers while bilateral monopoly is a market situation where a single seller of a commodity has only a single buyer of his product. The single seller is called a monopolist and the single buyer is called monopsonist.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain the concept of price discrimination
- describe the operation of bilateral monopoly
- analyse the applicability of price discrimination
- explain the mathematical analysis of price and output under monopoly.

3.0 MAIN CONTENT

Price Discrimination Bilateral Monopoly

3.1 Meaning of Price Discrimination

Price discrimination according to Ahuja (2008:670), refers to the practice of a seller selling the same good at different prices to different buyers. A seller makes price discrimination between buyers when it is both possible and profitable for him to do so. For example, if a farmer sells a bag of rice at N7,000 to one buyer and at N10,000 to another buyer in the same market, he is practicing price discrimination. Thus Professor Stigler defines price discrimination as "the sales of technically similar products at prices which are not proportional to marginal cost". Note, the discriminatory monopolist does not necessary charge higher prices to the two or multiple customers, the price charged to buyer A may be lower than marginal cost and that of buyer B could be higher than marginal cost. The price charged depends on his motive, ranging from sales maximization, profit maximization and competing for a larger chung of the market.

Although, price discrimination is more easily implemented by a monopolist because he has full control over the supply of a given community, this price policy is quite common among most firms, which charge different prices and give different discounts to their customers depending on the item they purchase, length of time they have patronized the firm, their location and other factors. There are conditions that are necessarily important for the implementation of price discrimination.

i. The market must be divided into submarkets either based on income of consumers or based on location of consumers. Also, the nature of price elasticity of demand for the product in each market is important. A sub-market with highly elastic demand will be charged lower price since price sensitivity of consumers suggest that there is or are substitutes. A sub market with inelastic demand will be charged higher price, this is because consumers show insensitivity to price change either because of highly developed brand loyalty or because there are no close substitutes.

ii. There must be clear separation of the sub-markets and if possible there should be reasonable distance between the two sub markets. This is to avoid a situation where a consumer will buy the product in the lower price sub-market and sell it in the higher price market. Price discrimination is more effective, when dealing with goods and services that are consumed by the buyer and cannot be resold directly, for example, electricity,

entertainment, transportation, services of doctors and teachers etc. It should be emphasised that price discrimination is profitable only if elasticity of demand is one sub-market is different from elasticity of demand in the other sub-market.

3.2 Application of Price Discrimination: International Trade (Dumping)

The theory of pricing of a discriminating monopolist has an important application in the field of international marketing. Dumping occurs when a producer sells a commodity in a foreign country at a price that is lower (net of transportation cost and tariffs) than the price he changes in the domestic market. Price discrimination of dumping is possible because domestic and foreign markets are separated from each other on the basis of geographical distances; tariff and quota etc. consider a monopoly producer in a domestic market who is facing other competitors in the international market. In this situation, it is expected that price elasticity of demand will be higher (elastic) in the foreign market and inelastic (low) in the domestic market for his product. See figure 12.1

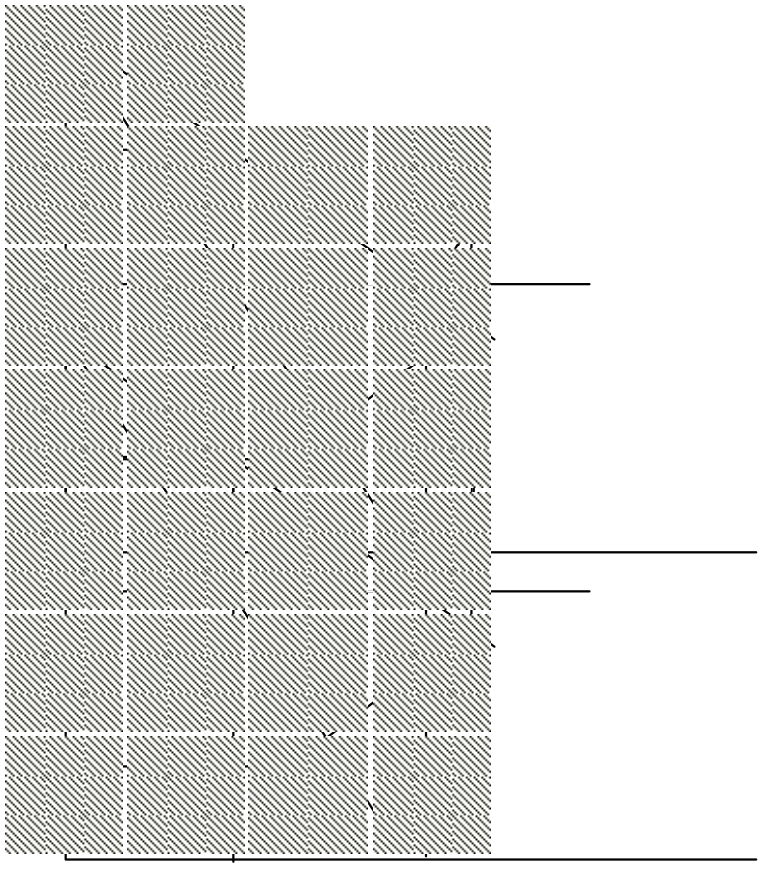


Figure 12.1:

In the domestic market where the producer has monopoly power the demand or average curve is downward sloping so also is the shape of the domestic marginal revenue (MRD). In the foreign market where the producer faces perfect competition, the demand or average or marginal revenue curve is horizontal or perfectly elastic, ARF = MRF = DF where (F) stands for foreign. The aggregate marginal revenue curve in this case is the composite curve BREDF which is the lateral summation of MRD and MRF. The Marginal Cost (MC) intersects the aggregate marginal revenue curve at point E and equilibrium output OQ2 is determined. The price discriminator will divide this total output OQ2 between the domestic and foreign markets in such a way that marginal revenue in the two markets are the same and equal to the marginal cost (Q2E). When he sells output OQ, in the domestic markets, the marginal revenue is Q1R, which is equal to marginal cost (Q2E). At the domestic market, price OPD will be charged and the demand in the domestic market is given by ARD. The remaining output Q1Q2 will be sold in the foreign market at price OPF. Since the producer faces other competitors abroad, his demand curve is horizontal and DF = ARF = MRF.

Total profit is measured by the shaded area XERB for the two markets. When dumping is undertaken by a firm for profit maximization like in this case, it is called 'persistent dumping'. On the other, if dumping is undertaken to capture or dominate the foreign market or price other competitors out of business, it is called 'predator dumping'. The predator dumping is achieved when a producer sells his product in a foreign market at a lower price in order to eliminate competitors, when he succeeds in gaining control over both the domestic and foreign consumers he then exploit the foreign consumers by raising the price of his product and thus maximizes long-run profit besides establishing monopoly power in the foreign market.

SELF-ASSESSMENT EXERCISE 1

Discuss the concept of dumpings in international trade as it relates to price discrimination.

3.3 Bilateral Monopoly (Price & Output)

Bilateral monopoly is a market situation in which one producer/seller (monopolist) faces a single buyer/consumer (monopsonist). One important features of this market is that, both the producer and consumer have equal bargaining strength; no one dictates the pace of affairs in this market. It has been said that price and output determination is not based on economic theory; it takes political and social factors to reach an equilibrium in this market. Consider figure 12.2.

To the consumer, DD is his demand curve, which is based on his marginal utility curve. This demand curve becomes the average revenue curve of the producer since he has only one consumer. The marginal revenue curve (MR) of the monopolist as usual lies below his AR curve MSP = Marginal Supply price and ASP = Average Supply Price. The monopsonist is likely to assume that he has power to set price subject to the cost condition of the producer, in such a case, he will consider the MC curve as the supply of monopolist for the product. If the buyer thinks he can force his price on the producer, then the producer is expected to supply to the consumer an output at which MC = P where P, is the price set by the monopsonist. In such a situation, the producers MC becomes his average supply price at which various corresponding quantities would be offered to the consumer. The ASP for the consumer rises as he consumes more quantities of the goods, also the marginal supply price MPS curve which is also called the marginal supply cost will lie above the ASP curve. If the producer thinks he has his usual monopoly power to set a price and adjust quantity to maximize profits, he must produce an output that equates MC to MR (MR = MR) In this case, above, he will produce OQ1 and set price OP, with equilibrium at R where MC = MR.

However, if on the other hand, the buyer thinks he has power to set price such that he can maximize utility, he will equate his marginal supply price (MSP) with his marginal utility (ie the price he is prepared to pay). Since DD indicates his marginal utility or the price he is ready to pay, he will maximize utility by purchasing OQ2 and pay OP2, the consumer's equilibrium is established at point K. It is clear from here that there exists a price and quantity gap in the market. The producer wants (OP1).

Both the buyer and the seller think themselves as price givers and therefore, act independently. We know that trade cannot take place except there is an agreement between the producer and buyer on both price and quantity. Now, the forces of demand and supply cannot determine equilibrium, the only option left is for the two parties to enter into negotiations.

The actual price that they will both settle for, will be somewhere between Op1 and OP2. Economic theory is inefficient in determining price and output in a bilateral monopoly. The actual price they may eventually reach out will depend on individual bargaining power, political/social standing in the society and perhaps public opinion. An example of this market is that of Federal Government of Nigeria (FGN) as single employer of lecturers and Academic Staff Union of Universities (ASSU) as single supplier of qualified lecturers in Nigeria.
In conclusion, price and output under bilateral monopoly is in determinate.

