BUS 802: ECONOMIC THEORY

MODULE ONE: ANALYTICAL TOOLS AND MODELS OF ECONOMIC ANALYSIS

UNIT 1: THE BASIC ECONOMIC PRINCIPLES

Content

1.0 Introduction

When you look at the National Income Accounts of any nation and asks why a number you saw is what it is, a person would honestly answer "I don't know." If you ask how this number may change, the number alone has no clue. In short, there is no way to understand economic relationships or changes in these relationships without first organising the thought process so as to facilitate the handling of the above questions. This is the basic tasks of economic theories. You need to note however, that the theory of anything does not assume responsibility to provide a complete explanation to social science or any questions. In this unit, we introduce such theories, the micro and macroeconomic theories.

2.0 Objectives

By the time you must have actively participated in the activities of this unit, you will be in a position to:

1. Enumerate the differences between micro and macroeconomics.
2. Describe the basic branches of economic analysis
3. Define the concept of equilibrium in economics

3.0 Main Content

3.1 Introduction to Microeconomic Theory

Like most other academic disciplines, economics is divided into branches and sub-branches. The two major branches are basically **Microeconomics** and **Macroeconomics**. The tools of economic analysis are derived from these two basic branches. While *microeconomics* is the study of economic actions of individual households and firms, *macroeconomics* is the study of

broad aggregates including total employment, national income, inflation, and foreign trade, among others.

Both branches of economics deal with price and income determination, as well as the use of scarce resources. Microeconomics however, concentrates on the analysis of individual product prices and markets, and the allocation of specific factors of production to particular uses. In microeconomics, the determination of the incomes of individuals is encompassed within the general pricing process within an economy. Individuals earn their incomes by selling factors of production, the prices of which are determined in the same manner as all other prices.

Microeconomic analysis encompasses:
(i) the theories of individual behavior in a perfectly competitive economy;
(ii) the theory of consumer behavior;
(iii) the theory of the firm; and,
(iv) welfare economics.

Microeconomic theories are sufficiently flexible to permit variations in their underlying assumptions. Such assumptions include the assumption that no single individual can influence prices or the actions of other individuals in competitive environments.

3.2 Introduction to Macroeconomic Theory
Macroeconomics as a concept is concerned with aggregate quantities and relationships, such as aggregate consumption, investment, and government expenditures. Macroeconomic analysis emphasizes the interactions in the economy as a whole. It simplifies the individual building blocks of the analysis in order to retain a manageable analysis of the complete interaction of the economy.

Macroeconomists typically do not worry about the breakdown of consumer goods into cars, bicycles, televisions, and radios, for example. They prefer to treat them all as a single bundle referred to as "consumer goods" because they are more interested in studying the interaction between households' purchases of consumer goods and services, and firms' decisions about purchases of machinery, building, and equipments.

To give you some ideas of the building blocks of macroeconomics, let us look at three concepts which you have probably come across in the radios, televisions, and newspapers:

The Gross Domestic Product (GDP)
This represents the value of goods and services produced in the economy in a given period, such as a year. Gross Domestic Product is the basic measure of the total output of goods and services in the economy.

Aggregate Price Level
This is a measure of the of the average level of prices of goods and services in a given economy. It tells you what is happening to prices on the average. When the price level is rising, we say that the economy is experiencing inflation, and when it is falling, we say the economy is experiencing deflation.

The Unemployment Rate

Unemployment rate is the percentage of the economy's labour force without a job. The term, 'labour force refers to those people of the working age who in principle would like to work if a suitable job were available to them. Those individuals that are of working age but have no intentions and willingness to look for job are not in the labour force and not counted as unemployed.

3.2.1 Advantages and Disadvantages of Aggregation in Macroeconomics

The practice of aggregation has advantages and disadvantages or problems.

The Advantages

One of the major advantages of working with highly aggregated variables is that they confer a high degree of stability to aggregate relations that may not be found otherwise. Since the structure and composition of the aggregates are usually ignored, all extreme forms of activity tend to cancel out in the adding up process. For example, the consumption patterns of those engaged in communal living are offset by the consumption patterns of the status-seeking suburbanite. It follows that many relations you find in macroeconomic theory that can be tested repeatedly can be highly stable, making successful predictions feasible.

The Disadvantages

The aggregation problem, often referred to the problem of classifying widely varying goods or activities into one general category treated as a homogenous variable and the failure to recognise the separate components of macroeconomic aggregates often results in faulty and misleading work in macroeconomics. Thus for instance, to speak of changes in investment expenditures in an economy would imply that the total investment has changed, but it is clear that during any period some industries expand, some contract, and others remain stable, so that the change in the aggregate may not reflect accurately the structure and composition of the demand for investment goods. If macroeconomic policy were being construed to affect the flow of investment spending, it would be important to know which industries were expanding and which were contracting, or which types of investment goods were being purchased and which were not. Otherwise, policies designed to stimulate or stabilize investment spending could be ineffective or incorrect.

The same argument is true for aggregate consumption. You will note that consumption expenditures (C) depends to a large extent on household or family income (Y). Thus, functionally, C = C(Y). Thus, consumption expenditures will change if household income changes. Aggregate theories of consumption behaviours are based on simple relations and in most cases are quite adequate. There can however, be cases when a prediction of the direction of change of consumption expenditures in relation to income changes are wrong. This is one of the aggregation problems, for there are instances when it is important to know whose incomes have changed and how their consumption patterns resemble those of the rest of the society.

In a nutshell, you need to note that one of the dangers of macroeconomic theory is that of over aggregation, with the result that the structure and composition of the aggregate magnitudes may be overlooked and that policies designed to influence those aggregates may be ineffective or inefficient.

Another problem in macroeconomic theory is the careless use of logic in going from the particular to the general. The inductive method of reasoning can lead to errors referred to as fallacy of composition that is, what is true for the part may not be true for the whole. Thus, generalising from particular cases can be hazardous.

There are also some difficulties in deciding which variables to aggregate and how to aggregate them. Data can be aggregated in a variety of ways, some meaningful and others not. The aggregation technique must be meaningful for the problem at hand and must be capable of being related to other aggregates.

3.2.2 Macroeconomic Variables

Some of the variables used in macroeconomic analysis have already been enumerated, including consumption, investment, unemployment, and the price level. Others are the interest rate, the wage rate, the exchange rate, and the money supply. These variables appear to be self-explanatory, but closer look reveals the need for further clarifications so that you can understand them thoroughly and use them properly.

The first distinction you should make among macroeconomic variables is whether they are stock or flow variables. This distinction is necessary because of the time element present in all economic variables. A stock variable is one that has meaning only at a specific point in time. Thus the capital stock of an economy has meaning only when it is expressed as a magnitude at a certain time. For example, you can say that, as of December 31, 2015, the capital stock of the nation is x billions of Naira. Other examples of stock variables are the money stock, inventory, savings, and population data. When added, the aggregates become macroeconomic stock variables.

There are also the flow variables which are found difficult to be meaningfully expressed except in terms of a time period. Thus, you can speak of income per year, income per quarter, or income per week; investment, consumption, and savings per quarter, per week, or per year. The time period must be explicitly specified when referring to flow variables, or else it makes little sense using them. It would not make sense to say that personal income was N800 billion without stating over what time period this amount of income was earned. It must be stated as N800 billion for the year 2010, for example.

The distinction between stock and flow variables can be further clarified by the following: investment spending is a flow variable and capital stock is a stock variable, but the relationship between them can be erroneously interpreted. Positive net investment, I, adds to the stock of capital, K, or subtracts from the stock of capital by another flow variable such as depreciation, D, according to the following symbolic expressions:

If gross investment ($\boldsymbol{Ig}$) – depreciation ($\boldsymbol{D}$) > 0; net investment ($\boldsymbol{In}$) > 0, then $\boldsymbol{\Delta K} > 0$, then capital stock grows.

If $\boldsymbol{Ig} - \boldsymbol{D} = 0$; $\boldsymbol{In} = 0$, then $\boldsymbol{\Delta K} = 0$, capital stock remains constant.
And,

If $\boldsymbol{Ig} - \boldsymbol{D} < 0$; $\boldsymbol{In} < 0$, then $\boldsymbol{\Delta K} < 0$, capital stock declines.

The interaction between stock and flow variables can be illustrated by the above example, selected because of its importance in macroeconomics.

3.2.3 The Use of Variables in Macroeconomic Analysis

Variables can be manipulated in many ways. The method of manipulation depends largely on the nature of the problem being addressed and the degree of sophistication required. Economists generally use some variant of two broad methods or types of analysis: static and dynamic analysis.

Static analysis deals with states of equilibrium, and static models attempt to inquire into the forces leading to, maintaining, and reestablishing , if necessary, the equilibrium condition. The market mechanism establishing an equilibrium price is a good example of static analysis. The influences on the market are enumerated, and a model is built showing how the market establishes an equilibrium that clears the market. Yet the exact process by which the market forces act upon the model is left unexplored, and there is no particular emphasis given to the passage of time in the process. Static analysis is more interested in the basis for an equilibrium than in given a detailed account of how the condition was established or how long it took to get there.

With a model in equilibrium, any change in the variables will cause the model to react until a new equilibrium is reached. The comparison of the first and the new equilibrium states is referred to as comparative statics. Again there is no exact accounting for how the new position was reached or how long it took to reach it.

Dynamic analysis is concerned with precise delineation of how economic models work at various stages, or disequilibrium situations. In dynamic analysis, the path that the variables take to reach an equilibrium (or disequilibrium) can be made explicit by bringing in the time element. The variables take on values by time periods, and thus there movement and interaction can be studied. For the fact that dynamic analysis can be too mathematical and complex, most dynamic analysis are left for advanced work.

3.2.4 The Concept of Equilibrium

Economists define equilibrium as the balancing of opposing forces, or a stabilizing process where there is no tendency for change unless the balance is disturbed. Time is extremely important in explicit discussions of equilibrium concepts. Time here refers to the period of time in which certain changes in an equilibrium situation can take place and when changes cannot take place. Thus a short-run equilibrium refers to some arbitrary time period in which the capital stock of an economy is held constant, for example. The economy can then be examined under this constraint, which emphasises the utilisaion of existing of existing resources and focuses upon the employment of existing factors of production.

A short-run equilibrium assumes that other variables both within and acting upon an economic system remain unchanged. Thus in the short-run equilibrium of an economy, demographic data,

social and political attitudes, various legal and religious institutions, customs, tradition and many other attitudes are assumed to remain constant and permit the examination of the economy without serious disturbances.

When you relax the assumption of constancy, permitting capital to grow and some or all of the other variables to change, the long-run equilibrium concept takes effect. The long-run equilibrium concept embodies economic growth and deals with the type of variable that changes only slowly over time. Disturbances that occur to an economy in various short-runs become smoothed out, and long trends of the economy become apparent. The meaning of an equilibrium analysis in the long-run context is the analysis of the condition necessary for an economy to grow while maintaining some balance.

Another way you can view these equilibrium concepts is to look at them in terms of stock and flow conditions. The short-run concept is satisfied when flow variables are in equilibrium. For example, since investment spending also occurs in the short run, to achieve a flow equilibrium condition, additions to the stock of capital as a result of current net investment must be ignored. In the short run, the emphasis is on the demand side of investment spending. In the long run, additions to capital stock cannot be ignored, and you can view the long-run equilibrium as a stock equilibrium. In the long run, the effects of investment spending on the productive capacity of the economy, the supply side, must be recognised. For an equilibrium growth over time, the growing capacity must be balanced by the growth on the demand side.

You need to note that it is possible to have a short-run or flow equilibrium but not a long-run or stock equilibrium. Additions to capital stock do disturb the long-run equilibrium. The analysis of how an economy adjusts to these disturbances received much attention from post-Keynesian scholars. It can be said that it is not possible to have a long-run or stock equilibrium without having a flow equilibrium. When an economy reaches "full" equilibrium, both flow and stock equilibria must be attained, implying the economy has reached the stationary state. In this stationary state, the additions to capital are balanced by an equal consumption of capital, so that the stock of capital remains fixed or constant.

Self-Assessment Exercise
Use what you have learned from this unit to distinguish between microeconomic and analysis and macroeconomic analysis.

4.0 Conclusion
You must have learned the two basic branches of economics: micro and macroeconomics. You were also informed of the basic differences between micro and macroeconomic analysis. The features of macroeconomic analysis were highlighted as follows:
First, the distinguishing feature of macroeconomic analysis is its emphasis on aggregate quantities and relationships. Secondly, while the most important benefit of economic aggregation is that it confers a high degree of stability to aggregate relations that may not be found otherwise, its major problem is that of classifying widely varying goods or activity into one general category. Third, the major macroeconomic variables include: consumption expenditure, investment expenditures, unemployment, and the price level. Finally,

macroeconomic equilibrium can be viewed as the balancing of opposing macroeconomic forces, or stabilising process where there is no tendency for change unless the balance is disturbed.

5.0 Summary

Economics is a discipline that is divided into two major branches basically made up of **Microeconomics** and **Macroeconomics**. The tools of economic analysis are derived from these two basic branches.

While *microeconomics* is the study of economic actions of individual households and firms, *macroeconomics* is the study of broad aggregates including total employment, national income, inflation, and foreign trade, among others.

Both branches of economics deal with price and income determination, as well as the use of scarce resources. Microeconomics however, concentrates in the analysis of individual product prices and markets, and the allocation of specific factors of production to particular uses. In microeconomics, the determination of the incomes of individuals is encompassed within the general pricing process within an economy. Individuals earn their incomes by selling factors of production, the prices of which are determined in the same manner as all other prices.

Macroeconomics as a concept is concerned with aggregate quantities and relationships, such as aggregate consumption, investment, and government expenditures. Macroeconomic analysis emphasizes the interactions in the economy as a whole. It simplifies the individual building blocks of the analysis in order to retain a manageable analysis of the complete interaction of the economy. Macroeconomists typically do not worry about the breakdown of consumer goods into cars, bicycles, televisions, and radios, for example.

The building blocks of macroeconomics are discussed in terms of the following three concepts:

1. The Gross Domestic Product (GDP)

This represents the value of goods and services produced in the economy in a given period, such as a year. Gross Domestic Product is the basic measure of the total output of goods and services in the economy.

2. Aggregate Price Level

This is a measure of the of the average level of prices of goods and services in a given economy. It tells you what is happening to prices on the average. When the price level is rising, we say that the economy is experiencing inflation, and when it is falling, we say the economy is experiencing deflation.

3. The Unemployment Rate

Unemployment rate is the percentage of the economy's labour force without a job. The term, 'labour force refers to those people of the working age who in principle would like to work if a suitable job were available to them. Those individuals that are of working age but have no intentions and willingness to look for job are not in the labour force and not counted as unemployed.

You were informed that one of the major advantages of working with highly aggregated variables is that they confer a high degree of stability to aggregate relations that may not be found otherwise. The major problem is that of aggregation.

The aggregation problem, often referred to the problem of classifying widely varying goods or activities into one general category treated as a homogenous variable and the failure to recognise the separate components of macroeconomic aggregates often results in faulty and misleading work in macroeconomics.

We considered the importance of macroeconomic variables and pointed out that the first distinction you should make among macroeconomic variables is whether they are stock or flow variables. This distinction is necessary because of the time element present in all economic variables. A stock variable is one that has meaning only at a specific point in time. Thus the capital stock of an economy has meaning only when it is expressed as a magnitude at a certain time.

You can look at macroeconomic equilibrium by looking at them in terms of stock and flow conditions. The short-run concept is satisfied when flow variables are in equilibrium.

6.0 Tutor-Marked Assignment
With typical examples, discuss the building blocks of micro and macroeconomic analysis.

7.0 References and Further Readings
Campagna Anthony, S (1974) *Macroeconomics Theory and Policy,* Boston: Hougthon Mifflin

Hendersen, J. M. and Quandt, R. E. (1980) Microeconomic Theory: A Mathematical Approach, 3rd edition, New York: McGraw-Hill Book Company

UNIT 2: TOOLS AND MODELS OF ECONOMIC ANALYSIS

Content

1.0 Introduction

This unit is aimed at acquainting learners with the basic tools of economic analysis. It introduces the basic concepts of economic models, economic data, diagrams, lines, and equations as tools of economic analysis. By being acquainted to these concepts, the learner will begin to appreciate the application of economic principles to business, economic and administrative decisions. The idea is that economic models give rise to tools of economics analysis. And data are needed for a reasonable analysis Therefore, we will begin with the basic models and principles of data that will aid in the understanding of the relevant tools of economic analysis.

2.0 Objectives

Having gone through the activities of this unit, you should be able to:
1. Define economic data and economic models.
2. Enumerate and explain the tools of economic analysis
3. Explain the use of data and equations in the analysis of economic issues.

3.0 Main Content

3.1 Models of Economic Analysis

There are basically two basic classifications of models in economic analysis:
(i) The Microeconomic Models; and,
(ii) The Macroeconomic Models.

3.1.1 The Microeconomic Models

The basic analytical model in any economic analysis consists of five basic steps:
(i) specification of the economic environments; (ii) imposition of behavioral assumptions;
(iii) adoption of economic institutional arrangements; (iv) determination of equilibrium; and,
(v) evaluation of outcomes resulting from the undertaken institutional arrangement.

1. Specification of Economic Environments
The first step in the analysis of an economic issue is to specify the economic environment. The specification of economic environment can be divided into two levels:
(i) description of the economic environment; and,
(ii) characterisation of the economic environment.

The more clear and accurate the description of the economic environment, the greater the probability of the correctness the theoretical conclusions. The more refined the characterisation of the economic environment, the simpler the economic arguments and conclusions will be.

2. Imposition of Behavior Assumptions
The second step in the analysis of an economic issue is to make assumptions on individuals' behaviour. Making appropriate assumptions about individual behaviours is of fundamental importance for making valuable economic assessments. For instance, one key assumption modern economists make about an individual's behavior is that an individual is self-interested. This assumption appears reasonable and realistic.

3. Adoption of Economic Institutional Arrangement
The third step in the analysis of an economic issue is to adopt the economic institutional arrangements or economic mechanisms, often regarded as the rules of the game. Depending on the problem under consideration, an economic institutional arrangement could be exogenously given or endogenously determined. For instance, when studying individuals' decisions in the theories of consumer and firm behaviour, one implicitly assumes a competitive market mechanism.

4. Determination of Equilibrium Position
The fourth step in the analysis of an economic issue is to make trade-off choices and determine the "best" one or the equilibrium choice. Given the economic environment, institutional arrangement, and other constraints, such as resources, and budget constraints, individuals will react, based on their incentives and own behavior, by choosing an outcome from identified feasible or equilibrium outcomes.