3.4 Mathematical Derivation of Equilibrium of The Monopolist

The major objective of monopolist is profit maximization. Given his profit function

$p = TR - TC$

Profit is maximized when MR = MC

When we differentiate the profit function with respect to Q we get

$$\frac{dp}{dQ} = \frac{dTR(Q)}{dQ} - \frac{dTC(Q)}{dQ} = 0$$

$$\frac{dTR(Q)}{dQ} = \frac{dTC(Q)}{dQ}$$

Where

$$\frac{dTR(Q)}{dQ} = MR \text{ and}$$

$$\frac{dTC(Q)}{dQ} = MC$$

The second order condition requires that the slope of MR be less than the slope of MC

$$\frac{d2p}{d2Q2} = \frac{d2TR(Q)}{dQ2} - \frac{d2TC(Q)}{dQ2} < 0$$

Therefore, $\frac{d2TR(Q)}{dQ2} < \frac{d2\,TC(Q)}{dQ2}$

Assuming a monopolist is faced with the following demand and cost function P = 120 – 5Q and TC = 40 + 20Q Determine (i) The market price and output (ii) the maximum profit.

Solution

(1) p = T R – TC =

TR = P.Q

TR = (120-5Q)Q

TR = 120Q-5Q2

$MR = \frac{dTR}{dQ} = 120 - 10Q$

$MC = \frac{dTC}{dQ} = 20$

MR = MC at equilibrium

120 – 10Q = 20

120 – 20 = 10Q

100 = 10Q

Q = 10

Substitute Q into the demand or Price function

P = 120 – 5 (10)

P = 120 – 50

P = N70

ii.

Total revenue is P x Q

TR = 70x10 = N700

TC = 40 + 20 (10)

TC = 40 – 200

TC = 240

p = TR – TC

p = N460.00k

A price discriminating monopolist charges two different prices for his product as follows

P1 = 14 – Q1

P2 = 22 – Q2 his cost function is given as TC = 4 + 4Q calculate

(i) Price and output in market 1 and 2

(ii) Determine the total profits of the discriminating monopolist

Solution

Product maximization requires that:

MR1 = MR2 = MC that is marginal revenue in the two markets equal is marginal cost.

TR1 = P1 x Q

TR1 = 14Q-Q2

TR2 = P2 x Q

TR2 = P2 x Q

TR2 = 22 Q – Q2 2

$MR1 = \frac{dTR1}{dQ} = 14 - 2Q1$

$MR2 = \frac{dTR2}{dQ} = 22 - 2Q2$

TC = 4 + 4Q

$MC = \frac{dTC}{dQ} = 4$

To find Q1

MR1 = MC

14 – 2Q1 = 4

14 – 4 = 2Q1

Q1 = 5

To find Q2

MR2 = MC

22-2Q2 = 4

22 – 4 = 2Q2

Q2 = 9

To find P1 substitutes

Q1 in the 1st Price function

P1 = 14 – 5

P1 = 9

To find P2 substitutes

Q2 in the 2nd price function

P2 = 22 – 9

P2 = 13

ii. The grand profit is

p = (TR1 - TR2) – TC

TR1 = P1 x Q1 = N45

TR2 = P2 x Q2 = N117

TC = 4 + 4 (5 + 9)

TC = 4 + 56

TC = N60

p = 45 + 117 – 60

p = 162 – 60

p = N102

4.0 CONCLUSION

Price discrimination is possible and profitable if the sub-market are separated from each other and each sub market has a different price elasticity. Because the monopolist is the sole supply of the product he can afford to treat customers differently. Dumping in international trade is a good sample of how a price discriminating monopolist operates and charges two different prices for his products, a lower price abroad. Bilateral monopoly simply means the existence of two monopolists the one from the supply side is the monopolist while the one from the demand side is called monopsonist. The buyer and the seller in this market have equal bargaining power, therefore, price and output under bilateral monopoly is indeterminate.

5.0 SUMMARY

This unit examined the existence and operation of price discrimination monopoly Explanation was made for the condition necessary for the application of price discrimination. These conditions are that the market must be divided into sub-markets and secondly, there must be effective separation of the sub-markets. A discussion on the meaning and output price determination of bilateral monopoly was undertaken. We defined bilateral monopoly as a market where a single buyer and a single seller exist. Economic theory does not determine price and output in this market. The unit ended with the analysis of mathematical derivation of equilibrium of the monopolist.

6.0 TUTOR-MARKED ASSIGNMENT

1. Carefully explain the conditions under which price discrimination is possible and profitable.
2. A monopolist is faced the following price and cost functions

$$P = 18 - 0.05Q$$

$$TC = 6Q + 0.05Q2$$

i. Determine the output and price charged by the monopolist
ii. Calculate the maximum profit
iii. State with reason(s) whether the monopolist is operating in the short or long-run.

7.0 REFERENCES/FURTHER READING

Ahuja, H. L. (2008). Advanced Economic Theory Microeconomic *Analysis. New Delhi: S. Chand and Company Ltd.*

Akaahan, T.J. (2004). Principles of Microeconomic. Jos: Mono Expression Ltd.

Kontsoyiannis, A. (2003). Modern Micro Economics. London: Macmillan Press Ltd.

UNIT 2 OLIGOPOLY

CONTENTS

1.0 INTRODUCTION

We have analysed two forms of market structure perfect competition and monopoly, where there is only one large firm in the market. However, much of the world fits in between these two extremes. Often there are a number of competitors in the market but not so many that we can regard the contribution of individual competitor as insignificant in the market. This is the situation known as oligopoly.

Oligopoly is said to prevail when there are few firms or sellers in the market producing or selling a product. In other words, when there are two or more than two, but not many, producers or sellers of a product, oligopoly is said to exist. In this unit, we shall be discussing some models of oligopoly and how output price is determined.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain the meaning and features of oligopoly
- discuss non-collusive oligopoly
- analyse collusive oligopoly
- mathematically explain output determination under oligopoly.

3.0 MAIN CONTENT

Price and Output Determination under Oligopoly

3.1 Basic Features of Oligopoly

Oligopoly as a market model is defined as a market situation characterized by a few number of sellers facing a large number of buyers. Oligopoly can be classified into pure or differentiated oligopoly. Pure oligopoly refers to a situation where firms sell homogenous products. On the other hand, if the firms are selling differentiated products, it is called differentiated oligopoly. Under oligopoly, the firms are aware of their inter-dependence, the pricing policy of one firm affects the behaviour of other competitors. Oligopoly has the following characteristics.

i. **Interdependence: Firm under oligopoly are interdependent in** terms of decision making. This is because when the number of competitors is few, any change in price, output, product etc by a firm will have a direct effect on the fortune of its rival, which will then retaliate by changing their own price, output, or products as the case may be. A good example is that of the firms in Nigeria's telecommunication industry. MTN as a firm cannot just fixed price without considering the reaction of other firms in the industry such as Zain, Glo, etc. If MTN increases its tariff, the other firms may reduce their tariff to attract customers to themselves and away from MTN. On noticing that it is losing its customers to other competitors, MTN will react by cutting price or tariff below that of its rivals to gain back its customers. It is therefore, clear that oligopolistic firm must consider not only the market demand for the industry's product but also the reactions of other firms in the industry to any action or decision it may take.

ii. **Keen Competition: A direct effect of interdependence of** oligopolists is that the various firms have to employ various aggressive and defensive marketing weapons to gain greater share of the market or to prevent a fall in the share. As a result, various firms have to incur a good deal of cost on advertising and on other measure of sales promotion. Take the case of firms in the soft drinks industry, they spend huge money on advertisement e.g. coca-cola and pepsi cola. The 'competition is so fierce that the firms have 'reactions' curves instead of demand curves. To the oligopolist, true competition consists of the life of constant struggle, rival against rival. Those who cannot survive the

competition will fold up or will be acquired by stronger firms. For example, Limca cola has been acquired by Coca-cola and M-tel could not survive the competition in the telecommunication industry.

iii. Group behaviour: The theory of oligopoly is a theory of 'group behaviour' not of mass as in the case of perfect competition or individual behaviour as in the case of monopoly. Because of their interdependence, it is difficult to determine an individual firm's price and output or even profit maximization in isolation of the behaviour of other firms in the industry. Therefore, oligopoly is studied under 'group behaviour' not as an individual firm. Even so, there is no generally accepted theory of group behaviour. For example, do the members of a group agree to pull together in promotion of common interest or will they fight to promote their individual interest. Does the group possess any leader? If so, how does he get the others to follow him? These are some of the many questions that need to be answered by the theory of group behaviour.

iv. Barrier to Entry: In the long-run only few firms will survive, these surviving firms will earned super normal profits, enjoy economies of scale which will result in lower cost of production. They may also have monopoly control over some essential sources of raw material including patent rights and absolute cost advantage over new entrants. All these will prevent and discourage new entry into the industry.

SELF-ASSESSMENT EXERCISE 1

Mention and discuss the features of an oligopoly

3.2 Non-Collusive Oligopoly Model

3.2.1 Cournot's Duopoly Model

The simplest form of oligopoly is called Duopoly, developed by a French Economist, Augustine Cournot in 1838. Cournot's model is based on the assumption that, there are only two firms A and B, each owning a mineral well with zero production costs. This assumption was made just to simplify the analysis. Each Duopolist knows the market demand for mineral water; they can see every point on the demand curve. The market demand curve for each firm is linearly a straight line and each firm acts on the assumption that its rival will not change its price or output. Give the demand function $Qd = 100 - 4P$, this implies

that no one pay more than N4.00k and no one would buy more than 50 units (See fig 13.1).