Evaluations
The fifth step in the analysis of an economic issue is to evaluate outcomes resulting from the institutional arrangement adopted and to make value judgments of the identified equilibrium outcome based on the criterion of efficiency. If an outcome is not efficient, there is room for improvement. The other criterions include equity, fairness, incentive-compatibility, informational efficiency, and operation costs for running an economic mechanism.

With these preliminaries, we can enumerate the microeconomic models as follows:

1. *Models of Consumer behaviour*: the utility maximization model; the demand model; and, the income and leisure model.

2. *Models of the Production behaviour*: profit-maximisation model; cost-minimisation model; and, input-output model.

3. *The Market Equilibrium models*: the static equilibrium model; and, the dynamic equilibrium model.

The scope of this course material does not allow for detailed discussion on examples of these models, but you can refer to: ***Henderson and Quandt (1980) "Microeconomic Theory: A Mathematical Approach," Third Edition***, as cited listed in the references below.

3.1.2 The Macroeconomic Models

A macroeconomic model can be regarded as an analytical tool designed to describe the operation of a given economy. Macroeconomic models are used in examining the dynamics of aggregate quantities such as, the total amount of goods and services produced in an economy, total income earned, the level of employment of productive resources, and the level of prices;

Macroeconomic models may be logical, mathematical, or computational. The different types of macroeconomic models serve different purposes and have different advantages and disadvantages.

The different classifications of macroeconomic models include:

1. ***Simple theoretical models***. These are simple textbook descriptions of the macroeconomy, involving simple equations or diagrams. Examples include the IS-LM model, the Mundell-Fleming model of Keynesian macroeconomics, and the Solow model of neoclassical growth theory. These models share many features: they are based on a few equations involving few variables, which can be explained with simple diagrams; many of the models are static and some are dynamic, describing the economy over many time periods. The variables appearing in these models often represent macroeconomic aggregates, such as gross domestic product (GDP), employment, and inflation, rather than individual choice variables.

2. ***Empirical forecasting models***. These are advanced quantitative models that are designed to estimate the relationships between different macroeconomic variables using time-series analysis. These empirical models describe relations between aggregate quantities in a very detailed manner. The models can use several equations to describe the evolution of several prices and quantities over time, making computers essential for their solution.

3. ***Dynamic stochastic general equilibrium models***. These are macroeconomic models based on rational choice. These models begin by specifying the set of agents that are active in the economy, such as households, firms, and governments in one or more countries, as well as the preferences, technology, and budget constraints of each economic agent. Each agent is assumed to be making optimal choices, taking into account prices and the strategies of other agents both in the current period and in the future.

4. ***Agent-based computational macroeconomic models***. This is derived from a model called agent-based computational economies (ACE). This model seeks to break down aggregate macroeconomic relationships into microeconomic decisions of individual agents. The models

also begin by defining the set of agents that make up an economy, and specifying the types of interactions individual agents can have with each other or with the market as a whole.

3.2 Data Applications

Economic data represent pieces of evidence or information about economic behaviour in a given society. Economic data are frequently used in analysing economic issues and problem situations. Economic data interact with economic models in two ways:

First, economic data helps in the quantification of the economic relationships to which theoretical models draw attention. It may be insufficient to theorize that all bridges across the Niger, for example, are likely to be congested. To choose the best route across the Niger, you need to know how long you would have to queue at each bridge, assuming multiple bridges across the Niger. You would need some facts. The model is useful as it helps you determine which facts are likely to be the most important.

Second, the data are used in testing economic models. Economists, like other social scientists, must check to see whether economic theories tally with the relevant facts that are available.

Economic data are basically classified into two types:
1. ***The Time Series Data.*** Time series is a sequence of measurements of a variable at different points in time, monthly or annually. These show how a variable changes in value over time. An example of time series data is presented in table 3.2.1 below, indicating the spending profile of the federal government.

Table 3.2.1: Spending Profile of the Federal Government on Education (1986 – 2000)

YEAR	Percentage Share of Education in Federal Government Expenditures	
	Recurrent (%)	Capital (%)
1986	6.3	4.3
1987	2.3	1.5
1988	7.5	3.9
1989	11.6	2.6
1990	6.6	1.7
1991	3.3	1.0
1992	3.6	1.3
1993	3.9	2.4
1994	8.2	3.9
1995	7.6	2.0
1996	9.0	1.5
1997	8.2	1.4
1998	0.8	3.4
1999	5.2	1.7
2000	8.5	4.4

Source: Central Bank of Nigeria, Annual Report (Various Issues).

2. *Cross-Section Data.* The cross-section data record at a point in time the way an economic variable differs across different individuals or groups of individuals. A simple example of the cross-section data is presented in table 3.2.2 below. The table shows a cross-section of employment rates in selected countries in 1998 (*a point in time*).

Table 3.2.2: Unemployment by Country, 1998
(% of Labour Force)

Country:	USA	Japan	German	France	United Kingdom
Unemployment Rate:	4.5	4.1	11.2	11.8	6.2

Source: OECD, Economic Outlook

3.2.1 Economic Models and Economic Data: Some Simple Examples

You can consider the following example of economics in action. The Power Holden Company of Nigeria (PHCN) is losing money. Some people think PHCN cannot survive without government subsidies. Others think that if it was privatized or run differently, it could break even and operate profitably. You are invited to advise on the demand charge for energy consumption that would raise revenue. How would you analyse the problem?

To organise your thinking, or in economic language, to build a model, you will require a simplified picture of reality which isolates the most important elements of the problem. You would begin with a simple equation or model in the following form:

Revenue (R) = (Unit demand charge)(Number of units consumed) (3.1)

Equation (3.3.1) organizes our thoughts around two factors: (i) the unit demand charge; and (ii) number of energy units consumed. PHCN controls directly the unit demand charge, but can influence the consumers only through the demand charge that it sets.

The number of PHCN's customers may be determined by need, convenience, and tradition, and may be completely unresponsive to changes in the demand charge. It follows that equation (3.1) should not look at the number of energy consumers as fixed, rather as variable. The economist needs a theory or model of what determines the number of consumers. The demand for energy must, therefore, be modeled as follows:

First, the demand charge itself matters. All things being equal, higher demand charges should reduce the demand for electricity. The important thing is the price of electricity relative to the price of other sources of energy, such as generators, wood, kerosene, and the like. If the prices of these other sources of energy remain constant, lower demand charges would encourage the use of electricity as an energy source. Rises in the price of these other sources of energy would also encourage the demand for electricity. In addition, if consumers' income rises, they can afford to increase their demand for electricity.

This leads us to a simple model of demand for electricity given as follows:

$$Qd = f(Pe, Ps, I, \ldots) \qquad (3.2)$$

where Qd = Quantity of electricity demanded by the consumers
Pe = the unit demand charge or price of electricity
Ps = Prices of other sources pof electricity
I = the consumers' incomes
f = depends on or is a function of

The notation f( ) is a shorthand for 'depends on all the things listed inside the brackets.' The dotted lines inside the brackets imply that we have omitted some possible determinants of demand for electricity.

You can begin to appreciate the fact that writing down a model is a safe way of tasking yourself to look for all the relevant events, to worry about which effects must be taken into account and which are minor and can somehow be ignored in answering economic questions.

From the above formulations, the total revenue collected by PHCN can be modeled as follows:

$R = Pe \times Qd$

$= Pe \times f(Pe, Ps, I, \ldots)$ (3.3)

where R refers to total revenue.

Your natural reaction may be to wonder why all the fuss on these equations. Given few minutes thought, you would probably have organised your approach along similar lines. This should be the correct reaction. Models are simply devices for ensuring that the economists think clearly about a particular economic problem. Clear thinking begins with some simplifications. You would agree that the real world is too complicated for us to think about everything at once. Too much simplicity would however, lead to the omission of a crucial factor in the analysis. On the same token, too much complexity will make us lose any feel for why the answer to our economic questions is turning out as we see it today.

Data are sometimes used as a guide on which economic factors are crucial and which are not crucial. It is often not enough to understand the forces at work. You need to quantify such factors or forces. For these reasons, it is important to look at the interaction between economic models and economic data.

The equation (3.3) above represents a simple model of the factors determining revenue from the consumption of electricity. In organising our thinking, we have concluded that, all things being equal, higher demand prices will be accompanied by lower quantity demanded of electricity. Theory alone cannot answer our economic question. Whether or not higher demand charges or prices raise or lower total revenue accruing to PHCN will depend entirely on the *empirical* or factual issue of how many consumers are discouraged by higher demand charges.

Nevertheless, economic models are useful. They help in predicting what will happen to the dependent economic variables when changes occur in the independent variables.

3.3 Tools of Economic Analysis

The illustrations in section 3.2 are typical examples of economic analysis, using tables, data, and equations as tools. Economists have put in place three basic tools of analysis, including diagrams, lines, and equations. In this section, we examine these tools individually.

Diagrams, lines, and equations are useful tools of economic analysis. While diagrams and lines present simplified picture of economic relationships, equations are models used in cause and effect relationships among economic variables.

3.3.1 Diagrams

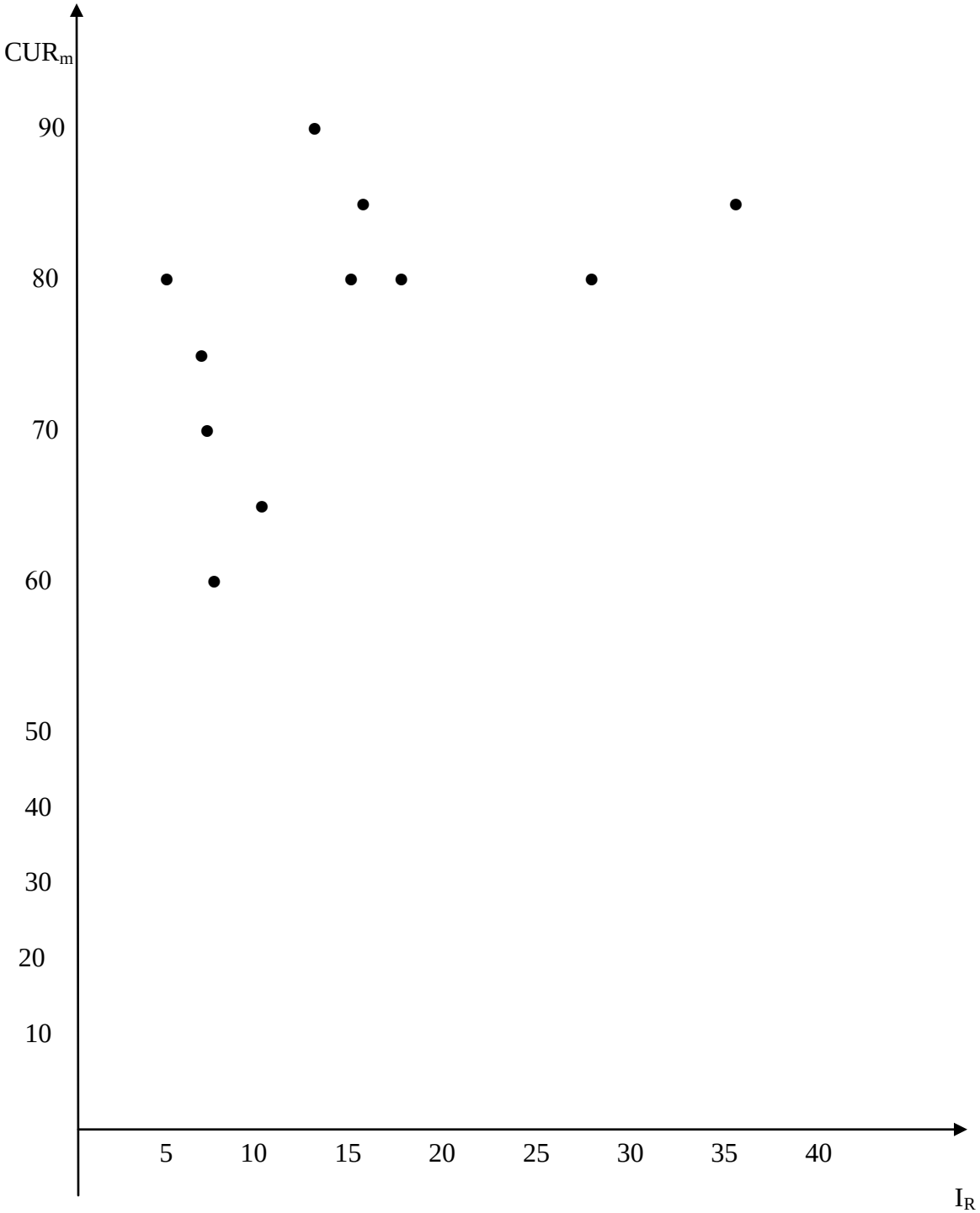
The most often used diagram in economic analysis is the *scatter diagram*. A scatter diagram shows how two variables are related. It plots pairs of values simultaneously observed for two different variables. As an example, consider the following table 3.3.1, which presents evidence of the relationship between capacity utilization rate in manufacturing (CUR_m) and the rate of inflation (I_R). The corresponding scatter diagram is presented in figure 3.3.1.

Table 3.3.1: Capacity Utilisation and Inflation Rates

Capacity Utilisation Rate	Inflation Rate
85	14
83	16
82	3
80	5
79	13
76	34
77	21
78	15
73	17
70	10
63	7

Source: CBN Statistical Bulletin, 1998

Figure 3.3.1: Scatter Diagram on Capacity Utilisation and Inflation Rate



If it is possible to draw a line or curve through all the points in figure 3.3.1, it will suggest, but not prove, that there is an underlying relationship between capacity utilisation rate (CUR_m) in manufacturing and the rate of inflation (I_R) Though economists may find it difficult to interpret scatter diagrams, scatter diagrams provide helpful clues on the underlying relationship between variables.

3.3.2 Lines

Lines are drawn through a scatter diagram to show the direction of the relationship between two variables. In figure 3.3.1 above, a line could be drawn through the scatter of points that were plotted. Such line would show the average relationship between capacity utilization rate and inflation rate. You can use the line to make more precise statement about the relationship between the two variables than otherwise. By examining the slope of the line, you could see how fast the capacity utilisation rate is changing with respect to changes in the inflation rate. You could also be able to quantify the average relationship between capacity utilisation in manufacturing and the rate of inflation.

An important question you should ask is: given a particular set of scatter points, how do we decide where to draw the line, given that it cannot fit all the points directly? The answer to this question can be provided by a branch of economics referred to as *econometrics*. This is a branch devoted to the measurement of relationships between variables using economic data. The details on econometric analysis are not our concern here, but the idea is simple enough. Having plotted he points describing the data, a computer is used to work out where to draw the line to minimise the dispersion or deviation of the points around the line.

3.3.3 Equations

As mentioned in the earlier discussions, equations are used in the analysis of cause and effect relationships in economics. They are helpful in summarizing economic behaviours. Equations contain variables explaining economic behaviours. By definition, a variable is anything whose value can change. Examples of variables in economics are income, age, consumer taste, quantity, price, and the like.

In any given equation, a variable either be *dependent* or *independent*. The dependent variable is the variable whose behaviour is to be determined by a given equation, while the independent variable is the variable through which the behaviour of the dependent variable can be determined. Variables can also be classified as either endogeneous or exogeneous. An endogeneous variable is a variable whose behaviour or value are determined within a given equation, while exogeneous variables are variables whose values are given in the short run and determined outside a given equation.

A typical example of an equation used in economic analysis is given below (equation 3.4). The equation represents the behaviour of quantity demanded of a commodity, say, commodity A.

$$Q^A_d = a - bP_A \qquad (3.4)$$

where Q^A_d = quantity demanded of commodity A

a = the demand intercept

b = slope of the demand equation

P_A = unit price of commodity A

Equation (3.4) can be referred to as the demand equation for commodity A. The variable Q^A_d, is the dependent variable, while P_A is the independent variable. Interpreting equation (3.4), we say that the quantity demanded of commodity A can be explained by variations in the unit price of

commodity A. The negative sign before the coefficient, b in equation (3.4) indicates that when plotted, the demand equation is downward-sloping. Increases in the unit price of commodity A, other things being equal, will lead to decreases in the quantity demanded of commodity A, and vice versa.

The constant term, a, can be said to be composed of the exogeneous variables. The value of this term can only change as a result of changes in the exogeneous variables such as income, taste, prices of other commodities, not included in equation (3.4).

To illustrate the use of equation (3.4), look at a specific form of the equation given as follows:

$$Q^A_d = 100 - 0.2P_A \qquad (3.5)$$

Equation (3.5) shows that no matter the unit price of commodity A, the consumers will be willing to demand 100 units of it at any given period. The coefficient, 0.2, shows the rate at which the quantity demanded of commodity A changes with respect to a unit change in the price of commodity A. If the unit price rises by N1, for example, the quantity demanded will fall by 0.2 units. The reverse will be true for a unit decrease in the price of commodity A.

If P_A = N5/unit, $Q^A_d = 100 - 0.2(5) = 99$ units

If P_A = N6/unit, $Q^A_d = 100 - 0.2(6) = 98.8$ units

If P_A = N4/unit, $Q^A_d = 100 - 0.2(4) = 99.2$ units

Self-Assessment Exercises

1. Enumerate and briefly discuss two major differences between micro and macroeconomic models of economic analysis.
2. You have been employed by the Police research department to study whether the level of crime is affected by the percentage of people unemployed. How would you approach this issue? What data would you look for?

4.0 Conclusion

This unit has exposed learners to economic data, the models, and basic tools of economic analysis. There are two basic classifications of economic models, the micro and macroeconomic models. The basic tools that were discussed relate to economic models, economic data, diagrams, lines, and equations. You learned that economic data can be classified into time-series and cross-section data. To practicalise these discussions, the pricing system of the Power Holden Company of Nigeria (PHCN) was used as an example. Your also learned that the most often used diagram in economic analysis is the scatter diagram. Finally, an important emphasis was placed on the linear demand equation, with relevant practical examples.

5.0 Summary

In an outline form, we summarise our discussions as follows:
There exists a continuing interplay between economic models and economic facts in economic analysis., economic relations, and economic problems. A model is a simplified framework for organising the way we think about a problem.

Data, often referred to as facts are important in economic analysis for two basic reasons: they suggest relationships which economists aim to explain; having formulated our economic theories, we also use data to test our hypotheses and to quantify the effects implied by them. Time-series data contain information about values of a given variable at different points in time.

Cross-section data refer to data at the same point in time but to different values of the same variable across different people.

Tables are used in presenting data the way they can easily be understood.