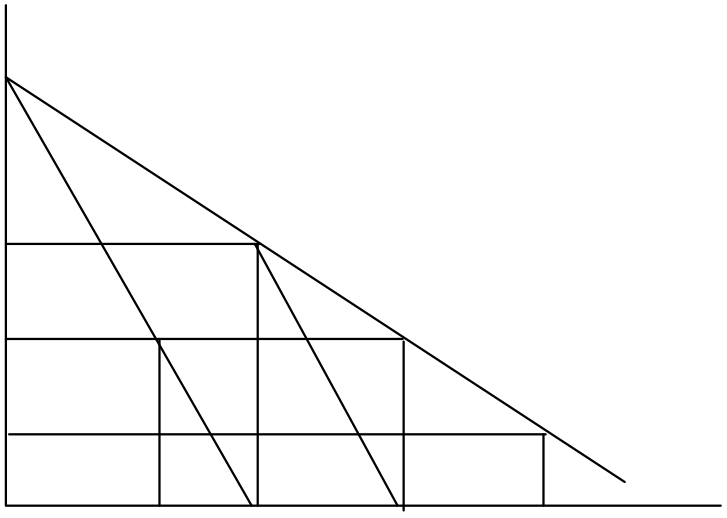


Figure 13.1:

Suppose the demand curve facing the two firms is a straight line DD, each firm is expected to have a maximum daily output of 50 units which will add to 100 units. If output 100 unit is to be produced and offered in the market, the price will be N00.00k zero. Let us assume that firm A is a monopoly. Firm A will produce 50 units which is his daily output and change N2 as price, his profits will be N100 = (2 x 50). Since there is no cost of production, total revenue equals profits. Supposing, the second firm enters the industry and noticed that firm A is producing 50 units, based on Cournot's behavioural consumption, firm B belief that firm A will sustain the output for a long time regardless of what output firm B will produce, firm B will therefore, regard KD as his own demand curve and will produce 50 units (½ 100). Total output will be 100 that is, 50 + 50. The law of demand comes in; price falls to 50 kobo as a result of increase in output. Total profits for the two firms will be N50.00, profits for firm A is 5k x 50 = N25.00 and that of firm B is N25 too. The profits of firm A has reduced as a result of firm B entering the industry. Firm A has lost N75.00k. Because of the naive assumption of the Cournot model, firm A will assume that firm B will continue to produce 50 units, now the best firm A can do is to produce half of what firm B produce ½ (50) = 25 units. Firm B will be surprise by A's action of reducing output, firm B will therefore adjust his too.

As if firm B has not learned any lesson, he still believes that firm A will continue to produce 25 units. Firm B will get his maximum profits by producing output equals to ½ (100-25) = 37.5 units. In this case, B's profits will be greater than that of A. Firm A will counter firm B's moves by increasing its output, as he produces an output equals to ½ (100-37.5) = 31.3. This process of adjustment and readjustments by each firm continues. As firm A is force to reduce its output gradually while firm B increases it output until the total output of 75 units is produced (75= ¾ 100). This means that each firm will produce the same output equal to (1/3 100). Finally, firm A and B will produce 37.5 units each and N1.00 will be the price. This output will give the maximum profits as adjustments are exhausted, therefore, there will be no incentive for any firm to adjust its output further. There are other forms of duopoly model such as Betrand, Edgeworth Chamberlain and Stackleberg Doupoly models, they are all example of non-collusibe oligopoly.

3.3 Cullusive Oligopoly Model

One way of avoiding the uncertainty arising from oligopolistic interdependence is for the firms to enter into collusive agreements. There are two main types of collusion, cartels and price leadership. Both forms generally imply tacit (secret) agreements among member firms.

3.3.1 Cartels

A cartel is a formal association of firms in an industry who came together for the purpose of joint maximization of their profits or sharing the market. The joint profits cartel occurs when all the firms in the industry are producing homogenous product, the aim of the cartel in this case is the joint profit they expect to maximize jointly which may be less if they were operating individually. In pursuance of their goal of profit maximization, the firms appoint a central agency to which they delegate the authority to decide the total quantity and price at which they must sell so as to attain maximum profits. The central agency also allocates production quota among the member of the cartel. This is done through the assessment of cost curve and marginal revenue of individual firms.

Given this condition and prices of factor inputs, the cartel maximizes its profit by producing at the level of output where the summation of all the marginal costs of the firms in the industry intersects the marginal revenue curve as shown in Fig. 13.2 where SMC = MR at point (E).
The profit maximizing

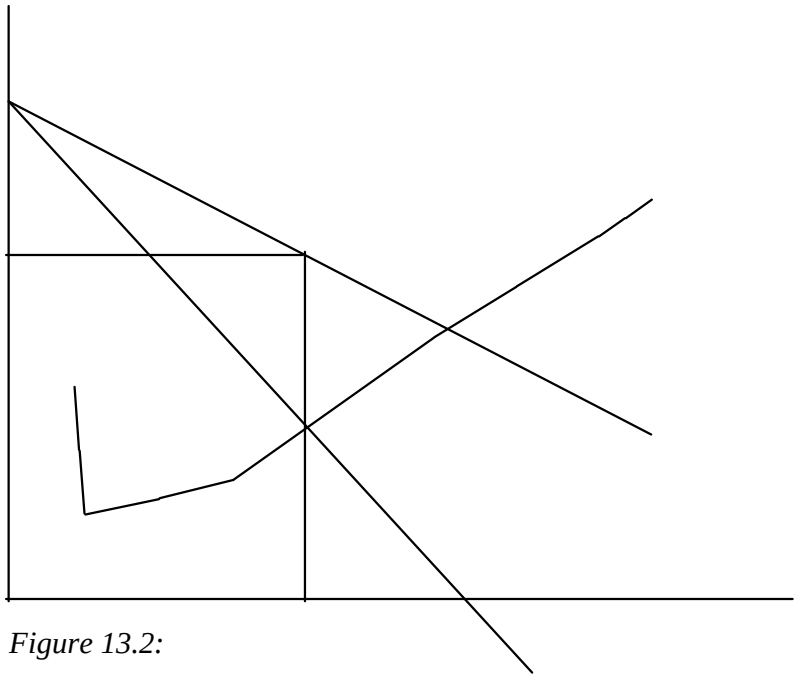


Figure 13.2:

Output is Qf, this output is the summation of the output of all the individual firms. The cartel price is P which covers the average cost adequately, suggesting excess profits. Sharing of these profits is however, at the discretion of the central agency of the cartel.

3.3.2 Price Leadership

Price leadership is an informal position of a firm in a oligopolistic setting permitted to lead other firms in pricing. This form of oligopoly allows one firm to set the price and the others follow, either because the other firms feel it is advantageous to them or because they are avoiding uncertainty and risk. It could be that they are not capable of predicting their rival's reaction. Therefore, they follow the pricing policy of their leader, even if it implies forfeiting their profit maximizing position. Price leadership is possible under both product homogeneity and product differentiation. The three common types of price leadership models identified by traditional theory includes

a. Price leadership by low cost firm
b. Price leadership by a dominant firm
c. Barometric price leadership

The analysis of price leadership is based on the following assumptions:

- There are only two firms

- They produce homogenous product
- They have different cost of production
- The leader sets his price based on the output at which MR = MC
- The firms may collude to share the market with unequal shares.

Given these assumptions, the price and output determination under price leadership of a low cost firm is as shown in Fig. 13.3

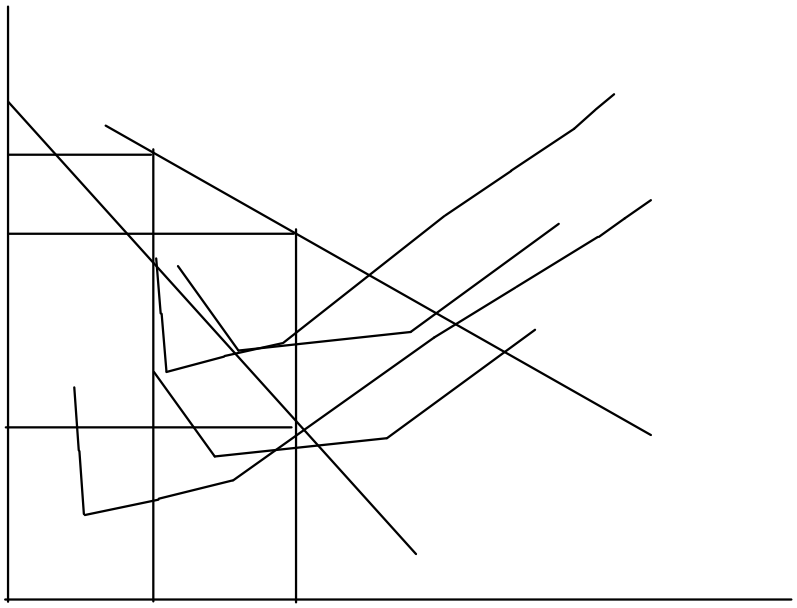


Figure 13.3:

Assuming all the firms face identical revenue curves as shown by AR = D and MR. The largest firm or the low cost has its curves represented AC, and MC1. All other competing firms, with smaller capacities have their cost curves indicated by AC2 and MC2. This implies that the larger firm enjoys economies of scale with lower per unit cost than other firms. Given these advantages, the low cost firm find its profitable to fix it price at OP2 and sell output OQ2 at the point where MR = MC, and profits are maximum.

On the other hand, the high cost firms will maximise profit by charging OP3 for output OQ1, however, it is expected that they will lose their customers to the low cost firm because of high price charge (OP3). As a result, the high cost firms are forced to accept OP2 and recognize the price leadership of the low cost firm. If the lower cost firm so wish, it can eliminate other firms and become a monopoly by fixing a price so low that other smaller firms cannot sustain. We also have price leadership by a dominant firm and price leadership by Barometric firm. All these models have the same analysis and conclusion. These models

assume the existence of a powerful firm with considerable size and share of the market and the firm also has a fair knowledge of the operation of the market, therefore, the smaller firms look up to the bigger firm in terms of pricing and output policies. In both cases the bigger firm becomes measuring rod, through which the smaller firm assess themselves.

SELF-ASSESSMENT EXERCISE 2

Discuss the basic condition under which price leadership exists.

3.4 Mathematical Derivation of Duopolist Equilibrium

3.4.1 Cournot's Model

Cournot's model assumes a demand function of

$X = a + bp$ or a price function of

$P = a + bx$

Given that $x = x1 + x2$ such that:

$$\frac{dx}{dx1} = \frac{dx}{dx2} = 1$$

According to Koutsoyiannis (2003:222) the marginal revenue of the duopolist must not necessarily be the same. The duopolist with the largest output will have the smaller marginal revenue.

Proof: $TR1 = P.x1$

$P = a + b(x1 + x2) = f(x1, x2)$ Thus:

$$\frac{dTR1}{dx1} = P + x1\frac{dP}{dx1}$$ but

$$\frac{dP}{dx1} = \frac{dP}{dx2} = \frac{dP}{dx} = b$$ thereafter

$$\frac{dTR1}{dx1} = P + x1\frac{dP}{dx1} = P + (x1)(b)$$

Given the $P > 0$ while $b < 0$, it is obvious that the larger xi, the smaller the MR will be. The two duopolists have different costs.

$TC1 = F1(x1)$ and $TC2 = F2(x2)$. The first duopolist maximizes his profit by assuming that the output of his rival (x2) will remain constant, while the second duopolist maximizes his profit by

assuming that the output (x1) of his rival will remain constant. The first order condition for maximum profit of each duopolist is

$$\frac{dp1}{dx1} = \frac{dTR1}{dx1} - \frac{dTC1}{dx1} = 0$$

$$\frac{dp2}{dx2} = \frac{dTR2}{dx2} - \frac{dTC2}{dx2} = 0 \text{ re-arranging}$$

$$\frac{dTR1}{dx1} = \frac{dTC1}{dx1}$$

$$\frac{dTR2}{dx2} = \frac{dTC2}{dx2}$$

When we solve these equations, we get the reaction curves of the duopopolist. The second order condition requires that:

$$\frac{d2p_i}{dx2} = \frac{d2TR1}{dxi^2} - \frac{d2TC1}{dx2_i} < 0 \quad (l = 1,2)$$

$$\frac{d2TR1}{dx1^2} < \frac{d2TC1}{dx1^2}$$

Numerical example

Assuming the demand and cost function of the duopolist are:

$P = 120 - 0.5 (x1 + x2)$

$TC1 = 5x1$

$TC2 = 0.5x2$ 2 The profit function the duopolists are

$p1 = P.x1 - TC1 = \{120 - 0.5(x1 + x2)\} x1 - 5x1$

$p1 = 120 x1 - 0.5x1 \quad 2 - 0.5x1 x2 - 5x1$

$p2 = P.x2 - TC2 \{120 - 0.5(x1 + x2)\} x2 - 0.5x2 \quad 2$

$p2 = 120x2 - X2 \quad 2 - 0.5x1x2$

$p1 = 115x1 - 0.5x1 \quad 2 - 0.5x1x2$

$$\frac{dx1}{dx1} = 115 - x1 - 0.5x2$$

$$\frac{dx2}{dx1} = 120 - 2x2 - 0.5x1$$

$X1 = 115 - 0.5x2$ firm A's reaction curve

$X2 = 60 - 0.25x1$ firm B's reaction curve

$X1 = 115 - 0.5 (60 - 025x1)$

$X1 = 97$

$X2 = 60 - 0.25 (97)$

$X2 = 36$

X = x1 + x2 = 133
Remember that

P = 120-0.5x
P = 120-05 (133)
P = N67

$$MR1 = \frac{dTR1}{dx1} = \frac{dPx1}{dx1} = P + x1\,dP$$

MR1 = 67 + 97 (-0.5)
MR = 19
MR2 = 67+36 (-0.5)
MR2 = 49 it has been proven that the firm with the larger output has the smaller MR.

p1 = TR1 – TC1
p2 = P. x1 – TC1
p1 = (67) (97) – 5 (97)
p1 = N6,014
p2 = P.x2 – TC2
p2 = (67) (36) – 0.5 (36)2
p2 = N1,764

The second order condition is satisfied

$$\frac{d2p1}{px1} = \frac{1}{2} < 0 \quad \text{and}$$

$$\frac{d2p2}{dx2} = \frac{-2}{2} < 0$$

Numerical example of price leadership model

(The low cost price leadership)

The market demand is defined by the function
P = a – b (x) which can be written as
P = a – b (x1 + x2).

Where x1 = output of firm A
X2 = output of firm B

The duopolists have different cost functions

TC1 = f1 (x1)
TC2 = f1 (x2)

Where TC1 < TC2, which means that firm A is the low-cost firm. He assumes that firm B will produce an equal amount of output to his own, that is x1 = x2 with this assumption, the demand curve function relevant to the leader's decision is now

P = a – 2b (x1) it is important to consider the output of firm B in his pricing policy otherwise, he is likely to make an error. The low-cost leader will set price which maximizes his own profit.

p1 = TR1 – TC1 = P1 x1 – TC1

p1 = (a – 2bx1) x1 – TC1 The first order condition for maximization of profit requires

$$\frac{dx1}{dx1} = \frac{dTR1}{dx1} - \frac{dTC1}{dx1} = 0$$

$$\frac{dTR1}{dx1} = \frac{dTC1}{dx1}$$

That is to say
MR = MC

The second order condition requires that

$$\frac{d2x1}{dx1^2} < 0$$

$$\frac{d2TR1}{dx1^2} < \frac{d2TC1}{dx1^2}$$

According to Koutsoyiannis (2003:249) the solution of this problem yields the price and output x1 that the leader must produce in order to maximize his profit, the follower will adopt the same price and will produce an equal amount of output (x2 = x1). However, given that TC2>TC1, the follower does not necessarily maximize his profit. He would prefer (under the assumptions above) to produce lower level of output and sell it at a higher price.

Assuming that the market demand is

P = 105 – 2.5x
P = 105 – 2.5 (x1 + x2)

The cost function of the firms is
TC1 = 5 x1

TC2 = 15 x2 firm A is enjoying low cost and therefore is the larger firm among the two. Thus the demand function relevant to the leader's decision is

P = 105 – 2.5 (2x1) = 105 – 5x1

p1 = TR1 – TC1 = Px1 – TC1

p1 = (105-5x1) x1 – 5x1

p1 = 105x1 – 5x1 2 – 5x1

p1 = 100x1 – 5x1 2 from the first order condition

$\frac{dp}{dx1} = 100 - 10x1$

X1 = 10

P = 105 – 5 (10)

P = N55

The follower firm will adopt to same price (N55) and will produce an equal quantity (X2 = 10 units). Otherwise, his profit maximizing output would be (X2 = 9units) and he would sell it at (N60). But if he fails to follow the leader, customers will run away from him and go to the low-cost firm (leader) as seen as fig 13.3 above. However if he were to maximise profit his profit function would have been.

p2 = TR2 – TC2 = (105 – 5x2) x2 – 15x2

p2 = 105x2 – 5x2 2 – 15x2

p2 = 90x2 – 5x2 2

$\frac{dx2}{dx2} = 90\text{-}10x2$

X2 = 9

P = 105 – 5 (9)

P = N60

p1 = P1 x1 – TC1

p1 = 550 – 50

p1 = N500.~~00~~k

The profit of the follower is N400 as he adopts the price and output of the low cost firm. But if is to produce his profit maximizing output of 9 unit and charge N60 price his profit would have been N405.

4.0 CONCLUSION

This unit analyses the basic concept and features of oligopoly as an example of an imperfect market. The model lies in between perfect competition and monopoly. For the fact that the sellers are few, there is stiff competition or rivalry among the firms which include price war and advertisement. The firm in the industry can produce homogenous

product or differentiated product. The theory of oligopoly explains that firms can come together to share the market or profits like in cartels, price leadership etc. In this case there is a mutual understanding between the firms formerly or informerly. On the other hand, the firms can operate independently and engaged themselves in competition, in the long-run, only the strong firm will survive.

5.0 SUMMARY

This unit provided us with the definition of oligopoly. The basic features of oligopoly were discussed. We differentiated between non-collusive and collusive oligopolist, in each of these subdivisions we have examples, such as: Cournot's duopoly under non-colusive oligopoly and cartel/price leader under collusive oligopoly. Finally, the unit ended its analyses on the mathematical derivation of price and output under oligopoly. In the next unit we shall be discussing the welfare economics.

6.0 TUTOR-MARKED ASSIGNMENT

1. List and explain the features of oligopoly.
2. Assuming the market demand and cost function of duopolists are

$$P = 100 - 0.5 (x1 + x2)$$

$$TC1 = 5 x1$$

$$TC2 = 0.5x2^2$$

a. What type of oligopoly is this?
b. Determine the reaction curves for the two firms
c. Determine the price and output for the two firms
d. Calculate the maximum profits for the two firms
e. Establish that the second order condition is satisfied for both doupolists.

7.0 REFERENCES/FURTHER READING

Ahuja, H. L. (2008). Advanced Economic Theory Microeconomic *Analysis. New Delhi: S. Chand and company Ltd.*

Akaahan, T.J. (2004). Principles of Microeconomic. Jos: Mono expression Ltd.

Kontsoyiannis, A. (2003). Modern Micro Economics. London: Macmillan Press Ltd.

MODULE 5

Unit 1 Welfare Economics
Unit 2 Input-Output Analysis

UNIT 1 WELFARE ECONOMICS

CONTENTS

1.0 INTRODUCTION

So far we have been analysing what has been called positive economics which simply explains "how it is". That is we have been concerned with explaining how prices of products and factors are determined and further on the basis of these prices how the allocation of resources is made in a free enterprises economy. That is, the previous units were mainly concerned with how individuals firms maximise their profits function and how individual consumers maximize their utility function. It is possible to imagine that if these economic agents optimized their individual objective function, the total economic welfare of the entire society is optimized. However, this is not true, because private and public interests do not necessary conform, infact, in most cases they conflict. It is thus, the concern of welfare economics to evaluate

alternative economic situation from the point of view of society's well being as a whole. This unit therefore, introduces us to welfare economics.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain the meanings and criteria of welfare economics
- explain Pareto optimality criterion
- describe Pareto's condition as logical condition of perfect competition
- explain market failure and role of government

Welfare economics as defined by Lange "In Akaahan: 2004:127) is a branch of economics concerned with the conditions which determine the total economic welfare of a community. According to Ahuja (2008:1113) welfare economics establishes norms of behaviour which satisfy the requirements of social rationality of economic activity. The term "social rationality" of economic activity is to be interpreted as that activity which ensures optimum allocation of resource and therefore guarantees maximum social welfare. In other words, welfare economics concerns itself mostly with policy issues which arise out of the allocation of resources, with the distribution of input among the various commodities and the distribution of commodities among various consumers. It should be emphasized that allocation of resources is efficient or optimum when social welfare is maximum. Thus a central problem in welfare economics relates to whether a particular change in resource allocation will increase or decrease social welfare. Though, it is not possible to measure social welfare objectively.