Analytical diagrams are useful in building economic models. They show relationships two variables, other things being equal. If one or more of these other things change, the line or curve resulting from the plot of the values of the two variables will shift.

Equations are used in analysing causes and effects among economic variables. They contain variables explaining economic behaviours.

6.0 Tutor-Marked Assignment

The following equation represents a relationship between household consumption expenditure, C and income, Y: $C = 120 + 0.65Y$

(a) Explain what the figure, 120 stands for in the consumption-income relationship, and the type of relationship

(b) Suppose the different income levels are as follows(N'billions):

Y = 100, 120, 125, 140, 80, 115, 145, 150, 166, 200, calculate the corresponding consumption levels using the relationship specified and plot the figures on a two-dimensional graph, with consumption, C, at the vertical axis and income, Y, at the horizontal axis.

7.0 References and Further Readings

Begg, D., Fischer, S., and Dornbusch. R, (2000) *Economics, 6th Edition* (England: McGraw-Hill Publishing Company).

Gujarati, D. N. (1995) Basic Econometrics, 3rd edition, New York: McGraw-Hill Inc.

Hendersen, J. M. and Quandt, R. E. (1980) Microeconomic Theory: A Mathematical Approach, 3rd edition, New York: McGraw-Hill Book Company

UNIT 3: MARKET PARTICIPANTS AND CIRCULAR FLOW OF ECONOMIC ACTIVITY

Content

1.0 Introduction

Unit 2 has exposed you to the basic tools of economic analysis. In this unit, we look at the circular flow of economic activity and how market participants influence the activities of a given economy. The unit is important for all business decision makers, as businesses cannot operate in isolation.

2.0 Objectives

Having gone through the activities in this unit, you will be expected to:

1. Define the circular flow of economic activities
2. Enumerate the major characteristics of market participants on a macro level
3. Explain business decisions based on the information you acquired from the unit.

3.0 Main Content

3.1 Market Participants

Over 140 million consumers and tens of thousands of businesses and government agencies directly participate in the Nigerian economy. Thousands of foreigners also participate in the daily economic activities by selling and buying goods in the Nigerian markets. These market participants come into the marketplace to satisfy specific economic goals. Consumers, for example, come into the market with the basic objective of buying the most desirable goods and services that their limited budgets permit. You cannot afford everything you want. So you must make choices about how to spend your limited available naira. Your goal is to maximise the satisfaction or utility you get from your disposable income. Businesses also attempt to maximise earnings in the marketplace. Business earnings or profits are the difference between sales receipts and total costs. To maximise profits, business firms must use their resources efficiently in the production of goods needed by the consumers for maximizing their satisfaction. Government agencies or the public sector also have goals to maximise. The major purpose of government is usually to use available resources to serve public needs. The available resources are also limited, so that all arms of government, local, state, and federal must use scarce

resources carefully, with the major aim of maximizing the general welfare of the society. Foreigners pursue these same goals, participating in our markets as consumers or producers.

Market participants often lose sight of their respective goals. For instance, consumers sometimes make impulsive purchases and latter wish they had used their incomes more wisely. On the same token, a producer may decide to take a two-hour lunch, even at the expense of maximum profits. Elected officials sometimes put their personal interests ahead of the public's interest. In all sectors of the economy, however, the basic goals of utility maximisation, profit maximisation, and welfare maximisation explain most of the market activities.

The human desire to maximise the returns on limited resources leads us to participate in the market, buying and selling various goods and services. Our decision to participate in the exchange of goods and services is usually prompted by two motives:

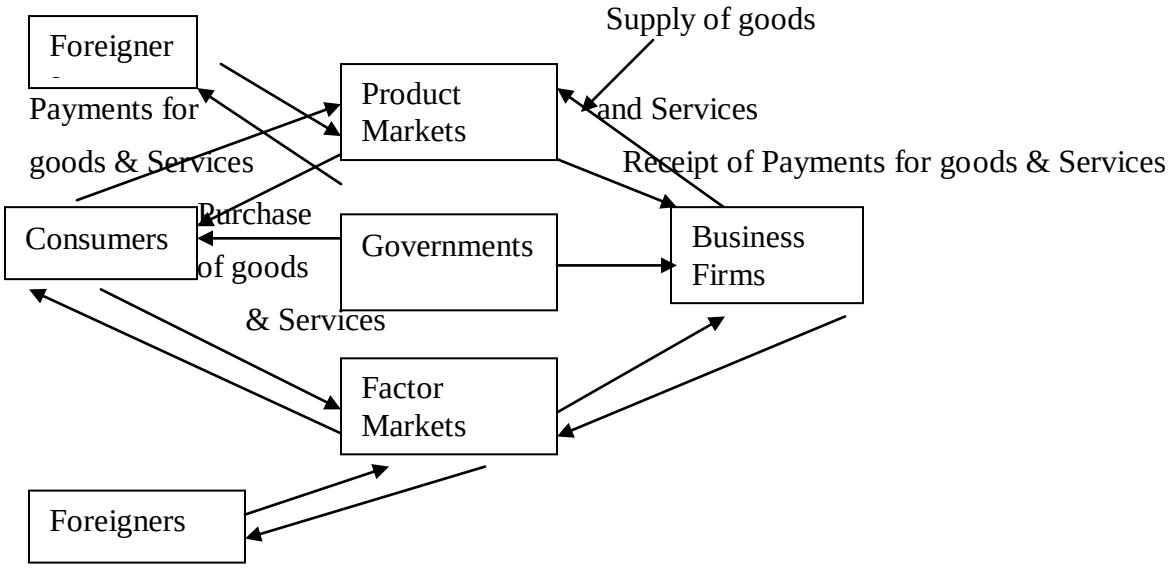
First, most of us are incapable of producing everything we desire to consume.
Second, even if we could produce all our own goods and services, it would still make sense to specialise in producing only one product we are good in producing and trading it for other desired goods and services.

Our economic interactions with others are necessitated by two major constraints:
First is our absolute inability as individuals to produce all the things we need or desire.
Second is the limited amount of time, energy, and resources we possess for producing those things we could make ourselves.

3.2 The Circular Flow of Economic Activities

The circular flow of economic activities show how all the market participants interact in the production and distribution of goods and services in an economy. It illustrates the flow of economic activities among businesses, households, the government, and foreigners. Figure 3.2.1 is an illustration of the circular flow. It summarises the kinds of interactions that occur among market participants

Figure 3.2.1: Circular Flow of Economic Activities



Note that the arrow → indicates supply of factors to the factor markets by consumers, reading from the consumer's box to the factor market box. The opposite direction ← indicates receipt of factor payments by the consumers, as we assume that the consumers are owners of factor of production. Same notation goes for the arrows between the factor market's box and business firm's box, as well as between foreigner's box and factor market's box. These notes were needed for a cleaner diagrammatic presentation.

Generally, the directions of the flow of activities are shown by the arrows as in figure 3.2.1. At the beginning is the household. The households or consumers supply factors of production to the business firms through the factor markets. The business firms, in turn, purchase the factors of production from the households through the factor markets. These business firms use the factors of production to produce goods and services. The goods and services are then supplied to the households or consumers through the product markets. The households, in turn, purchase the goods and services from the business firms through the product markets. Now the flow of goods and factors of production can be said to be complete.

The next flow is the flow of income from, or payments for goods, services, and factors of production. The households receive income from the sale of factors of production. These receipts are in the form of rent for land, Wages for labour, and interests for capital. The households, in turn, pay for the goods and services. These payments are received by the business firms in the form of revenue from sale of goods and services, and profits being the earnings from entrepreneurship.

The flow also shows that federal, state, and local governments acquire resources from factor markets and provide services to both consumers and business firms. Foreigners also participate by supplying import items, purchasing export items, and buying and selling factors of production.

The simplest way to keep tract of all the above market activities is to distinguish between two basic markets: the factor markets and the product markets.

3.2.1 The Factor Markets

The factor markets are the markets where factors of production are exchanged for money. These are the places where factors of production, such as land, labour, and capital, as well as entrepreneurship are bought and sold.

3.2.2 The Product Markets

The product markets are markets where finished goods and services are bought and sold. At the end of a hard day's work, consumers or households go to the market to purchase goods and services. In this context, consumers interact with business firms, purchasing goods and services these firms produced. Foreigners also participate in the product market by supplying goods and services (imports) to Nigerians and buying some of its products (exports).
The arrows connecting product markets to consumers in figure 3.2.1 emphasise the fact that consumers, by definition, do not supply products. To the extent that individuals produce goods and services, they do so within the government or business sector. An individual who is a medical doctor, a dentist, a lecturer, or an economic consultant, functions in two sectors. When selling services in the market, this person is regarded as a "business", when away from the

office, the person is regarded as a "consumer." This distinction is essential in emphasizing that "the consumer is a final recipient of goods and services produced."

Self-Assessment Exercise

Discuss briefly the role of market participants in economic development

4.0 Conclusion

Unit 3 has informed us about the composition of market participants in an economy, including: (i) the consumers; (ii) the businesses; (iii) the foreigners; and, (iv) the governments. These participants come into the marketplace to satisfy specific economic goals. Consumers attempt to maximise their satisfactions. The businesses aim at maximizing their earnings or profits. Governments attempt to maximise public welfare. We also learned that the circular flow of economic activity summarises the directions of the flow of economic activities. In this flow, factor markets and product markets were distinguished.

5.0 Summary

You have been informed of the fact that multiple number of businesses and government agencies directly participate in the Nigerian economy. Thousands of foreigners also participate in the daily economic activities by selling and buying goods in the Nigerian markets. The market participants come into the marketplace to satisfy specific economic needs. Consumers, for example, come into the marketplace with the aim of buying the most desirable goods and services that their limited budgets permit. Businesses attempt to maximise earnings in the marketplace. Business earnings or profits are the difference between sales receipts and total costs. To maximise profits, business firms must use their resources efficiently in the production of goods needed by the consumers for maximizing their satisfaction.
Government agencies or the public sector also have goals to maximise. The major purpose of government is usually to use available resources to serve public needs. The available resources are also limited, so that all arms of government, local, state, and federal must use scarce resources carefully, with the major aim of maximizing the general welfare of the society. Foreigners pursue these same goals, participating in our markets as consumers or producers.

We noted that the decision to participate in the exchange of goods and services is usually prompted by two motives:
First, most of us are incapable of producing everything we desire to consume.
Second, even if we could produce all our own goods and services, it would still make sense to specialise in producing only one product we are good in producing and trading it for other desired goods and services.
We also noted that the simplest way to keep tract of all market activities in the circular flow of economic activities is to distinguish between two basic markets: the factor markets and the product markets.

6.0 Tutor-Marked Assignment

Using the circular flow model, present the flow of economic activities associated with the sale of a piece of landed property to a business organization.

7.0 References and Further Readings

Begg, D., Fischer, S., and Dornbusch, R, (2000) *Economics, 6th Edition,* England: McGraw-Hill Publishing Company

Campagna Anthony, S (1974) *Macroeconomics Theory and Policy,* Boston: Hougthon Mifflin

Hailstones, T. J. (1980) *Basic Economics, 6th Edition,* Cincinnati: South-Western Publishing Co.

MODULE TWO: THEORIES OF CONSUMER BEHAVIOUR, INDIVIDUAL AND MARKET DEMANDS

UNIT 1: CONSUMER CHOICE AND MAXIMISATION OF UTILITY

Content

1.0 Introduction

Because economic systems are made up of a collection of individuals involved in choosing among different alternatives, it will be wise to begin our analysis of consumer behaviour in terms of individual choice patterns. Individuals attempt to choose among different alternatives with the aim of maximising utility or satisfaction. To effectively address the choice and utility maximisation issues, we shall look at the roles of individuals that of interest to economists, the axioms of rational choice, the economic definition of utility, the indifference curve, and the principle of utility maximization.

2.0 Objectives

Having gone through the activities in this unit, you will be able to:
1. Explain consumer choice
2. Define the concept of utility
3. Explain the principle of utility maximization

3.0 Main Content

3.1 Role of Individuals

Every rational individual operates in at least three roles that are of interest to economists. The roles include:

(i) ***The individual as a consumer***. Individuals demand a variety of goods and services, because they presumably derive some welfare from them.
(ii) ***The individual provides productive services***. The most important resource provided by the individual is labour. The individual must decide how much labour to trade in exchange for goods and services in the market. Individuals also provide capital as a productive resource

through savings. An individual may also decide to invest in his/her own education or health thereby investing in human capital.
(iii) The individual participates in the political process. By voting and being involved in other political activities, the individual expresses his/her preferences regarding a given political party and government's provision of goods and services like defense, policy, trash collection. The individual also expresses his/her willingness to pay for these services by paying taxes.

It is important to note that these roles cannot be separated from one another. Any decision an individual makes as a consumer will have an effect on decisions as a provider of resources, and on decisions as a voter in the political process.

Economic textbooks often refer to an individual as "economic man" (or *homo economicus*) and concentrate attention on the individual's role as a consumer only. Other roles are never discussed explicitly. Nevertheless, we discuss, in general, ***individual preferences*** and the ***concept of utility***

3.2 Axioms or Postulates of Rational Choice
Economists often begin the analysis of individual's choices by specifying a basic set of postulates (or axioms) that characterize *rational* behaviour. They begin with the concept of "preferences": when an individual prefers choice A to choice B, it is taken to mean that, all things being equal, he/she feels better off with choice A than with choice B. Such preference relation is assumed to have two basic properties:

(i) ***Completeness***: If A and B are two choice situations, the individual can always specify exactly one of the following three possibilities:
(a) A is preferred to B
(b) B is preferred to A
(c) A and B are equally attractive

Individuals are assumed to completely understand and can always make up their minds on the desirability of any two alternatives.

(ii) ***Transitivity***: If an individual feel that choice A is preferred to choice B and that B is preferred to choice C, then he/she must always feel that A is preferred to C. It follows that individuals do not articulate preferences that are self-contradictory.

Economists refer to this ranking of relative desirability as ***utility***, following the terminology introduced by a political theorist, Jeremy Bentham in 1848. The term utility assumes that more desirable alternatives offer more utility than do less desirable ones. Let us examine in detail the concept of utility.

3.3 The Concept of Utility
Economists are of the opinion that individuals make those choices that are most favourable to them, so that from among available alternatives, individuals are assumed to select the one that maximizes their utility. The utility-maximisation hypothesis recognizes the fact that individuals seldom take actions that are against their best interests.

Because the term utility is used to refer to overall satisfaction which can be affected by a variety of factors, a common practice has been to devote attention exclusively to choices among quantifiable alternatives such as, relative quantities of goods and shelter, number of hours worked per day, or votes among specific tax formulas, while holding other things that affect choice behaviours constant. This ***ceteris paribus*** (other things being equal) assumption is invoked so as to make analysis of choices manageable within a specified setting.

An important example of the ***ceteris paribus*** assumption is as follows:
Consider an individual's problem of choosing, at a given point in time, among n consumption goods: X1, X2, X3, …, Xn. Assuming the individual seeks to maximise utility *function* of the form:

Utility = U(X1, X2, X3, …, Xn; other things), (3.3.1)

where the X's are quantities of the goods chosen and the "other things" is to remind us that many aspects of the individual's welfare is being held constant in the analysis.

The utility function is often used to indicate how an individual ranks certain bundles of goods available at a given period.

It is important to note that the measurability of utility in terms of units of measurement has been a problem in economic theory. It is also problematic to compare utilities. To say that the utility of a bundle of goods A, U(A), is greater than that of another bundle of goods B, U(B), only means that the bundle of goods A is preferred to the bundle of goods B. You cannot answer the question by "how much?" bundle A is preferred to bundle B.

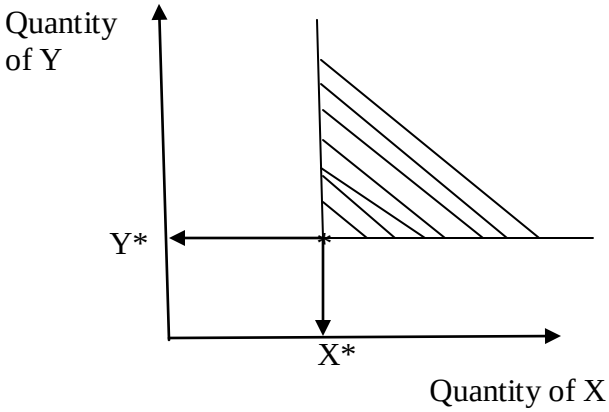
3.3.1 Assumptions on the Utility Function

The following are few basic assumptions guiding the use of utility functions in the analysis of consumer behaviours. These assumptions must be taken serious as they help in drawing inferences about an individual consumer's behaviour.

Assumption 1: The More the Better

An obvious assumption you can make about an individual's preference is that "more of a good or service is preferred to less". This assumption can be simply illustrated in figure 3.3.1 below.

Figure 3.3.1: More of a Good is Preferred to Less



All points in the shaded area of figure 3.3.1 are preferred to the quantities X* of good X and Y* of good Y. We assume here that the individual consumer is not satiated. Movements from point X*, Y* to any point in the shaded area is an unambiguous improvement, since the individual would obtain more of one good without being forced to accept less of any other.

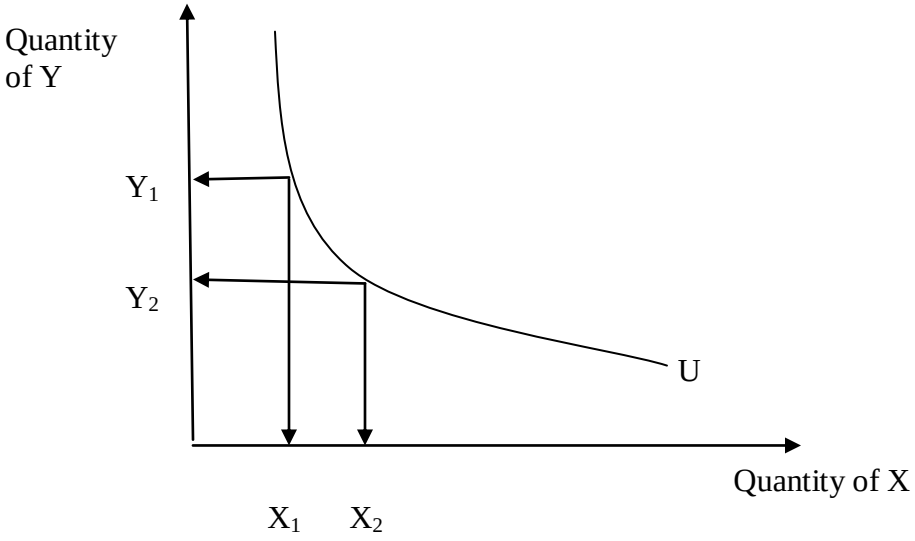
Assumption 2: Trades and Substitution

This assumption states that individuals give up more of a good to get more of the other good. Given up units of one commodity to get back some other commodity is what trade and markets in economics is all about.