3.0 MAIN CONTENT

3.1 The Welfare Criteria

Economists at different times have suggested various criteria to evaluate the social welfare of the society as a whole. Some of these criteria include:

i. Growth of the GNP Criterion: This criterion is credited to Adam Smith. Smith believed that the growth of Gross National Product of an economy can translate into increase of social welfare; this is based on the assumption that growth in GNP automatically increases employment, income and aggregate demand. But we know that unless the fruits of economic growth

is distributed equally, GNP growth may end up widening inequality instead of improve welfare.

ii. The Bentham's Criterion

This criterion assumes that welfare is improved when "the greatest good is secured for the greatest number" and this was the position held by Jeremy Bentham. He argued that social welfare is optimum when majority of the people's welfare improves. Assuming an economy consisting of four persons; W, X, Y and Z, the social welfare is the summation of the utility of these individuals in the economy. U = Wu + Xu – Yu+Zu. For example, given that these individuals have the following Wu = 10, xu = 12, Yu = 9 and Zu = 6. The total utility = 37.
This criterion has two problems first utility is difficult to measure objectively. Secondly, the welfare of the consumer W is two times greater than that of consumer Z. As such there is gross inequality which is a source of social conflict.

iii. The Pigovian Criterion

Pigou defines economic welfare of an individual to be the total satisfaction derives from goods and services that can be exchanged for money. He thus sees the welfare of a society as the sum of utilities of various individual in the society. His theory is based on the following postulates.

a. Consumers aim at utility maximization from expenditure made on goods and services based on the Marshallian price of equi-marginal utility.
b. Individuals are assumed to have equal capacity for satisfying their wants, irrespective of socio-cultural and economic status.
c. Money from the single commodity (real income) of the people and it is subject to the law of diminishing marginal utility and the marginal unit of money must give the amount of satisfaction to each individual. Based on these assumptions, Pigou stated that an increase in the value of National Income without corresponding increase in the supply of factors and transfer of income from rich to poor indicate increase in social welfare.

Two criteria can be identified here. The first that national income could be increased (Factor supply remaining constant) either by increasing some goods without decreasing the production of others or by transforming factors of production to activities in which their social

value is higher. Any such increase in national income without decrease in the share of the poor is to be considered as an improvement in the social welfare. Secondly, Pigou is of the view that redistribution of the National Income must not lead to decrease in the National Income. He concluded that any reorganization of the economy or redistribution of income should increase the share of the poor without causing reduction in the national income only such development should be accepted as an improvement in the social welfare.

However a Pigou criterion has been criticized on the following reasons:

- His definition of social welfare is wrong, social welfare cannot be calculated in arithmetic form since utility cannot be measured in cardinal terms.
- It is wrong to conclude that all individual have equal utility function for same money income because attitude towards money differs from individual to individual.
- Increase in National income does not mean social welfare because National Income may increase as a result of increase in the production of military hardware instead of food, how then will this improve the welfare of all? Also, is the system of distribution equitable?

3.2 Pareto to Optimality Criterion

This criterion is named after an Italian economist Wilfredo Pareto (1848 – 1923) who propounded the welfare optimality criterion. In his book,"the manual of political economy" published in 1906. Pareto disagreed and rejected the assumptions based on cardinal utility and the additive utility function and made his welfare conclusion that do not require any inter-personal comparison.

The Pareto criterion states that any change that makes at least one individual better off and no one worse off is an improvement in social welfare. On the other hand, a change that makes at least one person worse off and no one better off is a reduction in social welfare. In other words, a situation in which it is possible to make any better off without making someone worse off is said to be Pareto optimal or Pareto efficient. Pareto-optimality therefore, is a position from which it is not possible to improve the welfare of any one by reallocation of factors or of goods and services without impairing the welfare of someone else. For example, assuming the Federal Government of Nigeria decides to distribute yam and rice among students. It is assumed that some students likes rice and hate yam, while other like yam and dislikes rice. If in the cause of distribution, those who like rice got yam and those who likes yam got rice. It is obvious that such distribution of food stuff is not

Pareto efficient. It would have been better if those who like rice got rice and those who like yam did not get anything or vice versa. If the students are allowed to exchange rice and yam, they will voluntarily do so and both groups of students will be better off. Pareto optimality is based on the following marginal conditions:

i. Efficiency in exchange
ii. Production efficiency and
iii. General optimality of production and exchange.

These conditions imply that there must be allocative efficiency, exchange efficiency and production and exchange efficiency, before Pareto optimality condition is said to exist. For the fulfilment of marginal condition, the following assumptions are made:

a. We assume a model of two commodities (x and y) two consumers (A and B) two factors L and K) and two firms (F1 and F2) respectively.
b. Consumers maximize their respective utility functions which are independent of each other.
c. Factors L and K are homogenous, perfectly divisible and available in fixed quantities which are exogenously determined. Both are used in the production of goods A and B.
d. The production of both goods are given.
e. There is perfect competition in both the product and factor markets.

We shall use the elgeworth box as our tool of analysis.

3.2.1 Pareto Optimality Condition of Exchange

Efficiency in exchange is achieved when allocation of commodities among the consumers is such that it is not possible to increase the satisfaction of any person without reducing the satisfaction of someone else. The marginal condition for the attainment of Pareto efficiency in exchange is that, marginal rate of substitution between the two goods must be the same for every consumer. Based on our earlier assumption, this can be expressed as:

MRSAx,y = MRSBx,y. This implies that the ratio of the marginal utilities of any two products must be the same for every consumer. Where this condition is not realized it will be possible to increase the total welfare by redistributing some units of a units of good away from the person who derives higher utility to the person with lower utility. We will use the Edgeworth box to explain this condition. In figure 14.1, goods x and

y, which are consumed by two individuals A and B represents a society. OA and OB are origins for A and B respectively. Ia1, Ia2,Ia3 and Ib1, Ib2, Ib3 are indifference curves showing successively higher level of satisfaction of consumers A and B respectively. CC' is the contract curve passing through various tangency points Q, R, S of indifference curves A and B.

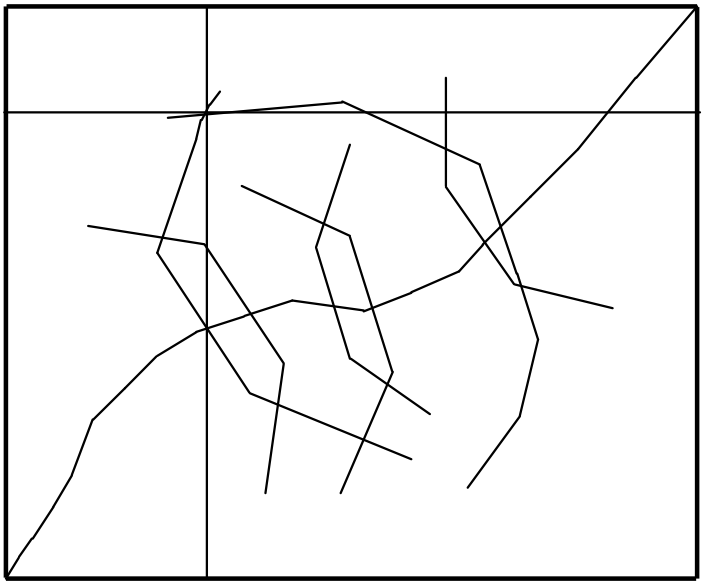


Figure 14.1:

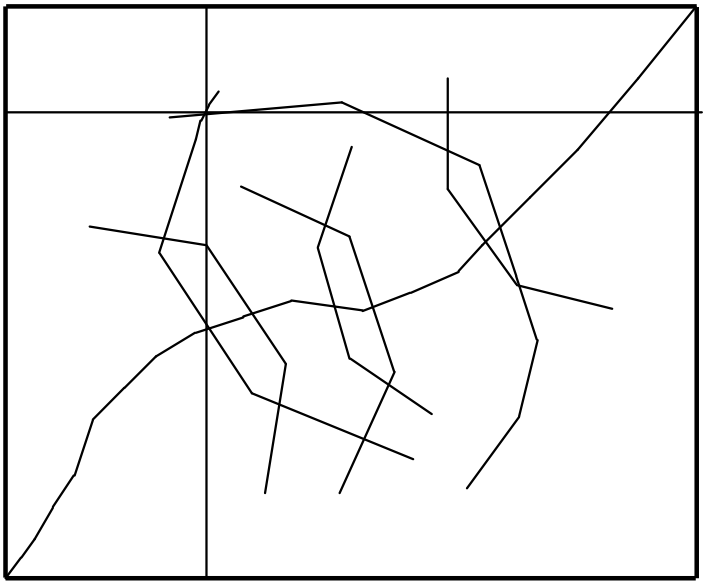
The MRS between x and y for individuals A and B are equal on the various points of the contract curve CC'. Any point outside the contract curve does not represent the equality of MRS between the two goods for individuals A and B of the society. Let consider point K where indifference curve Ia1, and Ib1 intersect each other instead of being tangential. At point K the MRS between x and y of individuals A is not equal to that of B. Therefore point k represents inefficient distribution. A movement from K to S increases the satisfaction of A without any decrease in B's satisfaction. Similarly, a movement from k to q increases B's satisfaction without any decrease in A's satisfaction. The movement from K to R increase the satisfaction of both as they all lie on higher indifference curves Ia2, and Ib2 instead of Ia1, and Ib1 that k represents which is also outside the contrast curve CC'. Thus, a movement from K to Q or to S or any other point on the segment SQ of the contract curve will, according to Pareto criterion, increase the level of social welfare.