Assumption 3: Diminishing Marginal Rate of Substitution

The curve representing the trade-off between two goods, say X and Y, is referred to as indifference curve, because, while moving along the curve, the individual is indifferent about where he/she is on it. The slope of this curve is negative indicating that if the individual is forced to give up some units of good Y, he/she must be compensated by additional units of good X to remain indifferent between the two bundles of goods. As indicated by figure 3.3.2 below, the indifference curve is drawn so that the slope increases as units of X increases. Figure 3.3.2 is a graphical representation of the assumption of a diminishing marginal rate of substitution.

Figure 3.3.2: The Indifference Curve



The marginal rate of substitution of good X for good Y, MRSx,y is defined as the negative of the slope of the indifference curve. Thus,

$MRS_{x,y} = -(dY/dX)$, U is constant. (3.3.2)

It follows that the value of MRSx,y diminishes as the quantity of X increases, indicating that for very low quantities of an individual is willing to give up a large amount of Y to get one more unit of good X.

The assumption of diminishing marginal rate of substitution is both analytically important and tallies with an intuitive notion that people tend to be progressively less willing to consume more of a commodity as they acquire more of it. An individual's psychic rate of trade off between commodities depends on how much of those commodities he/she is currently consuming.

Assumption 4: Convexity of the Indifference Curve

The assumption of diminishing marginal rate of substitution, MRS, is equivalent to the assumption that all combinations of X and Y, which are preferred to or indifferent to a particular combination, X*, Y*, form a convex set or quasi-concave. The convexity assumption rules out the possibility of an indifference curve being straight over any portion of its length.

3.3.2 The Concept of Marginal Utility

The marginal utility from the consumption of good X, for example, is defined as the extra utility obtained from consuming extra units of X while holding the quantity consumed of other goods constant. The value of the marginal utility depends on how much the commodity the individual is currently consuming.

Considering two goods, X and Y, the marginal rate of substitution of X for Y, MRSx,y, is defined as equal to the ratio of the marginal utility of X to the marginal utility of Y. These definitions can be illustrated by the following derivations.

Suppose an individual ranks goods by a utility function:

$$\text{Utility} = U(X_1, X_2, X_3, \ldots, Xn), \qquad (3.3.3)$$

where Xi (i = 1, 2, 3, …, n) are the amounts of each of the n different goods are consumed. By the marginal utility of good X_1, for example, we mean the function:

$$\text{marginal utility of } X_1 = MU_{X1} = \partial U/\partial X1$$

We can derive the total derivative of equation (3.3.3) as:

$$dU = (\partial U/\partial X_1)dX_1 + (\partial U/\partial X_2)dX_2 + \ldots + (\partial U/\partial Xn)dXn$$

$$= (MUx_1)dX_1 + (MUx_2)dX_2 + \ldots + (MUx_n)dXn \qquad (3.3.4)$$

Equation (3.3.4) reveals that extra utility obtained from an additional unit of X_1, X_2, X_3, …, Xn, is simply the sum of additional utility provided by each of these increments.

The concept of MRS can be developed by considering changing the level of two goods, X and Y, so as to keep an individual indifferent (that is, dU = 0). By equation (3.3.4), we get:

$$dU = 0 = MUxdX + MUydY \qquad (3.3.5)$$

Holding other goods constant therefore, dU is only affected by changing the quantities of the two goods, X and Y,

Dividing equation (3.3.5) by dX and rearranging terms, you get:

$$-(dY/dX)|dU = 0 = MUx/MUy = \frac{\partial U/\partial X}{\partial U/\partial Y} = MRSx,y \qquad (3.3.6)$$

Thus, the marginal rate of substitution of X for Y is equal to the ratio of the marginal utility of X to the marginal utility of Y, MRSx,y.

3.3.3 Maximisation of Utility

To maximise utility, given a fixed amount of expenditure, an individual will buy those quantities of goods for which the psychic rate of trade-off between any two goods (the MRS) is equal the rate at which the goods can be traded one for the other in the market place. We will illustrate this point use the two goods, X and Y.

Assume that an individual has I naira to allocate between good X and good Y. If Px represents the unit price of good X and Py the unit price of good Y, then the individual's budget constraint would be:

$$PxX + PyY \leq I \qquad (3.3.7)$$

Implying that no more than the income, I, can be spent on goods X and Y. This budget/income constraint is shown graphically in figure 3.3.3 below.

Figure 3.3.3: Individual's Budget Constraint for Goods X and Y

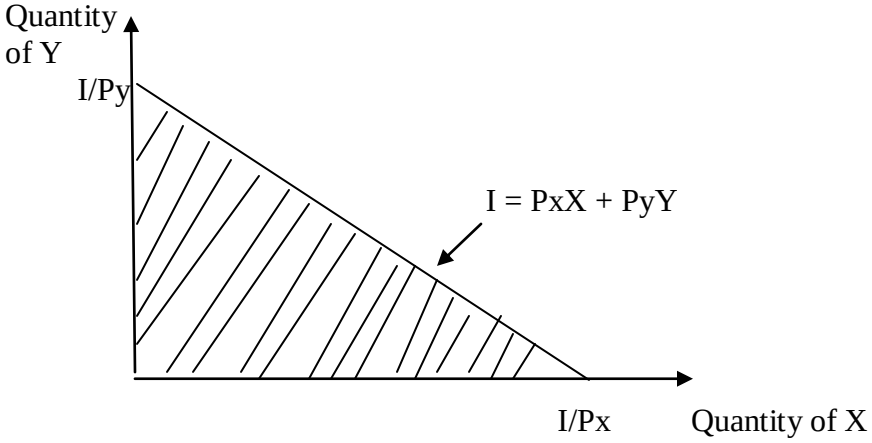
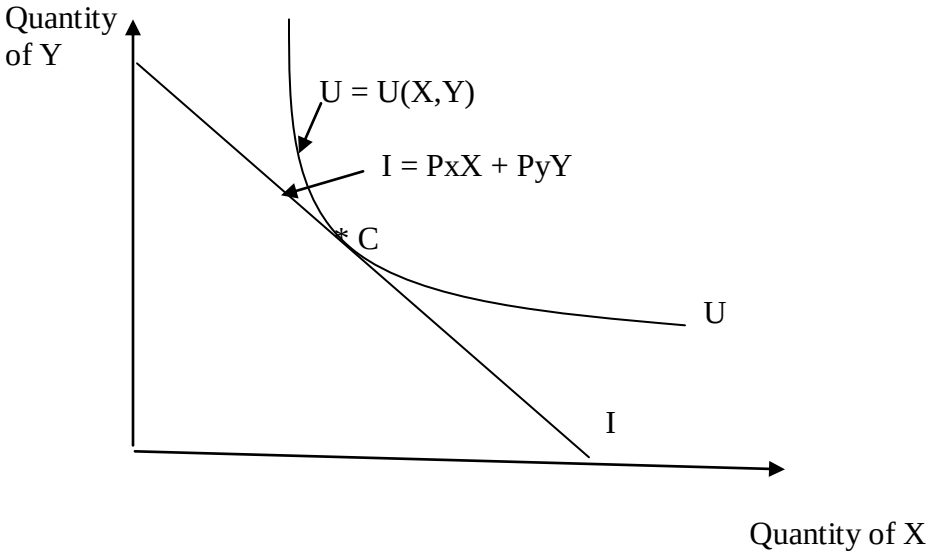


Figure 3.3.3 indicates that the individual can only choose combinations X and Y bounded by the shaded triangle. If all the income, I, is spent on good X, the individual will buy I/Px units of X, and if all is spent on good Y, the individual will buy I/Py units of Y. The slope of the constraint (or the budget line) can be shown to be –Px/Py.

As shown in figure 3.3.4, you can impose the budget constraint in figure 3.3.3 to the indifference curve in figure 3.3.2 to illustrate the utility maximizing process for an individual consumer.

Figure 3.3.4: Graphic Illustration of the Utility maximization Process



The utility maximising point is indicated by point C on figure 3.3.4. This is the point for which the slope of the budget line, I equals the slope of the indifference curve, U. At this point, the optimal combination of goods X and Y consumed are X* units and Y* units, respectively. Point C is therefore referred to as the utility maximising point for the individual. Observe also that at point C, -Px/PY (slope of the budget line) equals –(Mux/MUy), slope of the indifference curve or the marginal rate of substitution, MRS. It can be said, in general, that to solve for the optimal combinations of goods X and Y that will maximise the individual's utility, you just need to equate the slope of the relevant budget constraint to the marginal rate of substitution as derived from the given utility function. But to solve for the specific optimum values of individual goods consumed given the budget constraint, you need to use a function referred to as the lagrange function, λ , and the associated first-order condition. An example follows.

Example
Assume that an individual's utility function is given by: $U = X_1X_2$; that $P_1 = 2$ naira, $P_2 = 5$ naira; and, that the individual consumer's income for the period of analysis is N10,000. What are the units of goods X_1 and X_2 that the consumer must purchase and consume in order that he/she maximises his/her utility?

Solution
You can first formulate the budget constraint using the unit prices of the goods X_1 and X_2 as follows:
Budget constraint: $10,000 = 2X_1 + 5X_2$.

We want to maximise $U = X_1X_2$, subject to $10,000 = 2X_1 + 5X_2$.

Formulating the lagrange function, Z, and setting its partial derivatives equal to zero, we get:

$Z = X_1X_2 + \lambda(10,000 – 2X_1 – 5X_2)$, and setting the partial derivatives equal to zero:

$\partial U/\partial X_1 = X_2 - 2\lambda = 0$ (3.3.8)
$\partial U/\partial X_2 = X_1 - 5\lambda = 0$ (3.3.9)
$\partial Z/\partial \lambda = 10{,}000 - 2X_1 - 5X_2 = 0$ (3.3.10)

Solving the three linear equations for the unknowns, X_1, X_2, and λ, using the above equations, we get:

$$\frac{X_2}{X_1} = \frac{2}{5}$$

$X_1 = (5/2)X_2$ (3.3.11)

Substituting the expression for X_1 in equation (3.3.10), you get:

$10000 - 2(5/2)X_2 - 5X_2 = 0$
$10X_2 = 10000$
$X_2 = 1000$
$X_1 = 250$ (by equation 3.3.11)

Using equations (3.3.8) to solve for λ, you get:
$X_2 - 2\lambda = 0$
$X_2 = 2\lambda$
$2\lambda = 10$
$\lambda = 5$
The values for X_1, X_2, and λ are therefore, 250 units, 1000 units, and 5 respectively. By implication, to maximise his/ her utility, the individual consumer should purchase for consumption 250 units of good X_1 and 1000 units of product X_2.

Self-Assessment Exercise
List and discuss the axioms of a rational choice. Think of and discuss about two life examples of how these axioms can be applied.

4.0 Conclusion
This unit has expanded our knowledge on the theory of consumer choice with specific emphasis on the utility concept and how utility can be maximized by an individual consumer. The axioms of rational choice were also presented for guidance on choice of the best among different choice alternatives.

5.0 Summary
An important aspect of economic theories is its analysis of the role of individuals in economic activities. Assuming rationality in consumption behaviours and participation in economic activities, this unit began with the discussion of individuals as economic agents. The unit enumerated the role of individuals both as consumers and as providers of factors of production.

The unit also outlined the important axioms or postulates of rational choices, including the axiom of completeness and the axiom of transitivity. These axioms serve as guides in choosing among desirable economic choice alternatives.

Another important principle in the study of individual consumer behaviour is the concept of utility. This unit has outlined the important issues in utility analysis, including: the utility function; basic assumptions on utility functions; and, the concept of marginal utility. The unit introduced the basic application of utility analysis by examining the principle of utility maximization under budget constraints. It ended with a simply mathematical application to demonstrate the practice of optimum consumer choice.

6.0 Tutor-Marked Assignment

Find the optimum commodity purchases for a consumer whose utility function and budget constraint are given as: $U = U(q_1, q_2) = q_1^2 q_2$; and, $3q_1 + 4q_2 = 100$, respectively.

7.0 Reference/Further Reading

Henderson, J. M. and Quandt, R. E. (1980) *Microeconomic Theory: A Mathematical Approach* USA: McGraw-Hill, Inc.

UNIT 2: ANALYSIS OF INDIVIDUAL AND MARKET DEMAND

Content

1.0 Introduction

Unit 2 is aimed at expanding your knowledge of what market demand is all about. To achieve this aim, it provides for you the definition of market demand, complemented with discussions on the types of market demand and demand functions. The unit is an essential requirement for businesses. It provides a good background for demand planning and production forecasting. This is in recognition of the fact that the analysis of market demand for a business firm's product plays an important role in business decision making. In addition, for a firm to succeed in its operations, it must plan for future production, the inventories of raw materials, advertisements, and sales outlets. The knowledge of the magnitude of the current and future demand is therefore, indispensable.

The analysis of market demand enables business executives know:

1. the factors determining the size of consumer demand for their products;
2. the degree of responsiveness of demand to changes in its determinants;
3. the possibility of sales promotion through manipulation of prices;
4. the responsiveness of demand to advertisement expenditures; and,
5. the optimum levels of sales, inventories, and advertisement expenditures.

2.0 Objectives

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

1. Define individual and market demands
2. Explain demand schedules
3. Explain demand functions

3.0 Main Content

3.1 Definition of Market Demand

The market demand of any product is the sum of individual demands for the product at a given market price in a given time period. Note that the individual demand for the product per unit of time at a given price is the quantity demanded by an individual.

A horizontal summation of individual demand schedule gives rise to the ***market demand schedule.*** For example, assume three consumers, X, Y, and Z of a given commodity, say commodity A. Let the individual demands by the consumers, X, Y, and Z be represented as in table 3.1 below, the market demand schedule, that is, the aggregate of individual demands by the three consumers at different prices, as indicated, is shown by the last column of the table.

Table 3.1: The Market Demand Schedule

Price of A	**Quantity of A Demanded by:**			**Market Demand**
	X	**Y**	**Z**	
10	5	1	0	6
8	7	2	0	9
6	10	4	1	15
4	14	6	2	22
2	20	10	4	34
0	27	15	8	50

3.2 Types of Demand

The major types of demand encountered in business decisions are outlined below.

1. Individual and Market Demand. The quantity of a commodity an individual is willing and able to purchase at a particular price, during a specific time period, given his/her money income, his/her taste, and prices of other commodities, such as substitutes and complements, is referred to as the ***individual demand*** for the commodity. As illustrated in table 3.1 above, the total quantity which all the consumers of the commodity are willing and able to purchase at a given price per time unit, given their money incomes, their tastes, and prices of other commodities, is referred to as the ***market demand*** for the commodity.

2. Demand for firm's and Industry's Product. The quantity of a firm's product that can be sold at a given price over time is known as the demand for the firm's product. The sum of demand for the products of all firms in the industry is referred to as the market demand or industry demand for the product.

3. Autonomous and Derived Demand. An *autonomous demand* or direct demand for a commodity is one that arises on its own out of a natural desire to consume or possess a commodity. This type of demand is independent of the demand for other commodities.

Autonomous demand may also arise due to *demonstration effect* of a rise in income, increase in population, and advertisement of new products.

The demand for a commodity which arises from the demand for other commodities, called '*parent products'* is called *derived demand.* Demand for land, fertilizers and agricultural tools, is a derived demand because these commodities are demanded due to demand for food. In addition, demand for bricks, cement, and the like are derived demand from the demand for house and other types of buildings. In general, demand for producer goods or industrial inputs is a derived demand.

4. Demand for Durable and Non-Durable Goods. Durable goods are those goods for which the total utility or usefulness is not exhaustible in the short-run use. Such goods can be used repeatedly over a period of time. Durable consumer goods include houses, clothing, shoes, furniture, refrigerator, and the like. Durable producer goods include mainly the items under 'fixed assets', such as building, plant, machinery, and office furniture.

The demand for durable goods changes over a relatively longer period than that of the non-durable goods. The demand for non-durable goods depends largely on their current prices, consumers' income, and fashion. It is also subject to frequent changes.

Durable goods create replacement demand, while non-durable goods do not. In addition, the demand for non-durable goods change linearly, while the demand the demand for durable goods change exponentially as the stock of durable goods changes.

5. Short-term and Long-term Demand.
Short-term demand refers to the demand for goods over a short period. The type of goods involved in the short-term demand are most fashion consumer goods, goods used seasonally, inferior substitutes for superior goods during scarcities. Short-term demand depends mainly on the commodity price, price of their substitutes, current disposable income of the consumers, the consumers' ability to adjust their consumption pattern, and their susceptibility to advertisement of new products.
The ***long-term demand*** refers to the demand which exists over a long period of time. Changes in long-term demand occur only after a long period. Most generic goods have long-term demand. The long-term demand depends on the long-term income trends, availability of better substitutes, sales promotion, consumer credit facility, and the like.

3.3 Demand Functions

Mathematically, we can define a function as a symbolic representation of relationship between dependent and independent variables. A demand function states the relationship between the demand for a product (the dependent variable in this case) and its determinants (the independent variables).

It is the nature of demand-price relationship that determines the form of a demand function. The three most common forms of demand functions are the ***linear demand function***, ***non-linear demand function*** and the ***multi-variate or dynamic demand function***. Each of these forms will be presented briefly in the following discussions.

3.3.1 Linear Demand function

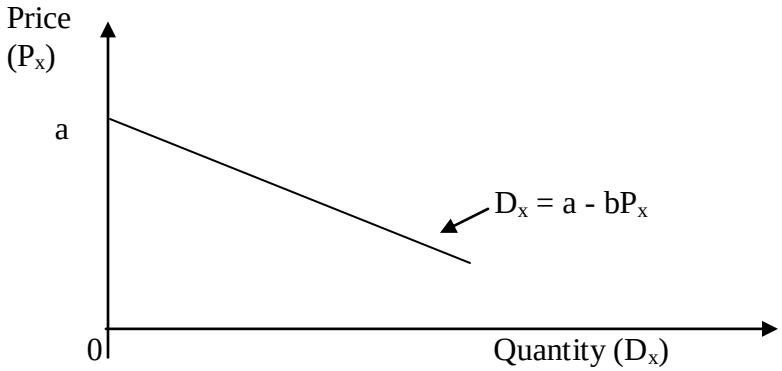
A demand function is said to be linear when its graph results in a straight line. The general form of a linear demand function is presented in equation (3.3.1) below:

$$D_x = a - bP_x \qquad (3.3.1)$$

Where a = the demand intercept or the quantity demanded at a zero price,
b = the slope of the demand function or the rate at which quantity demanded of product X changes with respect to the price (P_x). This slope is defined by $\Delta D_x/\Delta P_x$

The graphical form of this demand function is illustrated in figure 3.3.1 below.

Figure 3.3.1: Linear Demand Function



The price function can easily be obtained from the demand function (equation 3.3.1) in the following way:

$D_x = a - bP_x$

$bP_x = a - D_x$

$$P_x = \frac{a - D_x}{b} = \frac{a}{b} - \frac{1}{b}D_x \qquad (3.3.2)$$

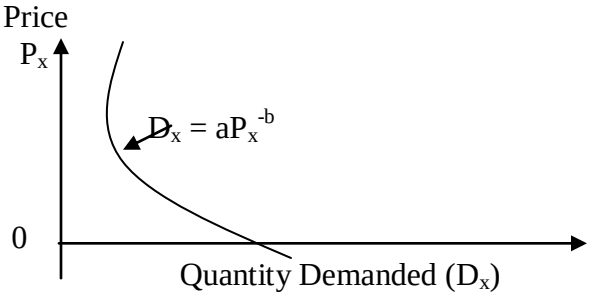
3.3.2 Nonlinear Demand Function

A demand function is said to be nonlinear or curvilinear when the slope of the of the demand function, $\Delta P/\Delta D$, changes along the demand curve. A nonlinear demand function yields a demand curve unlike the demand line yielded by a linear demand function as in figure 3.4 above. A nonlinear demand function is of the form of a power function as given in equation (3.3.3) below.

$$D_x = aP_x^{-b} \qquad (3.3.3)$$

You should note that the exponent of the Price variable P_x, that is, -b, in the nonlinear demand function (equation (3.3.3) is referred to as the price-elasticity of demand. The nonlinear demand function can be sketched as in figure 3.3.2 below.

Figure 3.3.2: Nonlinear Demand Function



3.3.3 Multi-Variate or Dynamic Demand Function

The demand functions discussed above are classified as single-variable demand functions, and, as such, referred to as short-term demand functions. In the long run, neither the individual nor the market demand for a given product is determined by anyone of its determinants alone, because other determinants do not remain constant. The long-run demand for a product depends on the composite impact of all its determinants operating simultaneously. It follows that in order to estimate the long-term demand for a product, all the relevant determinants must be taken into account.

The long-run demand functions describe the relationship between a demand for a product (the dependent variable) and its determinants (the independent variables). Demand functions of this type are referred to as *multi-variate* or *dynamic* demand functions. Consider the demand for product X, (D_x), which depends on such variables as its own price (P_x), consumer's income (Y), price of its substitutes (P_s), price of the complementary goods (P_c), consumer's taste (T), and advertisement expenditure (A), the functional form can be written as:

$$D_x = f(P_x, Y, P_s, P_c, T, A) \qquad (3.3.4)$$

If the relationship between the demand (D_x) and the quantifiable independent variables, P_x, Y, P_s, P_c, and A, is of a linear form, then the estimable form of the demand function is formulated as:

$$D_x = a + bP_x + cY + dP_s + eP_c + gA \qquad (3.3.5)$$

where 'a' is a constant and parameters b, c, d, e. and g are the coefficients of relationship between the demand for product X (D_x) and the respective independent variables.
For the market demand function for a product, other independent variables such as size of the population (N), and a measure of income distribution, the Gini-coefficient (G) may be included in equation (3.3.5).

Self-Assessment Exercise

Briefly distinguish between market demand and individual demand for a particular product.

4.0 Conclusion

This unit has been devoted to the analysis of market demand. You were informed that the market demand for a product is the horizontal sum of individual demands for the product. Other important discussions were made on types of demand and the different demand functions. The principles learned from the unit are important in decisions involving product marketing, forecasting, and production.

5.0 Summary

The analysis of market demand enables business executives know: (i) the factors determining the size of consumer demand for their products; (ii) the degree of responsiveness of demand to changes in its determinants; (iii) the possibility of sales promotion through manipulation of prices; (iv) the responsiveness of demand to advertisement expenditures; and, (v) the optimum levels of sales, inventories, and advertisement expenditures.

The market demand of any product is the sum of individual demands for the product at a given market price in a given time period. Few types of demand were outlined, including: the individual demand; demand for firm's and industry's product; autonomous and derived demand; demand for durable and non-durable goods; short- and long-term demand. The demand functions include: linear demand functions; non-linear demand functions; multivariate and dynamic demand functions.

6.0 Tutor-Marked Assignment

As a business manager, how would the knowledge of the different types of demand help in product decisions?

7.0 Reference and Further Reading

Dwivedi, D.N. (2007) *Managerial Economics, sixth revised edition,* Delhi: Gajendra

Printing Press

UNIT 3: DETERMINANTS OF MARKET DEMAND

Content

1.0 Introduction

Among the important decision variables in the production process is individual consumption decisions which are the determinants of demand in the commodity market. Unit 2 informed you of the derivation of market demand from individual demands. To complete our analysis of market demand, this unit examines the essential factors that are responsible for market demand.

2.0 Objectives

At the end of this unit, learners will be able to:

1. List and explain the factors that affect the market demand for given products
2. Explain the law of demand
3. Describe and apply strategic production decisions

3.0 Main Content

3.1 Determinants of Market Demand

For corporate managers at large and specifically, the marketing managers, it is highly important to understand the factors affecting the market demand for their products. This understanding is required for analysing and estimating demand for the products. Though there are several factors affecting market demand for a product, the most important are:

3.1.1 Price of the product or the own price (Po)

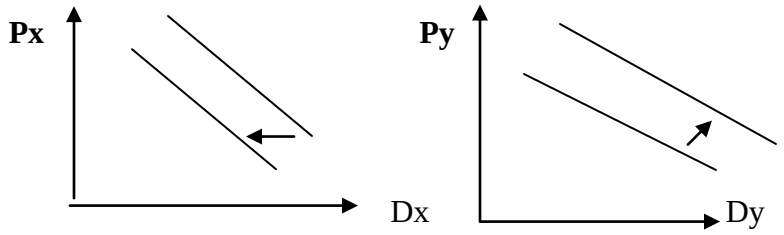
This is the most important determinant of demand for a product. The own price of a product and the quantity demanded of it are inversely-related so that,

$$\frac{\Delta Qo}{\Delta Po} > 0$$

3.1.2 Price of the related goods, such as substitutes and complements (Ps and Pc)

When two goods are *substitutes* for each other, the change in price of one affects the demand for the other in the same direction. If goods X and Y are substitute goods, then an increase in the price of X will give rise to an increase in the demand for Y. Note that changes in the price of related goods cause shifts in the demand for the goods. Changes in demand are illustrated graphically as rightward shifts (for increase) and leftward shifts (for decrease) in the demand for the products. As shown in figure 3.1 below, an increase in the price of good X will shift the demand for good Y to the right and shift that of good X to the left.

Figure 3.1: Shifts in Demand



Symbolically, $Dx = f(Py)$; $\Delta Dx/\Delta Py > 0$

$Dy = f(Px)$; $\Delta Dy/\Delta Px > 0$

When two goods are complements for each other, one complements the use of another. Petrol and car a complement goods. If an increase in the price of one good causes a decrease in demand for the other, the goods are said to be complements. Thus if the demand function for a car (Dc) in relation to petrol price (Pp) is specified by:

$Dc\ f(Pp)$, $\Delta Dc/\Delta Pp < 0$.

3.1.3 Consumer's Income

This is the major determinant of demand for any product since the purchasing power of the consumer is determined by the disposable income. Managers need to know that income-demand relationship is of a more varied nature than those between demand and its other determinants. The relationship between demand for commodity X, for example, and the consumer's income, say Y, keeping other factors constant, can be expressed by a demand function:

$Dx = f(Y)$, and $\Delta Dx/\Delta Y > 0$.

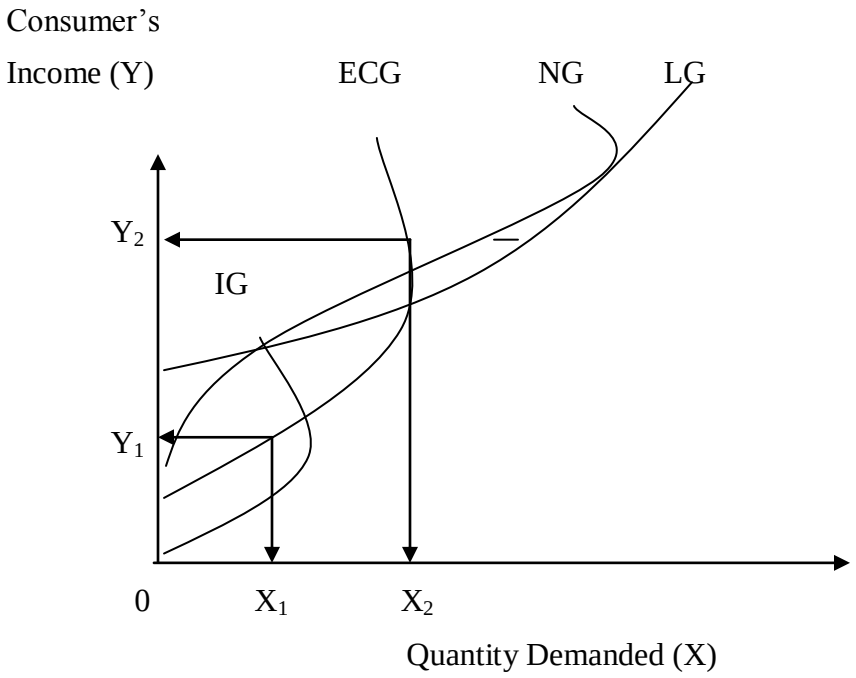
You should note that consumer goods of different nature have different relationships with income of different categories of consumers. The manager needs, therefore, to be completely aware of the goods they deal with and their relationship with consumer's income, particularly with respect to the assessment of both existing and prospective demand for a product.

Regarding income-demand analysis, consumer goods and services are grouped under *four* broad categories:

i. ***Essential Consumer Goods (ECG).*** Goods and services in this category are referred to as 'basic needs', and are consumed by all persons in a society. Such goods and services include food grains, salt, vegetable oil, cooking, fuel, housing, and minimum clothing. The demand for

such goods and services increase with increases in consumer's income, but only up to a certain limit, even though the total expenditure may increase in accordance with the quality of goods consumed, all things being equal. The relationship between goods and services of this category and consumer's income is shown by the curve ECG in figure 3.2 below.

Figure 3.2: Income-Demand Relationships



ii. ***Inferior Goods (IG).*** Inferior and superior goods are widely known to both buyers and sellers. Economists define inferior goods as goods in which their demands decrease as consumer's income increases, beyond a certain level of income. The relationship between income and demand for an inferior good is illustrated by curve IG in figure 3.2 above. Demand for such goods rises only up to a certain level of income, say (OY_1), and declines as income increases beyond this level.

iii. ***Normal Goods (NG***). In economic terms, normal goods are goods demanded in increasing quantities as consumer's income rises. Examples of normal goods are clothing, furniture, and automobiles. The type of relationship between income and demand for normal goods is shown by curve NG in figure 3.2 above. Note in the figure that up to a certain level of income, say Y_1, the relationship between income and demand for all types of goods is similar. The difference is only in terms of the degree of relationship. The relationship becomes distinctively different beyond the income level (Y_1).

iv. ***Luxury and Prestige Goods***. All such goods that add to the pleasure and prestige of the consumer without enhancing his or her earning fall in the category of luxury goods. Prestige goods are special category of luxury goods, examples, rare paintings and antiques, prestigious schools, and the like. Demand for such goods arises beyond a certain level of consumer's income. Producers of such goods, while assessing the demand for their product, need to consider

the income changes in the richer section of the society. The income-demand relationship for this category of goods is shown by curve LG in figure 3.2.

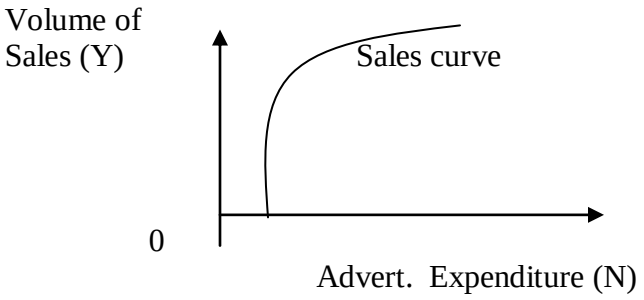
3.1.4 Consumers' Tastes and Preferences

Consumers' tastes and preferences play important role in the determination of the demand for a product. Tastes and preferences generally depend on life style, social customs, religious values attached to a commodity, habit of the people, age and sex of the consumers, and the like. Changes in these factors tend to change consumers' tastes and preferences.

3.1.5 Advertisement Expenditures.

Advertisement costs are incurred while attempting to promote sales. It helps in increasing product demands in at least four ways:
(a) by informing the potential consumers about the product's availability;
(b) by showing the product's superiority over the rival product;
(c) by influencing consumer's choice against the rival product; and,
(d) by setting new fashions and changing tastes. The impact of these causes upward shifts in the demand for the product. All things being equal, as expenditure on advertisement increases, it is expected that volume of sales will increase. The relationship between sales (S) and advertisement outlays (AD) can be expressed by the function:
$S = f(AD)$, and $\Delta S/\Delta AD > 0$. This relationship is indicated in figure 3.3 below:

Figure 3.3: Advertisement and Sales



The relationship as shown by figure 3.3 is based on the following assumptions:

(a) Consumers are fairly sensitive and responsive to various modes of advertisement
(b) The rival firms do not react to the advertisement made by the firm,
(c) The level of demand has not reached the saturation point and advertisement makes only marginal impact on demand for a product,
(d) Adding of advertisement cost to the product price does not make the price prohibitive for consumers, compared to the price of substitutes.

3.1.6 Consumers' Expectations

The consumers' expectations about the future product prices, income, and supply position of goods play significant role in the determination of demand for goods and services in the short run. A rational consumer who expects a high rise in the price of a nonperishable commodity would buy more of it at the high current price with a view to avoiding the pinch of the high price rise in the future. This partly explains the high demand for fuel during periods of expected increase of pump price of fuel in Nigeria. On the contrary, if a rational consumer expects a fall

in the price of goods he/she purchases, he/she would postpone the purchase of such goods with a view to taking advantage of lower prices in the future. This is especially the case for non-essential goods. This behaviour tends to reduce the current demand for goods whose prices are expected to decrease in the future.

An expected increase in income would similarly increase current demand for goods and services. For instance, a corporate announcement of bonuses or upward revision of salary scales would induce increases in current demand for goods and services.

3.1.7 Demonstration Effect

Whenever new commodities or models of commodities are introduced in the market, many households buy them not because of their genuine need for them but because their neighbours have purchased them. This type of purchase arises out of such feelings jealousy, competition, and equality in the peer group, social inferiority, and the desire to raise once social status. Purchases based on these factors are the result of what economists refer to as 'demonstration effect' or the 'Band-Wagon effect'. These effects have positive impacts on commodity demand.

On the contrary, when a commodity becomes a thing of common use, some rich people decrease their consumption of such goods. This behaviour is referred to in economics as the 'snob effect'. This has negative impact on the demand for the commodity concerned.

Other determinants of demand for commodities include *Consumer-Credit facility*, the *population of consumers*, and *income distribution*.

Self-Assessment Exercise

How do the changes in the following factors affect the demand for a commodity: (a) Price; (b) Price of the substitute; (c) Income;
(d) Advertisement

4.0 Conclusion

This unit has discussed extensively the determinants of market demand. In a nutshell, you learned that the followings are the major determinants of market demand for a given commodity:
(i) Own price of the commodity;
(ii) Price of related goods, such as the substitutes and complements;
(iii) Consumers' tastes and preferences;
(iv) Advertisement expenditures;
(v) Consumers' expectations; and,
(vi) Demonstration effects.

5.0 Summary

The very important information from our discussions in this unit are that: First, it is important for corporate managers to know the factors affecting the market demand for their products. Such factors were enumerated to include: the commodity's own price; price of related goods, such as substitutes and complements; consumers' tastes and preferences; advertisement expenditures; consumers' expectations; and, demonstration effects. Secondly, economists define inferior goods as goods in which their demands decrease as consumer's income increases, beyond a

certain level of income. They also define normal goods as goods that are demanded in increasing quantities as consumer's income rises; and, Luxury goods as goods that add to the pleasure and prestige of the consumer without enhancing his or her earning;

6.0 Tutor-Marked Assignment

Which of the following commodities has the most inelastic demand and why? (a) Salt; (b) Penicillin; (c) Cigarettes; (d) Soap

7.0 References And Further Readings

Dwivedi, D.N. (2007) *Managerial Economics, sixth revised edition,* Delhi: Gajendra

Printing Press

Nicholson, W. (1978) *Microeconomic Theory: Basic Principles and Extensions, 2nd edition* Illinois: The Dryden Press

UNIT 4: PRICE-ELASTICITY OF DEMAND, THE DEMAND FUNCTION, TOTAL REVENUE, AND OTHER IMPORTANT ELASTICITIES

Content

1.0 Introduction

The price-elasticity of demand for a product can be measured directly from the demand function. We look at this from the perspective of the Linear demand function, as well as the non-linear demand function. In this unit, we learn how demand elasticities can be derived from demand functions, the relationship between price-elasticity and total revenue, income-elasticity of demand, promotional elasticity of sales, and elasticity of price expectations. These are among the decision variables available to a marketing manager.

2.0 Objectives

Having worked through the activities in this unit, you must have become equipped with:
1. The description of the relationship between price elasticity and demand for a given commodity
2. Explanation of the importance of income-elasticity of demand, promotional elasticity of sales, and elasticity of price expectations.
3. Explanation of the use of economic variables in pricing and marketing decisions

3.0 Main Content

3.1 Price-Elasticity and Demand Functions

This section focuses on the derivation of price-elasticity from linear and non-linear demand functions. This enables you to compute price elasticities from given demand functions.