However, a movement along the CC' in either direction will make one individual better off and the other worse off since it will put one individual on his successively lower indifference curve and the other on his successively curve indifferent curve. Thus every point on the

contract curve (CC) denotes maximum social welfare but we cannot say which point is best using the Paretian criterion.

3.2.2 Pareto Optimality in Production (Optimum Allocation of Factors among Producers)

The second condition for Pareto optimum requires that the available factors of production should be utilized in the production of different goods in such a way that it is impossible to increase the output of one good without a decrease in the output of another or to increase the output of both the goods 'by any reallocation of factor inputs. This condition would be achieved if the marginal rate of technical substitution between any pair of factor must be the same for any two firms producing two different products and using both factors to produce the goods. This condition can also be explained with the help of Edgeworth Box Figure 14.2



Let us assume two firms A and B producing goods x and y by using two factors labour and capital. Ia1, Ia2, Ia3, and Ib1, Ib2, Ib3 represents isoquants for firms A and B. The slope of the isoquent, which is convex to the origin, represents the marginal rate of technical substitution (MRTs) between two factors. MRTs of one factor for another are the

amount of one factor necessary to compensate the loss of the marginal unit of another so that the level of output remains the same. If the MRTS between L and K for the two firms producing x and y are not the same, total out can be increased by transfer of factors from one firm to another. A look at figure 14.2 reveals that movement from point L off the contract curve to point v on the contract curve will increase the output of both the firms. Any movement from L to W or to U raises the output of one firm without any decrease in the output of the other. Line U to W show that MRTSL,K A = MRTSBL, K. By this equality, the allocation of factors between the two firms A and B producing x and y respectively is optimum. When the allocation of factors between the two firms is such that they are producing at a point on the contract curve, then no reallocation of factors will increase the total outputs of the two firms taken together.

3.2.3 Pareto Optimality in Product Mix

The third condition relates to the technical condition of production and the state of consumer's preferences. It is also called economic efficiency. This condition states that "the marginal rate of substitution between any pair of products for any person consuming both must be the same as the rate of transformation (for the community) between them. In another words social welfare is attained when the rate at which consumers substitute good x for y is equals to the rate at which producers substitute the production of good x for y or that what producers produce must be in accordance with consumer's preferences. Figure 14.3 shows optimum product mix:

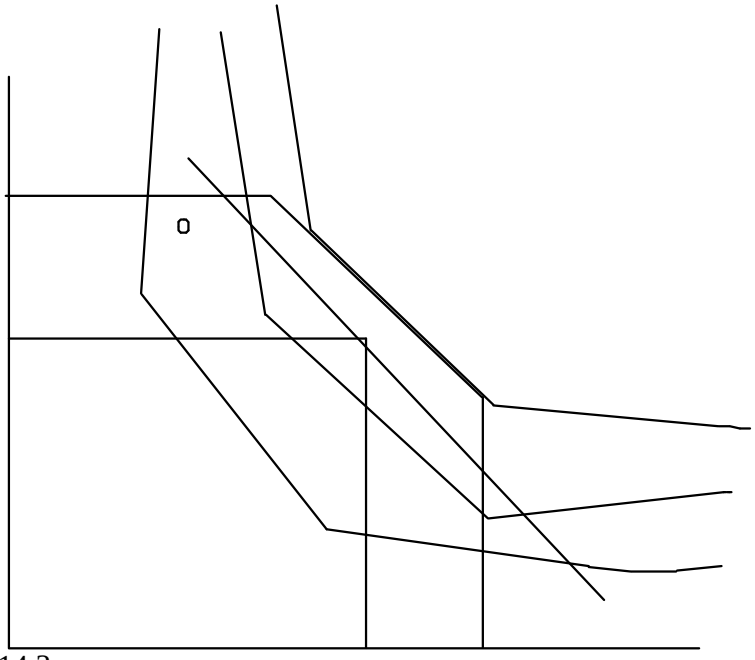


Figure 14.3:

Line AB represents production possibility curve (PPC), PP represents the consumers budget line or the producers is ocost. The PPC represents the maximum amount of x and y that can be produced given the society's resources and state of technology. Ic1 – Ic3 are the indifference curves reflecting the preference of the society for different quantities of goods x and y. At point E, MRSx, y = MRPTx; y. That is it represent optimum combination of production of goods x and y produced and consumed in OM and ON quantities. At points S, the preference of the society for goods x and y is less than the productive capacity of the society, and MRS x,y < MRPT x,y. Point E lies at a higher indifference curve which is tangential to the PPC and the price line PP'. If a combination of goods x and y represented by S is being produced and consumed; the consumers level of welfare would be lower because S lies on a lower indifference curve (IC), which intersects the PPC instead of being tangential to it.

SELF-ASSESSMENT EXERCISE 1

Discuss Pareto's optimum condition in product mix. So far, these three conditions can be summarized thus:

Marginal condition for exchange MRSA x,y = MRSB x, y

Marginal condition for factor substitution

MRTSxL,K = MRTSyLK

Marginal condition for product mix MRPTx, y = MRSx,y

3.3 Pareto's Condition as Logical Conclusion of Perfect Competition

In a perfectly competitive market the consumer and producer are price takers. The consumer maximizes utility

$$\frac{MUx}{MUy} = \frac{Px}{Py}$$ and the

Producers maximizes profits $\frac{MPL}{MPk} = \frac{w}{r}$

Where w = wage or price of labour

r = interest on capital or price of capital

Taking the first condition, consumer A maximizes utility when

$$MRSA\ x,y = \frac{MUx}{MUy} = \frac{Px}{Py}$$

For consumer B, $MRSBx,y = \frac{MUx}{} = \frac{Px}{}$

MUy Py

Both consumers are expected to equate the MU to the price ratio. Both face the same prices. This argument follows from the perfect market condition. If two consumer's maximize utility, they face the same condition ie. subject to Px and Py and Qx and Qy in the perfectly competitive market. Since the condition for efficiency in exchange is MRSA x,y = MRSB x,y = MRSx,y then we impose the condition of perfect competition to fill this where by price ratio are common to all, which means their MRS is the same.

We can also show that the second condition holds in the perfectly competition market. For the production of X, the MRTSx L,K = w

r

For producing y, the MRTSY L,k = w

r

In the perfectly competitive system the producer sets MPk = r because the prices of labour and capital are given.
MPL w

These two equalities means that the slope of the isoquant must be equal to the slope of the isocost for the producer to maximize his profits.

The same argument holds for the third condition, where we have MRPTx,y.

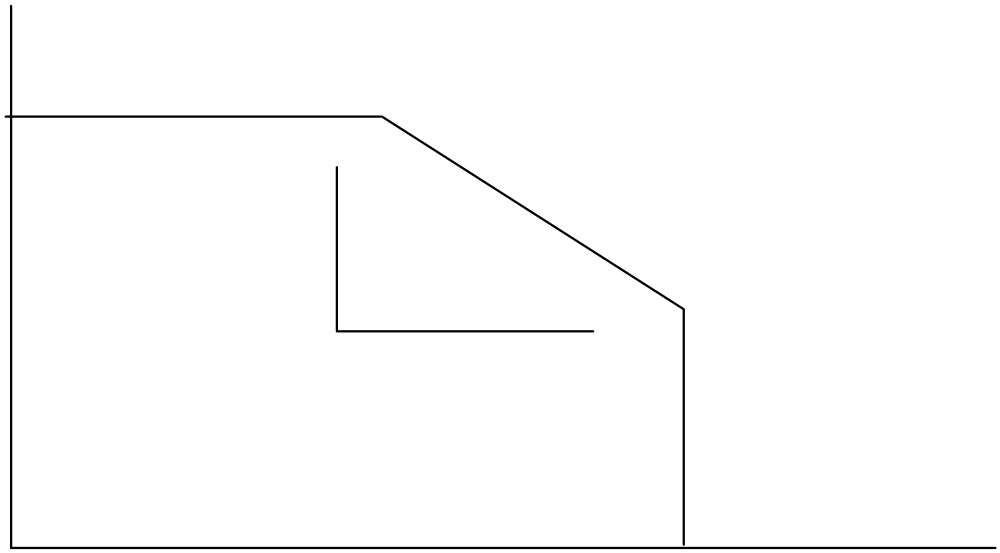


Figure14.4:

Given or PPC moving from pint S to P the producer is reducing the production of Y for X. Such that the slope of the PPC is = MRPT.

We want to show that it is equal to  as follows. The increase in cost will be MCx. x since we are on the same PPC, therefore, MCx x = -MCy y. It should be understood that increase in cost of x = Mcx x while decrease in the cost of Y = -MCy. Y. Movement from S – P means increase in the production of x and reduction in the production of Y i.e. increase the cost of x and decrease in the cost of y.

MCx x = - Y should be divided by McY

We have $\frac{MCx}{MCy}$ x = - y

We divide this again by x. We get

$\frac{MCx}{MCy}$ = $\frac{y}{x}$ = MRPT x y

In a perfectly competitive market, in order to maximize profits, a firm sets up

Mcx = MRx = Px for the firm producing x
Mcy = MRy = Py for the firm producing y

If we divide these two equations, we get

$\frac{Mcx}{Mcy} = \frac{MRx}{MRy} = \frac{Px}{Py}$ = MRS x, y = MRPT x, y

Since $\frac{Px}{Py}$ = MRS x,y then

MRS x,y = MRPT x, y

The long equation above states that cost ratio between x and y is equal to the revenue ratio between x and y is equal to the price ratio between x and y is equal to the preference of the consumers for x and y which is also equal to the amount of goods x and y produced in the society. Therefore there is improvement in social welfare in the society.

SELF-ASSESSMENT EXERCISE 2

Explain the statement that “the three marginal contrast are logical condition of perfect competition.