3.1.1 Measurement of Price-Elasticity from a Linear Demand Function

For a given linear demand function, you can measure the price-elasticity by first taking the first derivative with respect to the price variable, P, (dQ/dP), if price is the independent variable, or

with respect to the quantity variable, Q, (dP/dQ), if quantity is the independent variable. The result will the be multiplied by the price-quantity ratio (P/Q) for the first case, and the quantity-price ratio (Q/P) for the second case. Consider a linear demand function:

$$Q = 210 - 0.1P,$$

the point elasticity can be measured for any price by using:

$$\frac{dQ}{dP} \cdot \frac{P}{Q} \qquad (3.1.1)$$

For P = N5/unit, the price-elasticity would be:

$-0.1(P/Q)$, since $\frac{d(210 - 0.1P)}{dP} = -0.1$

Given that P = 5 (as specified above), we solve for Q in the demand function to get:

$Q = 210 - 0.1(5) = 210 - 0.5 = 209.5$

Therefore, the required price-elasticity of demand becomes,

$e_p = -0.1(5/209.5) = -0.002.$

3.1.2 Measurement of Price-Elasticity from a Non-Linear Demand Function

The computation of price-elasticity from a non-linear demand function follows the same process as that of the linear demand function. The only difference is in the nature of the demand function. If a non-linear demand function is given by:

$$Q = aP^{-b},$$

then, $e_p = \frac{dQ}{dP} \cdot \frac{P}{Q}$

where $\frac{dQ}{dP} = -baP^{-b-1}$

The price-elasticity of demand can therefore be expressed as:

$e_p = -baP^{-b-1}(P/Q)$

$$= \frac{-baP^{-b}}{Q}$$

Since $Q = aP^{-b}$, by substitution, you get:

$$ep = \frac{-baP^{-b}}{aP^{-b},} = -b \qquad (3.1.2)$$

According to equation (3.1.2), when a demand function is of a multiplicative or power form, the price-elasticity coefficient equals the power of the variable P. This implies that price-elasticity

for multiplicative demand function remains constant, regardless of a change in the commodity price.

3.2 Price-Elasticity and Total Revenue

A revenue-maximising firm would be interested in knowing whether increasing or decreasing the commodity price would maximise revenue. The price-elasticity of demand for the firm's product at different price levels would provide the answer to this question. The answer would come from the fact that if $e_p > 1$, then decreasing the price will increase the total revenue, and if $e_p < 1$, then increasing the price will increase the total revenue.

The relationship between price-elasticity (e_p) and total revenue (TR) is sumarised in table 3.1 below.

Table 3.1: Price-Elasticity, Price-Change, and Change in Total Revenue

Elasticity Coefficient	***If Price:***	***Then Total Revenue Will:***
$e_p = 0$	Increases Decreases	Increase Decrease
$e_p < 1$	Increases Decreases	Increase Decrease
$e_p = 1$	Increase Decrease	No change No change
$e_p > 1$	Increase Decrease	Decrease Increase
$e_p = \infty$	Increase Decrease	Decrease to zero Infinite increase, depending on size of the market

3.3 Price-Elasticity and Marginal Revenue

Note that Marginal Revenue (MR) is the first derivative of the total revenue (TR) function, and that TR = PQ (P = unit price; Q = quantity sold). The relationship between price-elasticity, MR, and TR is shown by the following derivations:

Since TR = P.Q,

$$MR = \frac{d(P.Q)}{dQ} = P + Q\frac{dP}{dQ}$$ (the product rule of differentiation)

$$= P\left[1 + \frac{Q}{P} \cdot \frac{dQ}{dQ}\right] \qquad (3.3.1)$$

Note that in equation (3.2.1):

$$\frac{Q}{P} \cdot \frac{dQ}{dP} = -1/e_p$$

By substituting $-1/e_p$ into equation (3.3.1), you get:

$$MR = P[1 - 1/e_p] \qquad (3.3.2)$$

Given this relationship between Marginal Revenue (MR) and price-elasticity of demand (e_p), the deciding manager can easily know whether it will be beneficial to change the price.
From equation (3.3.2), you can deduce that if $e_p = 1$, MR = 0. It follows that change in price will not affect the total revenue (TR).

If $e_p < 1$, MR < 0, TR decreases when price decreases, and TR increases when price increases. And if $e_p > 1$, MR > 0, TR increases when price decreases, and *vice versa.*

3.4: Income-Elasticity of Demand

The income-elasticity of demand can be defined as the degree of responsiveness of demand to changes in the consumer's income. Note that unlike the price-elasticity of demand, which is always negative due to the negative slope of the demand function, the income-elasticity of demand is always positive. This is because of the positive relationship between demand and the consumer's income. This is the case however, for normal goods. In the case of inferior goods, the income-elasticity of demand is always negative. This is so because the demand for inferior goods decreases with increases in consumer's income, and vice versa.

The income-elasticity of demand for a commodity, say X can be computed by:

$$e_y = \frac{Y}{Q_x} \cdot \frac{\Delta Q_x}{\Delta Y} \qquad (3.4.1)$$

Where, e_y = income-elasticity of demand; Y = consumer's income; Qx = quantity demanded of commodity X.

As noted above, for all normal goods, the income-elasticity is positive. However, the degree or magnitude of elasticity varies in accordance with the nature and type of commodities. Consumer goods of the three categories: ***necessities, comforts***, and ***luxuries*** have different elastiticies. The general pattern of income-elasticities of different kinds of goods for increase in income and their effects on sales is given in table 3.2 below for managers to take note:

Table 3.2: Magnitude of Income-Elasticity for different Categories of Goods

Consumer Goods	***Coefficient of Income-Elasticity***	***Effect on Sales***
Essential Goods	Less than 1 or unity ($e_y < 1$)	Less than proportionate change in sales
Comforts	Almost equal to unity ($e_y \equiv 1$)	Almost proportionate change in sales
Luxuries	Greater than unity ($e_y > 1$)	More than proportionate increase in sales

Own-price and cross-elasticities of demand are specifically significant in the pricing of products aimed at the maximisation of short-run revenues. Income-elasticity of products is highly significant in long-run planning and management of production, especially during the period of business cycles.

The concept of income-elasticity can be used in the estimation of future demand, provided that the rate of increase in income and income-elasticity of demand for the given product are known. This can be useful in forecasting demand for expected changes in consumers' personal incomes, other things remaining the same. Knowledge of income-elasticity of demand is also helpful in the avoidance of over- and under-production.

3.5 Advertisement- or Promotional-Elasticity of Sales

It is a known fact that expenditure on advertisements and on other sales promotion activities help in promoting sales, but not in the same magnitude or degree at all levels of sales. The concept of advertisement elasticity is found useful in the determination of optimum level of advertisement expenditure. This concept assumes a greater significance in deciding advertisement expenditure than other decision variables. This is so especially when the government imposes restriction on advertisement cost (as is the case in most developed economies), or there is competitive advertising by the rival firms.

By definition, advertisement-elasticity of sales is the degree of responsiveness of sales to changes in advertisement expenditures. It can be computed by the formula:

$$e_A = \frac{\Delta S}{\Delta A} \cdot \frac{A}{S} \qquad (3.5.1)$$

where S = sales; ΔS = change in sales; A = initial advertisement cost; and, ΔA = additional expenditure on advertisement

The advertisement-elasticity of sales varies between zero and infinity. Thus,

$0 \leq e_A \leq \infty$

Some values of the advertisement-elasticity of sales can be interpreted according to table 3.3 below:

Table 3.3: Interpretation of Advertisement-Elasticity of Sales

Elasticity (e_A)	***Interpretation***
$e_A = 0$	Sales do not respond to advertisement expenditure
$0 < e_A < 1$	Increase in total Sales is less than proportionate to the increase in advertisement expenditure
$e_A = 1$	Sales increase in proportion to the increase in expenditure on advertisement
$e_A > 1$	Sales increase at a higher rate than the rate of increase in advertisement expenditure.

Some of the ***important factors affecting the advertisement-elasticity*** of sales can be outlined as follows:

(i) ***The level of total sales***. As sales increase, the advertisement-elasticity of sales decreases.

(ii) ***Advertisement by rival firms***. In a highly competitive market, the effectiveness of advertisement by a firm is determined by the relative effectiveness of advertisement by the rival firms

(iii) ***Cumulative effect of past advertisements***. Additional doses of advertisement expenditures do have cumulative effect on the promotion of sales, and this may considerably increase the advertisement-elasticity of sales.

Other factors affecting the advertisement-elasticity of sales are those factors demand for the product, including *change in product's price; consumer's income; growth of substitute goods and their prices.*

3.6 Elasticity of Price-Expectations

During the period of price fluctuations, consumer's price expectations play a significant role in determining demand for a given commodity. The price-expectation-elasticity refers to the expected change in future price as a result of changes in current prices of a given product. The elasticity of price-expectation is defined and measured by the following formula:

$$e_x = \frac{\Delta P_f}{\Delta P_c} \cdot \frac{P_c}{P_f} \qquad (3.6.1)$$

where P_c and P_f are *current* and *future* prices, respectively.

The coefficient e_x is a measure of expected percentage change in future price due to a 1 percent change in current price. $e_x > 1$ implies that future change in price will be greater than the current change in price, and *vice versa*. $e_x = 1$ implies that the future change in price will be equal to the change in current price.

The concept of elasticity of price-expectation is very useful in future pricing policies. For instance, if $e_x > 1$, sellers will be able to sell more in the future at higher prices. Accordingly, businesspeople may determine their future pricing policies.

Self-Assessment Exercise

Which of the following statements is true, and why?
(a) If price elasticity = 1, MR = 0
(b) If price elasticity > 1, MR > 0
(c) If price elasticity < 1, MR < 0

4.0 Conclusion

The basic information obtained from this unit is that the price-elasticity of demand for a product can be measured directly from the demand function. We examined how price elasticity can be estimated both from a linear and a non-linear demand function. Other important discussions were on: the relationship between price elasticity and total revenue; income-elasticity of demand; promotional elasticity of sales; and, elasticity of price expectations.

5.0 Summary

We can summarise our discussions in this unit as follows:

For a given linear demand function, you can measure the price-elasticity by first taking the first derivative with respect to the price variable, P, (dQ/dP), if price is the independent variable, or with respect to the quantity variable, Q, (dP/dQ), if quantity is the independent variable. The result will the be multiplied by the price-quantity ratio (P/Q) for the first case, and the quantity-price ratio (Q/P) for the second case.

A revenue-maximising firm would be interested in knowing whether increasing or decreasing the commodity price would maximise revenue. The price-elasticity of demand for the firm's product at different price levels would provide the answer to this question. The answer would come from the fact that if $e_p > 1$, then decreasing the price will increase the total revenue, and if $e_p < 1$, then increasing the price will increase the total revenue.

The income-elasticity of demand can be defined as the degree of responsiveness of demand to changes in the consumer's income.

The concept of advertisement elasticity is found useful in the determination of optimum level of advertisement expenditure. This concept assumes a greater significance in deciding advertisement expenditure than other decision variables.

The price-expectation-elasticity refers to the expected change in future price as a result of changes in current prices of a given product.

6.0 Tutor-Marked Assignment

Explain your understanding of the term elasticity of price expectation (E_e). In the context of an environment of business recession, what are the implications of:
(i) $E_e > 1$; (ii) $E_e = 1$; $E_e = 0$; $E_e < 0$

7.0 References And Further Readings

Dwivedi, D.N. (2007) Managerial Economics, sixth revised edition, Delhi: Gajendra Printing Press

Nicholson, W. (1978) *Microeconomic Theory: Basic Principles and Extensions, 2nd edition* Illinois: The Dryden Press

MODULE THREE: THEORIES OF PRODUCTION, COSTS, AND PROFIT

UNIT 1: THE THEORY OF PRODUCTION

Content

1.0 Introduction

No matter the objective of any business organisation, achievement of efficiency in production or cost minimisation for a given production activity appear to be one of the prime concern of the managers. As a matter of fact, the survival of a business firm in a competitive environment depends on its ability to produce at competitive costs. Firms are, therefore, mandated to either minimise costs of production or maximise output from a given quantity of inputs. In the manager's effort to minimise production costs, the fundamental questions he or she faces are:

(a) How can production be optimized or costs minimised?
(b) What will be the beaviour of output as inputs increase?
(c) How does technology help in reducing production costs?
(d) How can the least-cost combination of inputs be achieved?
(e) Given the technology, what happens to the rate of return when more plants are added to the firm?

The theory of production attempts to provide theoretical answers to these questions, through abstract models built under hypothetical conditions. It follows that, though production theories may not provide solutions to the real life business problems, it can provide tools and techniques for the analysis of production conditions and for finding solutions to the practical business problems.

In this unit, we present the theory of production, using two input combinations, labour and capital.

2.0 Objectives

At the end of this unit, you will be expected to:

1. Understand the basic principles of production
2. Know how to develop a production function for given input combinations

3. Begin to think in terms of optimal input combinations for your production activities

3.0 Main Content

3.1 The Theory of Production

Production theory generally deals with quantitative relationships, that is, technical and technological relationships between inputs, especially labour and capital, and between inputs and outputs.

An ***input*** is a good or service that goes into the production process. As economists refer to it, an input is simply anything which a firm buys for use in its production process. An ***output***, on the other hand, is any good or service that comes out of a production process.

Economists classified inputs as (i) labour; (ii) capital; (iii) land; (iv) raw materials; and, (v) time. These variables are measured per unit of time and hence referred to as flow variables. In recent times, entrepreneurship has been added as part of the production inputs, though this can be measured by the managerial expertise and the ability to make things happen.

Inputs are classified as either ***fixed*** or ***variable*** inputs. Fixed and variable inputs are defined in both economic sense and technical sense. In *economic sense,* a fixed input is one whose supply is inelastic in the short run. In *technical sense*, a fixed input is one that remains fixed (or constant) for certain level of output.

A variable input is one whose supply in the short run is elastic, example, labour, raw materials, and the like. Users of such inputs can employ a larger quantity in the short run. Technically, a variable input is one that changes with changes in output. In the long run, all inputs are variable.

3.2 The Production Function

Production function is a tool of analysis used in explaining the input-output relationship. It describes the technical relationship between inputs and output in physical terms. In its general form, it holds that production of a given commodity depends on certain specific inputs. In its specific form, it presents the quantitative relationships between inputs and outputs. A production function may take the form of a schedule, a graph line or a curve, an algebraic equation or a mathematical model. The production function represents the technology of a firm.

An empirical production function is generally so complex to include a wide range of inputs: land, labour, capital, raw materials, time, and technology. These variables form the independent variables in a firm's actual production function. A firm's long-run production function is of the form:

$$Q = f(L_d, L, K, M, T, t) \qquad (3.2.1)$$

where L_d = land and building; L = labour; K = capital; M = materials; T = technology; and, t = time.

For sake of convenience, economists have reduced the number of variables used in a production function to only two: capital (K) and labour (L). Therefore, in the analysis of input-output relations, the production function is expressed as:

$$Q = f(K, L) \qquad (3.2.2)$$

Equation (3.2.2) represents the algebraic or mathematical form of the production function. It is this form of production function which is most commonly used in production analysis.

As implied by the production function (equation (3.2.2), increasing production, Q, will require K and L, and whether the firm can increase both K and L or only L will depend on the time period it takes into account for increasing production, that is, whether the firm is thinking in terms of the *short run* or in terms of the *long run.*

Economists believe that the supply of capital (K) is *inelastic* in the short run and *elastic* in the long run. Thus, in the short run firms can increase production only by increasing labour, since the supply of capital is fixed in the short run. In the long run, the firm can employ more of both capital and labour, as the supply of capital becomes elastic over time. In effect, there exists two types of production functions:

1. The short-run production function; and,
2. The long-run production function

The short-run production function, often referred to as the ***single variable production function***, can be written as:

$$Q = f(L) \qquad (3.2.3)$$

In The long-run, both capital (K) and labour (L) is included in the production function, so that the long-run production function can be written as:

$$Q = f(K, L) \qquad (3.2.4)$$

A production function ***is based on the following assumptions***:
(i) perfect divisibility of both inputs and output;
(ii) there are only two factors of production – capital (K) and lacour (L);
(iii) limited substitution of one factor for the other;
(iv) a given technology; and,
(v) inelastic supply of fixed factors in the short-run.

Any changes in the above assumptions would require modifications in the production function.

The two most important forms of production functions used in economic literature in analysing input-output relationships are the *Cobb-Douglas* production function and the *Constant Elasticity of Substitution (CES*) production function. Our interest at this level will be limited to the Cobb-Douglas production function.

3.2.1 The Cobb-Douglas Production Function
The Cobb-Douglas production function is of the following general form:

$$Q = AK^aL^b \qquad (3.2.5)$$

where a and b are positive fractions.

The Cobb-Douglas production function is often used in its following form:

$$Q = AK^aL^{(1-a)} \qquad (3.2.6)$$

3.2.2 Properties of the Cobb-Douglas Production Function

A power function of the Cobb-Douglas type has the following important properties:

First, the multiplicative for of the power function (3.2.5) can be transformed into its log-linear form as:

$$\log Q = \log A + a \log K + b \log L \qquad (3.2.7)$$

In its logarithmic form, the function becomes simple to handle and can be empirically estimated using linear regression techniques.

Second, power functions are homogeneous and the degree of homogeneity is given by the sum of the exponents a and b as in the Cobb-Douglas function. If a + b = 1, then the production function is homogeneous of degree 1 and implies constant returns to scale.

Third, a and b represent the elasticity coefficient of output for inputs, K and L, respectively. The output elasticity coefficient (ε) in respect of capital can be defined as proportional change in output as a result of a given change in K, keeping L constant. Thus,

$$\varepsilon_k = \frac{\partial Q/Q}{\partial K/K} = \frac{\partial Q}{\partial K}.\frac{K}{Q} \qquad (3.2.8)$$

By differentiating the production function, Q = AKaLb, with respect to K and substituting the result into equation (3.2.8), the elasticity coefficient, ε_k, can be derived:

$$\frac{\partial Q}{\partial K} = aAK^{(a-1)}L^b$$

Substituting the values for Q (equation (3.2.5)) and ∂Q/∂K into equation (3.2.8), you get:

$$\varepsilon_k = a\,AK^{(a-1)}L^b\left[\frac{K}{AK^aL^b}\right]$$

$$= a$$

It follows that the output coefficient for capital, K, is 'a'. The same procedure may be applied to show that 'b' is the elasticity coefficient of output for labour, L.

Fourth, the constants a and b represent the relative distributive share of inputs K and L in the total output, Q. The share of K in Q is given by:

$\frac{\partial Q}{\partial K} \cdot K$

Similarly, the share of L in Q can be obtained by:

$\frac{\partial Q}{\partial L} \cdot L$

The relative share of K in Q can be obtained as:

$\frac{\partial Q}{\partial K} \cdot K \cdot \frac{1}{Q} = a$

and the relative share of L in Q can be obtained as:

$\frac{\partial Q}{\partial L} \cdot L \cdot \frac{1}{Q} = b$

Finally, the Cobb-Douglas production function in its general form , $Q = K^{a}L^{(1-a)}$, implies that at zero cost, there will be zero production.

Some of the necessary concepts in production analysis can be easily derived from the Cobb-Douglas production function as shown below:

1. Average Products of L (AP_L) and K (AP_K):

   $AP_L = A (K/L)^{(1-a)}$

   $AP_K = A (L/K)^{1}$

2. Marginal Products of L (MP_L) and K (MP_K):

   $MP_L = a(Q/L)$

   $MP_K = (1 - a)Q/K$

3. Marginal Rate of Technical Substitution of L for K ($MRTS_{L,K}$):

   $MRTS_{L,K} = \frac{MP_L}{MP_K} = \frac{a}{(1-a)} \cdot \frac{K}{L}$

Note the $MRTS_{L,K}$ is the rate at which a marginal unit of labour, L, can be substituted for a marginal unit of capital, K (along a given isoquant) without affecting the total output.

3.2.3 Degree of Production Functions and Returns to Scale

The famous laws of returns to scale can be explained through production functions. Assume generally a production function involving two variables capital (K) and labour (L), and one commodity, X. The production function may be expressed in the form:

$$Q_x = f(K, L) \qquad (3.2.9)$$

Q_x denotes the quantity produced of commodity X. Assume also that the production function is ***homogeneous***, that is, when all inputs are increased in the same proportion, the proportion can be factored out mathematically. If when all inputs are increased by a certain proportion (say, k) and output increases by the same proportion (k), the production function is said to be homogeneous of degree 1. A production function of homogeneous of degree 1 is expressed as follows:

$kQ_x = f(kK, kL)$ (3.2.10)
$= k(K, L)$

A homogeneous production function of degree 1 implies ***constant returns to scale***. Equation (3.2.10) indicates that increases in the inputs K and L by a multiple of k, will increase output, Q_x, by the same multiple, k, implying constant returns to scale.

Note that increasing inputs, say K and L in the same proportion may result in increasing or diminishing returns to scale. Simply stated, it is likely that increases in all the inputs in certain proportion may not result in increase in output in the same proportion. If all the inputs are doubled, for example, output may not be doubled, it may increase by les than or more than double. In this case, the production function can be expressed as:

$hQ_x = f(kK, kL)$ (3.2.11)

where h denotes h-times increase in output, Q_x, as a result of k-times increase in inputs, K and L. The proportion, h may be greater than k, equal to k, or less than k. This touches on ***the three laws of returns to scale***:
(i) If h = k, production function reveals constant returns to scale
(ii) If h > k, production function reveals increasing returns to scale
(iii) If h < k, the production function reveals decreasing returns to scale.

Observe that in the production function, equation (3.2.10), k has an exponent equal to 1 (that is, $k = k^1$), hence, it is of homogeneous of degree 1. In general, the exponent of k can take the letter r, where $r \neq 1$. A production function is therefore, said to be homogeneous of degree r when if all the inputs are multiplied by k, output increases by a multiple of K^r. That is, if,
$f(kK, kL) = K^r(K, L) = k^rQ$ (3.2.12),
then the production function (equation, 3.2.12) is homogeneous of degree r.

From this production function, the laws of returns to scale can again be derived as follows:
(i) If k > 1, and r < 1, production function reveals decreasing returns to scale
(ii) If k > 1, and r > 1, production function reveals increasing returns to scale
(iii) If k > 1, and r = 1, production function reveals constant returns to scale.

Consider the following multiplicative form of a production function:
$Q = K^{0.25}L^{0.50}$ (3.2.13)
If K and L are multiplied by k, and output increases by a multiple of h, then
$hQ = (kK)^{0.25}(kL)^{0.50}$.

factoring out k, you get:

$hQ = k^{0.25 + 0.50}[K^{0.25}L^{0.50}]$
$= k^{0.75}[K^{0.25}L^{0.50}]$ (3.2.14)

According to equation (3.2.14), $h = k^{0.75}$ and r = 0.75, implying that r < 1, and, h < k. It follows that the production function (equation, 3.2.13) shows decreasing returns to scale.

Consider another production function of the form:

$$Q = f(K, L, X) = K^{0.75} L^{1.25} X^{0.50} \qquad (3.2.15)$$

Multiplying K, L, and X by k, Q increases by a multiple of h:

$$hQ = (kK)^{0.75} (kL)^{1.25} (kX)^{0.50}$$

Again factoring out k, you get:

$$hQ = k^{(0.75+1.25+0.50)}[K^{0.75} L^{1.25} X^{0.50}]$$
$$= k^{2.5}[K^{0.75} L^{1.25} X^{0.50}]$$

Observe that in this case, h = k2.5 and r = 2.5, so that h > k. Thus, production function (equation, 3.2.15) depicts increasing returns to scale.

Self-Assessment Exercise
Define production function and describe the underlying assumptions

4.0 Conclusion
The theory of production attempts to provide theoretical answers to these questions, through abstract models built under hypothetical conditions. Production function is a tool of analysis used in explaining the input-output relationship. It describes the technical relationship between inputs and output in physical terms.

5.0 Summary
The major issue of interest in this unit has been on the theory of production. We noted that the theory of production attempts to provide theoretical answers to these questions, through abstract models built under hypothetical conditions. Production function is a tool of analysis used in explaining the input-output relationship. It describes the technical relationship between inputs and output in physical terms. A production function is based on the following assumptions:
(i) perfect divisibility of both inputs and output;
(ii) there are only two factors of production – capital (K) and lacour (L);
(iii) limited substitution of one factor for the other;
(iv) a given technology; and,
(v) inelastic supply of fixed factors in the short-run.
Specific emphasis was on the Cobb-Douglas production function, using labour and capital as input combinations.

6.0 Tutor-Marked Assignment
State and illustrate the Cobb-Douglas production function

7.0 References
Dwivedi, D.N. (2007) *Managerial Economics, sixth revised edition,* Delhi: Gajendra Printing Press

Nicholson, W. (1978) *Microeconomic Theory: Basic Principles and Extensions, 2nd edition* Illinois: The Dryden Press

UNIT 2: OPTIMAL INPUT COMBINATIONS

Content

1.0 Introduction

Economists are of the opinion that profit-maximising firms seek to minimise costs for a given level of output, or to maximise its output for a given total cost. The two major instruments in the maximisation of output are the ***Isoquants curves*** and ***Isocost line***, often referred to as the ***budget constraint line.*** The logic of isoquant tells you that a given level of output can be produced with different input combinations. Given the input prices, however, only one of the input combinations would be the least cost combination. The least-cost combination represents the input combination for which the budget constraint line is tangent to the isoquant curve. In this unit, we continue our discussions on production functions with the way in which optimal input combinations can be determined.

2.0 Objectives

Having done the activities in this unit, you will be expected to:

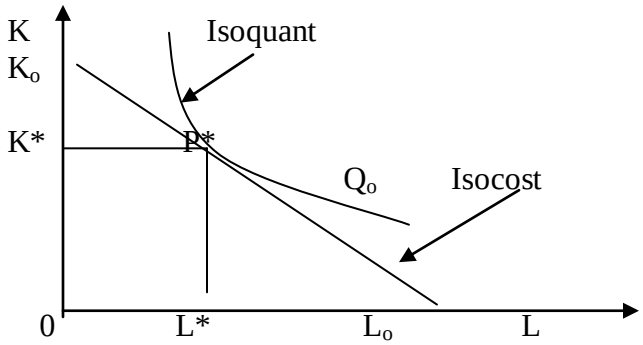
1. Know how to come up with the optimal input combinations
2. Understand the two major instruments in the maximisation of output, the isoquant curves and the budget constraint
3. Understand how changes in input prices can affect optimal input combinations.
4. Make strategic input combinations.

3.0 Main Content

3.1 The Least-Cost Combination of Inputs

The optimal input combination is the point for which the slope of the budget constraint line equals the slope of the isoquant curve, as indicated by figure 3.1.1 below. It is also the least-cost combination point.

Figure 3.1.1: Least-Cost Combination of Inputs



According to figure 3.1.1, the least-cost combination of the inputs, capital (K) and labour (L) is at the point (P*) for which the isocost line, K_oL_o is tangent to the isoquant curve, Q_o. At this point, the optimal combination of capital (K) and labour (L) is OK* of K and OL* of L. This combination is optimal since it satisfies the least-cost criterion:

$$\frac{MP_L}{MP_K} = \frac{P_L}{P_K} \qquad (3.1.1)$$

Or

$$\frac{MP_L}{P_L} = \frac{MP_K}{P_K} \qquad (3.1.2)$$

where MP_L and MP_K are marginal products of labour and capital, respectively, and P_L and P_K are prices of labour and capital, respectively.

The above least-cost criterion can be translated in values terms by multiplying the marginal productivities of capital (MP_K) and labour (MP_L) each by the product price (P) to obtain the marginal revenue product of labour (MRP_L) and the marginal revenue product of capital (MRP_K), and taking ratios to get:

$$\frac{MP_L.P}{MP_K.P} = \frac{MRP_L}{MRP_K} \qquad (3.1.3)$$

Equation (3.1.3) can be related to the ratio of input prices as follows:

$$\frac{P_L}{P_K} = \frac{MRP_L}{MRP_K}$$

Or,

$$\frac{MRP_L}{P_L} = \frac{MRP_K}{P_K} \qquad (3.1.4)$$

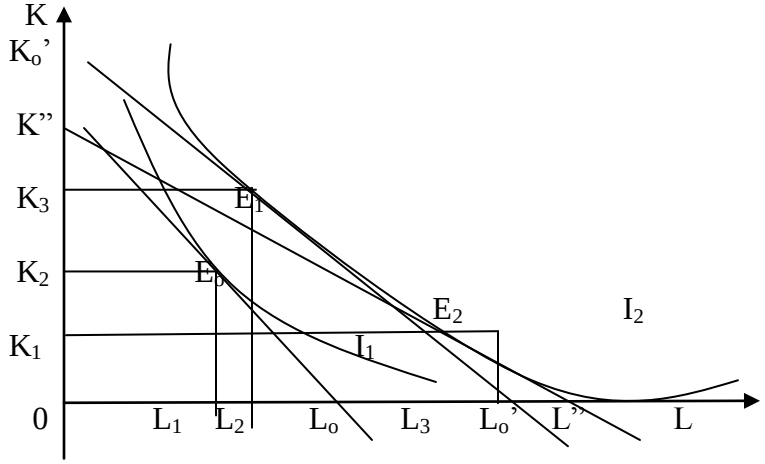
It can be inferred from equation (3.1.4) that least-cost or optimum input combination requires that the marginal revenue productivity ratio of factors should be equal to their price ratios, or that the marginal revenue productivity and factor price ratios of all the inputs must be equal.

3.2 Effect of Change in Input Prices on the Optimal Combination of Inputs

Changes in input prices affect the optimal combination of inputs at different magnitudes, depending on the nature of input price change. If all input prices change in the same proportion, the relative prices of inputs (that is the slope of the budget constraint or isocost line) remain

unaffected. But when input prices change at different rates in the same direction, or change at different rates in the opposite direction, or price of only one input changes while the prices of other inputs remain constant, the relative prices of the inputs will change. This change in relative input-prices changes both the input-combinations and the level of output. The change in input-combinations is as a result of the substitution effect of change in relative prices of inputs. A change in relative prices of inputs would imply that some inputs have become cheaper in relation to others. Cost-minimising firms attempt to substitute relatively cheaper inputs for the more expense ones. This refers to the ***substitution effect*** of relative input-price changes.
The effect of change in input prices on optimal input combinations is illustrated by figure 3.2.1 below.

Figure 3.2.1: Substitution Effect of Changes in Input Prices



We assume that, given the price of capital (P_k) and price of labour (P_L), and the total resources as indicated by the isocost line, K"L_o, the representative firm's optimum input-combination is given by point E_o in figure 3.2.1. Suppose that P_L decreases (P_k remaining constant), resulting in a new isocost, K"L", which is tangent to the isoquant, I_2 at point E_2. At this point, the firm's new optimum combination of inputs becomes $OK_1 + OL_3$. It follows that the decrease in price of labour (P_L) has given rise to the reduction of capital input by the amount K_1K_2 and increment of labour input by L_1L_3. The change in the input combination is referred to as the ***price effect*** of the decrease in the price of labour. This price effect is composed of substitution and budget effects, where the substitution effect is represented by the difference between price effect and budget effect. Thus,

Substitution effect = Price effect – Budget effect.

From figure 2, the Price effect = L_1L_3, and,
Budget effect = L_1L_2
Substitution effect = $L_1L_3 – L_1L_2 = L_2L_3$

We conclude therefore, that a firm's input combination changes with a change in the price of a given input, all things being equal. In this illustration, the firm employs more of the cheaper input (L) and less of the more expensive one (K). The level of output also changes, as you can infer from figure 3.2.1

3.3 Theory of Cost and Break-Even Analysis

Business decisions are generally taken based on the monetary values of inputs and outputs. Note that the quantity of inputs multiplied by their respective unit prices will give the monetary value or the ***cost of production.*** Production cost is an important factor in all business decisions, especially those decisions concerning:

(a) the location of the weak points in production management;
(b) cost minimisation
(c) finding the optimal level of output;
(d) determination of price and dealers' margin; and,
(e) estimation of the costs of business operation.

In this section, we present briefly the cost concepts applicable to business decisions, cost-output relations, and the break-even analysis.

3.3.1 The Business Cost Concepts

The cost concepts are theoretically grouped under two over-lapping categories:
(i) Concepts used for accounting purposes; and,
(ii) Analytical cost concepts used in economic analysis of business activities.

Accounting Cost Concepts

The accounting cost concepts include:

1. Opportunity Cost and Actual or Explicit Cost. Opportunity cost can be seen as the expected returns from the second best use of an economic resource which is foregone due to the scarcity of the resources. Some scholars refer to opportunity cost as *alternative cost.* There would be no opportunity cost if the resources available to the society were unlimited.

Associated with the concept of opportunity cost is the concept of ***economic rent*** or ***economic profit.*** Economic rent is the excess of earning from investment over and above the expected profit. The business implication of this concept is that investing in a given project will be preferred so long as its economic rent is greater than zero or positive. Additionally, if firms know the economic rent of various alternative uses of their resources, it will aid them in the choice of the best investment avenue.

The actual or explicit costs are those out-of-pocket costs of labour, materials, machine, plant building and other factors of production.

Self-Assessment Exercise

Explain briefly what you understand by isoquants

4.0 Conclusion

The unit points out the fact that economists are of the opinion that profit-maximising firms seek to minimise costs for a given level of output, or to maximise its output for a given total cost. The two major instruments in the maximisation of output are the Isoquants curves and the budget constraint line. The optimal input combination is the point for which the slope of the budget constraint line equals the slope of the isoquant curve

Changes in input prices affect the optimal combination of inputs at different magnitudes, depending on the nature of input price change. If all input prices change in the same proportion, the relative prices of inputs (that is the slope of the budget constraint or isocost line) remain unaffected.
Business decisions are generally taken based on the monetary values of inputs and outputs, where the quantity of inputs multiplied by their respective unit prices will give the monetary value or the cost of production.

5.0 Summary
The optimal input combination is the point for which the slope of the budget constraint line equals the slope of the isoquant curve.
The logic of isoquant tells you that a given level of output can be produced with different input combinations. Given the input prices, however, only one of the input combinations would be the least cost combination. The least-cost combination represents the input combination for which the budget constraint line is tangent to the isoquant curve. In this unit, we continue our discussions on production functions with the way in which optimal input combinations can be determined.

Cost-minimising firms attempt to substitute relatively cheaper inputs for the more expense ones. This refers to the ***substitution effect*** of relative input-price changes.
Business decisions are generally taken based on the monetary values of inputs and outputs.

Production cost is an important factor in all business decisions, especially those decisions concerning: the location of the weak points in production management; cost minimization; finding the optimal level of output; determination of price and dealers' margin; and, estimation of the costs of business operation.

6.0 Tutor-Marked Assignment
What do you understand by optimum input combination. What is the criteria for the least-cost combination of inputs?

7.0 References
Dwivedi, D.N. (2007) *Managerial Economics, sixth revised edition* (Delhi: Gajendra Printing Press).

Nicholson, W. (1978) *Microeconomic Theory: Basic Principles and Extensions, 2nd edition* (Illinois: The Dryden Press)

UNIT 3: THE COST FUNCTIONS

Content

1.0 Introduction

Economists often assume that the problem of optimum input combinations has been solved and attempts to conduct their analysis of the firm's behaviour in terms of revenues and costs expressed as functions of output. The problem of production is then to select an output level at which profits are maximized. In this unit, we examine the cost functions with aim of identifying the different categories of production costs and how they can be minimised.

2.0 Objectives

Having gone through the activities of this unit, you will be able to:

1. List the types of costs in a given production process
2. Define average and marginal costs
3. Explain the difference between Accounting and Economic profits
4. Explain the relationship between short-and long-run costs of a given firm.

3.0 Main Content

3.1 Definitions of Costs

Economists define three different concepts of costs: opportunity cost, accounting cost, and "***economic***" cost. For most economists, the most important of these is the *social* or *opportunity cost*. Due to limited resources, any decision to produce some goods necessitates some trade-offs or doing without some other goods. When some tubers of yams are produced, for example, an implicit decision has been made to do without, say 10 kilograms of beans that could have been produced using the available resources that went into the production of the tubers of yam. The opportunity cost of the tubers of yams is then 10 kilograms of beans.

The opportunity cost doctrine is extremely important in economic analysis. Many problems of social choice are often made conceptually clearer by recognising the alternatives inherent in a given economic process.

The two other concepts of cost are directly related to the firm's theory of choice. These include the accountant's concept of cost and the economist's concept of the firm's costs. The accountant's concept of costs stresses out-of-pocket expenses, historical costs, fixed costs, depreciation, and other book-keeping entries. The economists' definition uses the idea of opportunity cost, and defines cost to be that payment necessary to keep a resource in its present use or employment.

We can use a simple relationship to distinguish between ***accounting costs*** and ***economic costs***:

Accounting Costs = Total Variable Costs (TVCs) + Total Fixed Costs (TFCs)

Economic Costs = Accounting Costs + Opportunity Costs

3.2 Cost Functions

Cost functions are often classified into ***short-run*** and ***long-run*** functions. We summarise these in the following discussions.

3.2.1 Short-Run Cost Functions

We consider a system of equations consisting of:
(i) A production function of the form: $Q = f(K, L)$ (3.1)
where K and L represent capital inputs and labour inputs, respectively. The unit price of capital can be represented by the interest rate (r), and the unit price of labour by the wage rate (w).