3.4 Market Failures and Role of Government

We have explain above the various concepts of economic efficiency and have seen how a perfectly competitive market succeeds in achieving exchange efficiency, production efficiency and allocative efficiency. As a result, competitive market achieves maximum possible well-being of a society. In an economy characterized by perfectly competitive market, government performs only its basic functions, namely, to maintain law and order, enforce property rights and contracts made by economic agents while making economic transactions.
However, some economists have argued that there are significant market failure which in turn erodes social welfare. According to them, government intervention can bring about improvements in allocation of resources and distribution of incomes. Many markets in the economy are not sufficiently competitive and there are firms which wield great market power and restrict output of goods and raise prices. Government can take measures to check monopolistic and restrictive practices to encourage competition in the economy. Through passing laws, government can declare illegal the mergers such as a cartel which lead to monopolies.

Some economists lay emphasis on the failure of market which arises due to imperfect information that prevails in the real world. In perfect competition, it is assumed that the producers and consumers have perfect information about the quality of workers, return on investment, price and quantity of the commodity in the market. In the real world this is not true. Firms do not have perfect information about quality of worker and return on investment. The consumers do not have perfect information about quality and price goods. In this situation you cannot guarantee social welfare. The existence of negative externalities is another factor which prevents the competitive market from achieving economic efficiency. For example, environmental pollution by the productive activities of firms which harm others is an indication of market failure which erodes economic efficiency. Another significant failure of market is the existence of unemployment which exists on a large scale in the free market economies. Massive unemployment implies that some resources, human and material are idle and putting them to use will enable the society produce more goods which will reduce price and generate income to those hitherto unemployed, hence increase welfare for the society which include low crime rates.

Also, there are public goods which are collectively consumed by the members of a society and it is not possible to exclude anyone who does not pay it from consuming it or enjoying its services. Good such as national defence, law and order, road and street lights are public goods, it is not possible to exclude someone from consuming these goods because the person could not pay for the goods. This implies that such

goods are not profitable for private firm to produce them. Therefore, government has to provide these public goods. In recent times we have seen the governments in Europe, USA and Nigeria belling out financial institution as a result of global financial crisis which was caused partly by market failures.

We have explained above situations when markets do not perform well and therefore government intervention is needed to improve market efficiency. Nevertheless, it does not necessarily mean that government intervention will definitely improve efficiency. Just as there are market failures, there are government failures. In fact, it is even worse in countries like Nigeria where corruption strives. However, the role of government is essential in the economy to achieve social objectives of efficiency, improvement in distribution of income, reducing unemployment, reducing cost of producing through the provision of essential infrastructure and provision of public goods.

4.0 CONCLUSION

This unit discusses the concept and scope of welfare economies which is a branch of economics that establishes norms of behaviour aimed at satisfying the requirements of social rationality of economic activity. The Pareto criterion is favoured here over the other three because of its ability to incorporate the features of perfect competition into its analysis. We had agreed in unit 9 that perfect competition guarantees maximum social welfare. However, market failures can reduce efficiency and welfare. Therefore, the role or there is the need for government to intervene in economic activities in the areas of provision of public goods, distribution of income, provision of infrastructure, reduce unemployment etc.

5.0 SUMMARY

In this unit we have explained the meaning and criteria of welfare economics. Pareto's optimality criterion is discussed in detail especially the three marginal conditions and their relationship with the conditions under which perfect competition operates.

The unit equally discussed the obstacles to welfare maximization that arises from market failures. As a result the role of government in stabilizing the economy is analysed. In the next unit we shall be discussing input-output model.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss the weaknesses of GNP growth and Pigovian criteria of welfare economics.
2. Explain Pareto's optimality condition of exchange with the help of an Edgeworth Box.

7.0 REFERENCES/FURTHER READING

Ahuja, H. L. (2008). Advanced Economic Theory Microeconomic *Analysis. New Delhi: S. Chand and Company Ltd.*

Akaahan, T.J. (2004). Principles of Microeconomic. Jos: Mono Expression Ltd.

Kontsoyiannis, A. (2003). Modern Micro Economics. London: Macmillan Press Ltd.

UNIT 3 INPUT-OUTPUT ANALYSIS

CONTENTS

1.0 INTRODUCTION

Input output-economics is also called inter-industry economics, it emerged as one of the most useful and fascinating branches of applied quantitative methods to economic problems. Input-output analysis is a method of analysing how an industry undertakes production by using the output of other industries in the economy and how the output of the given industry is used up in other industries or sectors. The model explains the interrelationship and interdependence of various sectors of the economy. Economists working in many different fields find it an invaluable tool of analysis. Input-output tables are useful as a basis for economic planning in both developed and developing countries under both free enterprises and centrally planned systems.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain the concept of input-output analysis
- analyse how input-output system is set up
- describe a model of input-out
- explain a two sector input-output model.

3.0 MAIN CONTENT

The Concept of Input-Output Analysis

The input-output analysis is a method of analyzing how an industry undertakes production by using the output other industries in the

economy and how the output of the given industry is used up in other industries or sectors. Various industries are mutually inter-dependent; the output of an industry is an input for other industry. For example, the output of a steel industry is an input in agricultural sector. Whatever is used up in the production of a commodity by an industry is called input and whatever is produced is called output. Therefore input-output analysis explains the inter-dependence of inputs and outputs of various industries in the economy. Input-output analysis has the following features as identified by Ahuja (2008:1203).

i. Input-output is only concerned with production, it does not consider what determine final demand. Thus, the theory of consumer's demand does not have any place in this model.
ii. Input-output analysis is based upon only empirical facts, that is, the estimates of the quantities of various inputs and outputs, different industries are made on the basis of empirical data. The use of empirical facts is what differentiates input-output analysis from the theory of general equilibrium.
iii. Thirdly, input-output analysis is based on general equilibrium analysis. Accordingly, input-output analysis takes account of the mutual dependence of planned production of various industries in the economy.

3.1 Assumptions of Input-Output Analysis

In the input-output analysis some assumptions are made to simplify the analysis, these assumptions are:

i. That available resources, the demand for final products and the prices of all inputs and output are given and remain constant. If all or any of these varies it will be difficult to determine the interrelationship and interdependence of input and output. Therefore, they are assumed to be constant within the period of analysis.
ii. It is assumed that technical coefficient of production, that is the input ratio (or factor proportions) to produce a given output of various products are completely fixed. There is no technical substitution and technique of production is fixed.
iii. The input-output model assumes a constant return to scale in the economy. That is a one percent increase in input will bring about a one percent increase in output.
iv. Lastly, it is also assumed that demand for the final products is large enough to keep the economy operating at full production capacity. In other words, it is assumed that no input is unutilized or underutilized and no output is consumed or under consumed.

SELF-ASSESSMENT EXERCISE 1

Explain the concept of inter-industry economics.

3.2 How the Input-Output System is Set Up

To set up an input-output system, the following procedures should be followed.

i. The economy is divided into manageable number of sectors. Each sector is assumed to produce only one product. Examples of these sectors are agriculture, industry, transportation, mining etc. A sector may contain several industries producing closely related products, the products of these industries are lumped together to form a single composite product. For example, we can lump bread, biscuit, cake etc into one composite product. The criterion to select closely related product to constitute a sector is the similarity of their factor inputs rather than resemblance of their products.

ii. The next step in setting up a model is to frame a number of equations which will establish relationship between various inputs of each sector to output of its products. Further, a number of equations will also be framed which will relate the output of a sector to the output of other sectors which use the products of that sector as an input. In this way, the final output available for consumption demand or for making additions to the stock of capital is determined.

iii. Further, because for each sector one equation is established which relates its output to the input of other sectors, there will be as many equations as there are many output. It therefore, follows that a unique mathematical solution can be obtain from a given set of simultaneous equations. The solution will yield the outputs of various sectors that will be internally consistent (or feasible to produce) with the given resources and given state of technology without experiencing shortage of any input. Note, that a number of possible combination of outputs of various sectors are feasible, but only one combination will be consistent with the available resources and with the final demand for consumption and capital accumulation. Since the model assumes constant returns to scale, there will be a linear relationship between inputs and the resulting output of any product.

3.3 Input-Output Model

It is necessary to know about input-output table which depict the flow of output of a given industry into various industries and final demand and the requirement of various inputs for that input. The input-output table is called transaction matrix.

Table 15.1: Hypothetical Transaction Matrix

	Users of output			
		Inter-industry sector Final		Demand Sector
Total X1 X2... ...xn D				
Producers Xi Xii X12... ...xn D1				
Of X2 X21 X22... ...x2n D2				
Inputs : : : : :				
: : : : :				
Xn Xn1 Xn2... ...xnn Dn				

Looking at table 15.1 horizontally, you can see that output X1 of industry 1 partly flows into its own output x1 and partly into the output of other industries such as x2, x3...xn as input and the remaining product; part of it is used to meet final demand D1 for it. Part of x1 is used up by industry 1 as input represented by xii, part of output x1 of industry 1 is used as input by industry 2 this is captured by x12 industry n use part of output x1 as its input which in X1n and the remaining part of x1 is used by the final demand D1. Likewise a part X2 of output X2 of industry flows into (or use by) industry 1 as X21, industry 3 as X23 and the part used by the nth industry is X2n the other industries use the output of industry 2 as input, part of industry's 2 output is used by industry 2 itself as input (X22) and he remaining part is used by final demand D2. The same analysis is true for Xn.

Since the total output of an industry is fully used up either in industry as input or in meeting final demand we can write this in the form of the following equations

X1 = X1 + X12 ..... X1n + D1
X2 = X21+ X22 ..... X2n + D2
" " " " "
" " " " "
Xn = Xn1 +Xn2 ..... Xnn + Dn

Leontief has called the above equation as Balance equation which show how the output of each industry is used in various industries as input and for meeting final demand for consumption or capital formation. These balance equations are called input coefficients. An input coefficient means the amount of an input required to produce one unit of output of an industry. The input coefficient are represented by a11, a12, a21, a22, a23 etc.

The coefficient a12 implies the input coefficient of industry 2 with respect to output of industry 1 which is used as input in industry 2. Also, a23 implies the input coefficient of industry 3 with respect to output of industry 2, which is used as input of industry 2. If all the input coefficients are given and fixed, that is, the input requirements are strictly proportional to outputs, and then we can describe the balance equation thus:

$$
\begin{aligned}
X1 &= a11X1+a12x2 + a13x3 ..... ainXn + D1 \\
X2 &= a21X1+a22X2 + a23X3 ….. a2nXn+ D2 \\
X3 &= a31X1+a32X2 + a33X3 ….. a3nXn +D3 \\
&\text{“ “ “ “ “ “ “ …..} \\
Xn &= an1X1 + an2X2 + an3X3 … \quad annXn + Dn
\end{aligned}
$$

The balance equation which describes input-output relations of an economy is often written in compact matrix notation as follows:

X = Ax + D where

X = Column vector (X1, X2, X3 ...Xn)

D = Final demand column vector (D1, D2, D3 ...Dn)

A = Coefficient matrix

There are properties associated with coefficient (technology) matrix, these are:

i. Each element in the coefficient matrix must either be positive or zero. Negative inputs are not considered in economics.

ii. No element can exceed unity. If some elements exceeds unity, it would mean for example, that the value of steel used in producing a car is greater than the value of car produced. This will mean negative output of car.

iii. The sum of the elements in each columns of technology matrix including labour coefficient must be equal to unity. If the sum of the elements exceeds unity, it would mean that value of intermediate outputs and labour used in the production of a commodity is greater than the value of the commodity produced. If such is the case, it will imply that the industry concerned will not profit from such production.

3.4 Two Sector Input-Output Model

The hypothetical data on transaction matrix presented below on table 15.2 is adopted from Ahuja (2008:1206). Two sectors or industries have been taken, agriculture (A), manufacturing (M) and a primary factor of production labour. From the table, you can see that N300 worth of agriculture output is produced, of which N75 worth of output is re-invested in agriculture itself, N125 worth of output from agriculture is used as intermediate input in the manufacturing sector and N100 worth of output is taken to the market as the final demand of consumers. Notice that N500 worth of manufacturing output is produced, out of which N100 worth of this output is used in agriculture as input the manufacturing sector reinvested N150 worth of its own output. N250 worth of output is used to meet final demand. Finally, N350 worth of labour is shared between agriculture and manufacturing, N125 worth of labour is used in agriculture while manufacturing consumed N225 worth of labour.

Table 15.2:

	User of Output			
Agriculture	Manufacturing	Final Demand	Total input	
Agric	75	125	100	300
Manuf.	100	150	250	500
Labour	125	225	-	350
Total 300	500	350	1150	

Assuming the final demand for agriculture and manufacturing change to 150 and 300 respectively, estimate the total outputs of agriculture and manufacturing required to meet the new inter-industry demands and the new final demand assuming the technology matrix remain the same.

From here, we can find the relative value of input used for producing various inputs. These relative values of outputs are called input coefficients. The input coefficient can be obtained from the following formula:

aij = or by cross multiplication we get

aij Xj = xij

Where: aij = The amount of output of industry 1 required to produce one unit of output of industry 2.

Xij = the output of industry 1 used in the production of industry 2
Xj = The total output of industry 2
Xi = the total output of industry 1

Table 15.3 is our input coefficient or technology matrix

	A	M	A	M
Agriculture (A)	75	125	0.25	0.25
Manufacturing (M)	300	500		
Labour (L)	100	150	0.33	0.30
	300	500		
	125	225	0.42	0.45
	380	380		

3.4.1 Solution to Two-Industry Example

Let X denote output, G denote agriculture and M for manufacturing, then we have the following balance equation.

Total value of agricultural output XG = Value of agricultural output used in agriculture (G) itself + Value of Agriculture output used in manufacturing (M) + Value of agricultural output consumed by final demand

XG = Ag.25XG + 0.25M + 150

Similarly, for manufacturing

Xm = 0.33XG + 0.30Xm + 300.

In Matrix notation we can write

$$(1.) \quad \begin{bmatrix} = Xa \\ Xm \end{bmatrix} \quad \begin{bmatrix} 0.25 & 0.25 \\ 0.33 & 0.30 \end{bmatrix} \quad \begin{bmatrix} XG \\ XM \end{bmatrix} \quad \begin{bmatrix} 150 \\ 300 \end{bmatrix}$$

$$\text{Let } X = \begin{bmatrix} XG \\ Xm \end{bmatrix} \quad \text{and } D = \begin{bmatrix} 0.25 & 0.25 \\ 0.33 & 0.30 \end{bmatrix} \quad \begin{bmatrix} 150 \\ 300 \end{bmatrix}$$

Where X = output matrix, A = coefficient matrix
D = final demand matrix

From equation (1) we have
X = Ax + D ..... (2)
X -AX = D If I is the 2 x 2 identity

Matrix, then IX – AX = D

Factorize
(I – A) X = D ..... (3)

Now the matrix (I – A) is conformable for multiplication with the vector X. Finally, we premultiply both sides of equation (3) by the inverse of the matric (I – A), giving X = (I – A)-1 D.

The matrix I – A is known as Leontief matrix named after the pioneer of input-output analysis.

Therefore, in order to find out the new output values of agriculture (XG) and manufacturing (Xm) required to meet the inter-industry demand and the new final demands, we need to calculate Leontief matrix (i.e. I-A) and then multiply its inverse (I –A)-1 with the new final demands.
From our example in table 15.3 we have

A = $\begin{bmatrix} 0.25 & 0.25 \\ 0.33 & 0.30 \end{bmatrix}$ or $\begin{bmatrix} ¼ & ¼ \\ \frac{1}{3} & 3 \\ & \frac{}{10} \end{bmatrix}$

New final demand D = $\begin{bmatrix} 150 \\ 300 \end{bmatrix}$

I – A $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ $\begin{bmatrix} =1 & \frac{}{} & 1 \\ \frac{}{4} & & \frac{}{4} \\ \frac{1}{3} & \frac{}{} & 3 \\ & & \frac{}{10} \end{bmatrix}$ $\begin{bmatrix} \frac{3}{} & \frac{}{} & -1 \\ \frac{}{4} & & \frac{}{4} \\ -\frac{1}{3} & \frac{}{} & 7 \\ & & \frac{}{10} \end{bmatrix}$

I – A

= since |I-A| >0, the Simon-Hawkins conditions for validity of the system are satisfied, more so that the elements on the principal diagonal of the

I = 2 x 2 matrix are all positive

The co-factor matrix [Cij] of I-A = $\begin{bmatrix} \frac{7}{10} & \frac{}{} & 1 \\ & & \frac{}{3} \\ \frac{1}{4} & \frac{}{} & 3 \\ & & \frac{}{4} \end{bmatrix}$

Adjoint of (I – A) = [Cij]-1 = $\begin{bmatrix} \frac{7}{10} & \frac{}{} & 1 \\ & & \frac{}{4} \\ \frac{1}{3} & \frac{}{} & 3 \\ & & \frac{}{4} \end{bmatrix}$

(I – A)-1 = $\frac{1}{|I - A|}$ Adj (1 – A)

Therefore

(I – A)-1 = 120 ___ $\begin{bmatrix} 7 & \frac{}{} & 1 \\ 10 & & \frac{}{4} \\ \frac{1}{3} & \frac{}{} & 3 \\ & & \frac{}{4} \end{bmatrix}$

$$(I - A)^{-1} D = \frac{53}{120} \begin{bmatrix} 7/10 & -1/4 \\ -1/3 & 3/4 \end{bmatrix} \begin{bmatrix} 150 \\ 300 \end{bmatrix}$$

$$120 = \frac{53}{120} \begin{bmatrix} (7/10)\,150 + (1/4)\,300 \\ (1/3)\,150 + (3/4)\,300 \end{bmatrix} \frac{53}{120} \begin{bmatrix} 180 \\ 275 \end{bmatrix}$$

Therefore, agricultural output = $120 \times \frac{53}{120} 180 = 407.50$

And manufacturing output

$$120 \times \frac{53}{120} 275 = 622.64$$

We can find out the requirements of labour for these new output of agriculture and manufacturing, given the labour coefficient of 0.42 for agriculture and that of manufacturing be 0.45 (Table 15.3)

Labour required for agriculture = 0.42 x 407.5
= N171.15 worth of labour

Labour required for manufacturing = 0.45 x 622. 64
= N280.2 worth is labour

4.0 CONCLUSION

The input-output model analyses the interrelationship and inter-dependence among different sectors of the economy. Macro economists are interested in input-output analysis because of the wealth of sectorial detail it provides. The technique is highly useful and practical in the study of the effects of tariff policies, changes in wage rates, movement in consumer demand, the impact of foreign trade etc. on the economy. The study of input-output model teachers us that all sectors of the economy are mutually interrelated. The theory suggests that, the more you grow and develop all the sectors of the economy, the faster the growth of the entire economy and vice versa.

5.0 SUMMARY

This unit analysed the concept of input-output model or inter-industry economics. We had defined this concept to mean the study of how an industry undertakes production by using the output of other industries as

input. The technique of setting up the input-output model is also undertaken. A two sector input-output model has been set up and analysed. This unit ends the course units under price theory 1.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss the basic features of an input-output model.
2. Assuming an economy is characterized by the following technology matrix.

$$\begin{bmatrix} X1 \\ X2 \end{bmatrix} = \begin{bmatrix} 0.2 & 0.4 \\ 0.9 & 0.3 \end{bmatrix} \begin{bmatrix} 20 \\ 50 \end{bmatrix}$$

Where X1 = output of industry 1
X2 = Output of industry 2
20 = Final demand for industry 1
50 = Final demand for industry 2

Estimate the total output of industries 1 and 2 required to meet the inter-industry demand, assuming final demand remains constant.

7.0 REFERENCES/FURTHER READING

Ahuja, H. L. (2008). Advanced Economic Theory Microeconomic *Analysis. New Delhi: S. Chand and Company Ltd.*

James, D. E and Throsby, C. O. (1973). Introduction to Quantitative *Methods in Economics. Sydney: John Wiley & Sons Australasia* PEY Ltd.