(ii) A cost function: $C = rK + wL$ (3.2)

Equations (3.1) and (3.2) can be reduced to a single equation in which cost is stated as an explicit function of the level of output (Q) and input prices (r and w), plus cost of fixed inputs (or fixed costs), b:

$C = C(Q, r, w) + b$ (3.3)

Equation (3.3) becomes the short-run cost function.

In the short run however, it is assumed that input prices are invariant (do not vary), so that the cost function may be stated simply as a function of the output level, Q, plus the fixed cost:

$C = C(Q) + b$ (3.4)

The cost of the fixed inputs, fixed cost, must be paid regardless of the quantity of output, or whether zero unit is produced. The cost function gives the minimum cost of producing each output and is derived on the assumption that the producer or entrepreneur acts rationally.
Number of special cost-output relations can be derived from equation (3.4), including:
(1) The Average total cost (ATC);
(2) The Average variable cost (AVC);
(3) The Average fixed cost (AFC); and,
(4) The Marginal cost (MC).

The Average Total Cost (ATC), Average Variable Cost (AVC), and the Average Fixed Cost (AFC) are defined as the respective total, variable, and fixed costs divided by the level of output:

$$ATC = \frac{C(Q) + b}{Q}$$

$$AVC = \frac{C(Q)}{Q}$$

$$AFC = b/Q$$

ATC is the sum of AVC and AFC:

$$ATC = AVC + AFC \qquad (3.5)$$

The marginal cost, MC, is the derivative of the cost function with respect to output:

$$MC = dC/dQ = C'(Q).$$

Note that the derivatives of total cost (TC) and total variable cost with respect to output are identical since the term representing the fixed cost vanishes upon differentiation (derivative of a constant equals zero).

Specific cost functions assume different shapes. One possibility which exhibits properties often assumed by economists is shown in figures 3.1 and 3.2. Figure 3.1 indicates that total cost (C) is a cubic function of output (Q).

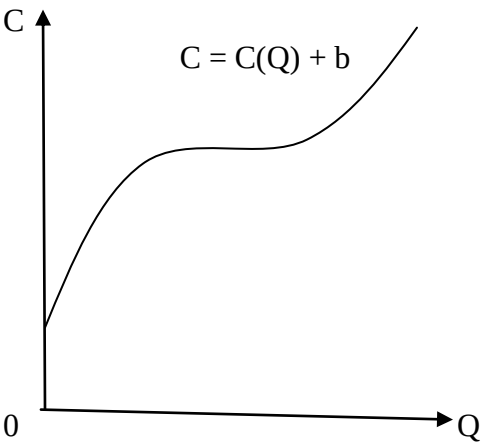


Figure 3.1: The Total Cost Curve

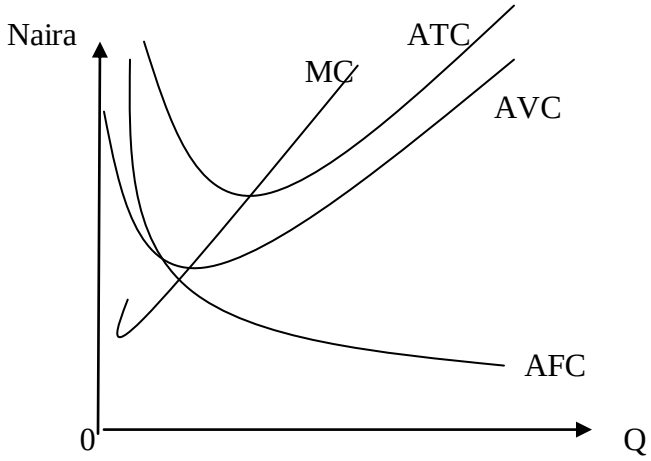


Figure 3.2: ATC, AVC, AFC, and MC Curves

Figure 3.2 shows that ATC, AVC, and MC are all second-degree curves which first decline and then increase as output expands. MC reaches its minimum before ATC and AVC, and AVC reaches its minimum before ATC. The MC curve passes through the minimum points of both the AVC and ATC curves. The AFC curve is a rectangular hyperbola regardless of the shapes of the other cost curves; the fixed cost is spread over a larger number of units as output expands,

thus, AFC declines monotonically. The vertical distance between the ATC and AVC curves equals the value of AFC, and hence decreases as output expands.

3.2.2 Long-Run Cost Functions

Let us assume that a given entrepreneur's fixed inputs are given by the parameter k, which represents the plant size. The greater the value of k, the greater the size of his plant. Let us also assume that the parameter k is continuously variable and we introduce it explicitly into the production function and the cost function:

$$Q = f(L, K, k) \qquad (3.6)$$

$$C = wL + rK + g(k) \qquad (3.7)$$

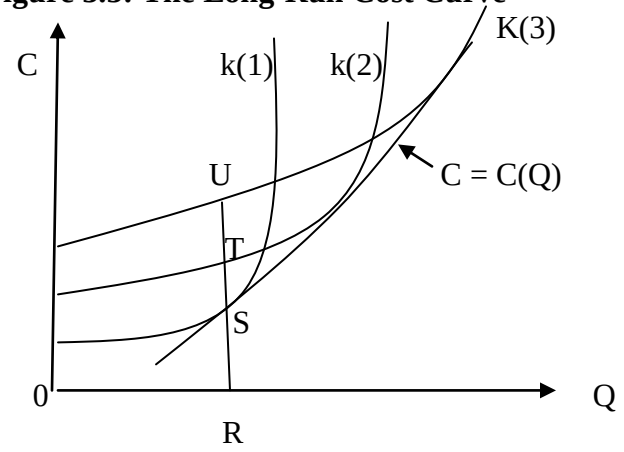
Fixed cost is an increasing function of the plant size: $g'(k) > 0$.

Eliminating the input prices, w and r, the total cost can be expressed as a function of output and plant size:

$$C = C(Q, k) + g(k) \qquad (3.8)$$

The equation (3.8) describes a family of short-run cost curves generated by assigning different values to the parameter k (different plant sizes). The equation represents the long-run cost function. The entrepreneurs long-run total cost function gives the minimum cost of producing each output level if he/she can vary his/her plant size. For a given level of output, he/she computes the total cost for each possible plant size and selects the plant size that minimises the total cost of production. Figure 3.3 presents the total cost curves corresponding to three different plant sizes.

Figure 3.3: The Long-Run Cost Curve



According to figure 3.3, the entrepreneur can produce OR units in any of the plants, represented by k(1), k(2), and k(3). His/her total cost would be RS for plant size k(1), RT for k(2), and, RU for k(3). The plant size k(1) gives the minimum production cost for OR units of output. Therefore the point S lies on the long-run total cost curve, defined as the locus of minimum-cost

points. The long-run cost curve is the envelope of the short-run cost curves, also represented in figure 3.3 as k(1), k(2), and k(3). The long-run cost function is shown in the figure as C = C(Q).

The long-run total cost curve is tangent to each short-run cost curve at the output level for which the short-run curve in question represents optimum plant size. The MCs can be defined as the slopes of the tangents of these short-run curves, and the long-run and short-run MCs are equal at such points.

Self-Assessment Exercise
Discuss the major differences between Accounting and Economic profits.

4.0 Conclusion
The unit began by explaining production costs in terms of two factors of production, capital and labour inputs. You were informed that production costs are generally classified into total, average, and marginal costs. You also learned that the major difference between accounting and economic profit is opportunity costs of production. We were also interested in the difference between short-and long-run costs. In sum, we observed that the long-run cost curve is the envelope of a series of short-run costs curves, as modeled by a firm's plant size.

5.0 Summary
Economists define three different concepts of costs: opportunity cost, accounting cost, and "economic" cost. For most economists, the most important of these is the *social* or *opportunity cost*.
We can use a simple relationship to distinguish between ***accounting costs*** and ***economic costs*** as follows:

Accounting Costs = Total Variable Costs (TVCs) + Total Fixed Costs (TFCs)

Economic Costs = Accounting Costs + Opportunity Costs

Cost functions are often classified into ***short-run*** and ***long-run*** functions.
A short-run cost function is basically made up of variable and fixed costs, as well as implicit or opportunity costs. In the short run, a firm is often interested in marginal costs of production, defined as the extra cost of producing additional units of output. The long-run average cost is the envelope of short-run average costs.

6.0 Tutor-Marked Assignment
Consider the cubic total cost function: $0.04Q^3 - 0.9Q^2 + 10Q + 5$
If the firm with this cost function produces 100 units of output:
(a) Compute the total cost of production
(b) Compute the average cost of production
(c) Compute the marginal cost of production.

7.0 References and Further Readings
Henderson, J. M. and Quandt, R. E (1980) *Microeconomic Theory: A Mathematical Approach* New York: McGraw-Hill Book Company

Nicholson, W. (1978) *Microeconomic Theory: Basic Principles and Extensions, 2nd edition* Illinois: The Dryden Press

Davis, H. (1991) *Managerial Economics for Business, Management and Accounting*, London: Prentice Hall

UNIT 4: PROFIT MAXIMISATION BY LINEAR PROGRAMMING METHODS

Content

1.0 Introduction

For most business organizations, optimisation essentially implies profit and/or revenue maximisation or cost minimisation, given productive resources and input prices. The conventional theories of production give optimum solution in some what abstract quantitative terms, through diagrams, mathematical derivations, logic, and symbols. They attempt to provide only guidance to decision-makers in their efforts to optimise resource allocation. They fail to provide exact solutions to practical problems of business. You should note that real life problems of maximisation and minimisation are much more complex than accounted for by the conventional theories of economics. These problems require real solutions in quantitative terms.

In the real business world, decision-makers deal with a large number of variables, with many constraints, in their efforts to arrive at an optimum solution to the problem of resource allocation. This problem is better solved by applying a sophisticated mathematical technique, referred to in this unit as *linear programming.* Linear programming is highly significant to business decisions, as it helps in measuring complex economic relationships and thereby provides an optimum solution to a resource allocation problem. Linear programming techniques thus, bridge the gap between abstract economic theories and managerial decision-making.

2.0 Objectives

At the end of this unit, learners will be able to:

1. Define the basic concepts in linear programming techniques;
2. Enumerate the basic assumptions of linear programming.
3. Explain the linear programming technique in optimisation problems.
4. Describe the efficient method of solving linear programming problems.

3.0 Main Content

3.1 Definition and Important Concepts in Linear Programming

Linear programming can be defined as a mathematical technique for solving maximisation and minimisation problems in business and economic decisions. It involves variables that have linear relationships with each other.

In linear programming, certain specific terminologies and concepts with specific connotations are used in the formulation of problems. You need to be familiar with these concepts, as discussed below.

3.1.1 Objective Function

In linear programming, objective functions are expressed in the form of equations. They refer to the quantity either to be maximised or minimised. As an example, if a business firm produces and sells outputs, X_1, X_2, and X_3, each yielding unit profit of 10, 4, and 7, respectively, the *objective function* or profit maximisation function can be expressed in the form:

$$\text{Maximise } \Pi = 10X_1 + 4X_2 + 7X_3 \qquad (3.1.1)$$

3.1.2 Constrained Optimisation

The objective functions for maximisation or minimisation problems are subject to constraints that can prevent the solutions from being infinitely large or small. These constraints specify the limiting conditions which arise either out of limited resources or technological limitations. As an example, you often observe that the maximisation of output is constrained by the limited availability of inputs, such as number of machines, hours of work, raw materials, and the like.

Constraints are expressed either in the form of equalities or in the form of inequalities. Assume a business firm has only 100 machine hours (M), and 1000 man-hours (L) available for its production process, you can express the production constraints as:

$$M \leq 100$$

$$L \leq 1000 \qquad (3.1.2)$$

3.1.3 Choice Variables

Choice variables are those variables chosen to maximise or minimise the objective function, satisfying all the constraints. Each choice variable is an indicator of the level of physical activity or operation, such as producing a commodity, buying or selling of goods, transporting of goods,

and the like. A choice variable may also represent price, which does not indicate a physical activity.

3.1.4 Non-negativity Condition

The non-negativity condition of variables in linear programming is an important requirement. This is because the variables business firms deal with, such as labour inputs, materials, space, output, and machines, cannot be negative. These variables can either be equal to or greater than zero. Using the variable in equation (3.1.2), for example, the non-negativity conditions can be expressed as follows:

$$M \geq 0; \quad L \geq 0$$

3.1.5 Feasible and Optimum Solutions

Feasible solutions are those that you can achieve with a given amount of resources or according to the resource constraints. Recall the 'budget line' in the analysis of consumer behaviour, or the 'isocosts' in production analysis. All the possible combinations on or below the 'budget line' or 'isocosts' are the feasible solutions. Note that feasible solutions do not have to satisfy all the constraints. It is the solutions that satisfy all the constraints that are known as the *optimum solutions* or *optimum feasible solutions*.

3.2 Assumptions of Linear Programming

Solutions to an optimisation or a minimisation problem in linear programming are based on the following assumptions.

3.2.1 Linearity

It is assumed that there exists a linear relationship between output and inputs. This linear input-output relationship is an assumption as well as a condition in linear programming solutions. Stated alternatively, linear programming solutions are based on the assumption of constant returns to a factor in the short run. This linear relationship is represented by a straight-line equation. For example, consider an automobile manufacturer requiring 200 labour hours (L), 250 machine hours (M), and 0.8 tonnes of steel (S) to produce 100 automobiles. The input-output linear relationship can be expressed as:

$$200L + 250M + 0.8S = 100 \qquad (3.2.1)$$

3.2.2 Continuity

Continuity requires that all variables are quantifiable in numerical values. This is because it is only numerical values that can provide continuity in measurement. In optimum solutions, non-numerical or unquantifiable values are meaningless.

3.2.3 Independence and Additivity

It is assumed that the variables and their quantitative specifications are independent of other variables. In other words, given the constraints, the variables should be capable of being arbitrarily chosen. These variables should also satisfy the condition of additivity, that is, the quality of being added together. Non-additive values cannot be used in linear programming solutions.

3.2.4 Proportionality

Proportionality implies that the linear relationship between the variables should be proportional and should not change in the course of solution. For instance, if production of 1 unit of a commodity requires 2 units of an input, production of 10 units would require 20 units of the input, and so on.

3.2.5 Constant Price

This is the assumption that input and output prices must be constant in linear programming problems, irrespective of the quantities purchased or sold. The price involved must be purely competitive price in both factor and commodity markets.

3.3 Applications of the Linear Programming Technique

In this section, you will see a practical business application of the linear programming techniques. We use the case of profit maximisation, for simplicity.

The Profit Maximisation Problem

You assume that a business firm produces two commodities, X and Y, with two different inputs, Labour (L) and Capital (K). The total quantities of L and K available per unit of time are specified as L = 1600 labour hours; and K = 2000 units. In addition, assume that producing 1 unit of commodity X requires 4 units of labour (L) and 2 units of capital (K). one unit of commodity Y requires 2 units of L and 5 units of K. Profits per unit of commodities X and Y are estimated at N10 and N8, respectively.

These information can be summarized in table 3.3.1 below

Table 3.3.1: Production and Input Requirements

Inputs	Total Inputs Available Per unit of time	Input Requirement per unit of product	
		X	Y
Labour (L)	1600	4	2
Capital (K)	2000	2	5

Given these information, the firm's objective is to maximise it total profit (Π). The problem is to choose an output mix of X and Y that maximizes profit.

Transformation of the Problem into Linear Programming

To transform the problem at hand to linear programming format, you need to restate the conditions of the problem in programming language. Take note of the following steps, they will help you.

Step 1: Specification of the Objective Function. The firm's objective function can be expressed in the following form:

$$\text{Maximise } \Pi = 10X + 8Y \qquad (3.3.1)$$

where X and Y represent quantities of commodities X and Y. When you multiply these quantities by their unit prices (or profits as the case may be) you will obtain the total profit (Π)

as indicated by equation (3.3.1). It will be the linear programming technique that you will use in determining the units of X and Y to produce in order that profit will be maximised.

Step 2: Specification of the relevant Constraint Inequalities. Using the information available in table 3.3.1, you will formulate the relevant constrain equations as:

The constraint inequality for input L may be specified thus,

$$4X + 2Y \leq 1600 \qquad (3.3.2)$$

The constraint inequality for input K may similarly be specified as,

$$2X + 5Y \leq 2000 \qquad (3.3.3)$$

Step 3: Specification of Non-negative Conditions. Note that a negative quantity in optimum solutions is not allowed and does not make economic sense so that, you must impose non-negative conditions in the linear programming problem. The relevant non-negative conditions for the problem at hand can be expressed as:

$$X \geq 0 \text{ and } Y \geq 0 \qquad (3.3.4)$$

You are now in a position to formulate the required linear programming problem in terms of equations and inequalities. The *problem* becomes:

Maximise $\Pi = 10X + 8Y$ (the *objective function*),
Subject to the constraints:

$$4X + 2Y \leq 1600 \qquad (3.3.5)$$

$$2X + 5Y \leq 2000, \qquad (3.3.6)$$

where $X \geq 0$ and $Y \geq 0$

You will obtain the optimum solution to the problem at hand by solving for the values X and Y in the above equations.

3.4 Methods of Solving Linear Programming Problems
You will now be introduced to two popular methods of solving linear programming problems:

(i) ***Graphical Method***

(ii) ***Simplex Method***

3.4.1 The Graphical Method

This method is the simplest technique in solving linear programming problem. You begin by converting the constraint inequalities into equalities, and them sketching them in a graph. Thus, the constraint inquality (3.3.5) becomes:

$$4X + 2Y = 1600 \qquad (3.4.1)$$

and that of (3.3.6) becomes:

$$2X + 5Y = 2000 \qquad (3.4.2)$$

Notice that equations (3.4.1) and (3.4.2) are linear equations in X and Y. To sketch these equations, you will begin by determining the intercept terms for the two-dimensional graph in X and Y. Thus, to graph equation (3.4.1), you obtain the Y- and X-axis as,

For the *Y-axis*: $4X + 2Y = 1600$

$$2Y = 1600 - 4X$$

When $X = 0$, $2Y = 1600$

$$Y = 800$$

The Y-intercept is therefore, 800.

For the *X-axis*: $4X + 2Y = 1600$

$$4X = 1600 - 2Y$$

When $Y = 0$, $4X = 1600$

$$X = 400$$

The X-intercept is therefore, 400.

Similarly for equation (3.4.2), you obtain the Y- and X-axis as:

$2X + 5Y = 2000$

$5Y = 2000 - 2X$

When $X = 0$, $5Y = 2000$

$$Y = 400$$

Here, the Y-intercept is 400, and,

$2X + 5Y = 2000$

$2X = 2000 - 5Y$

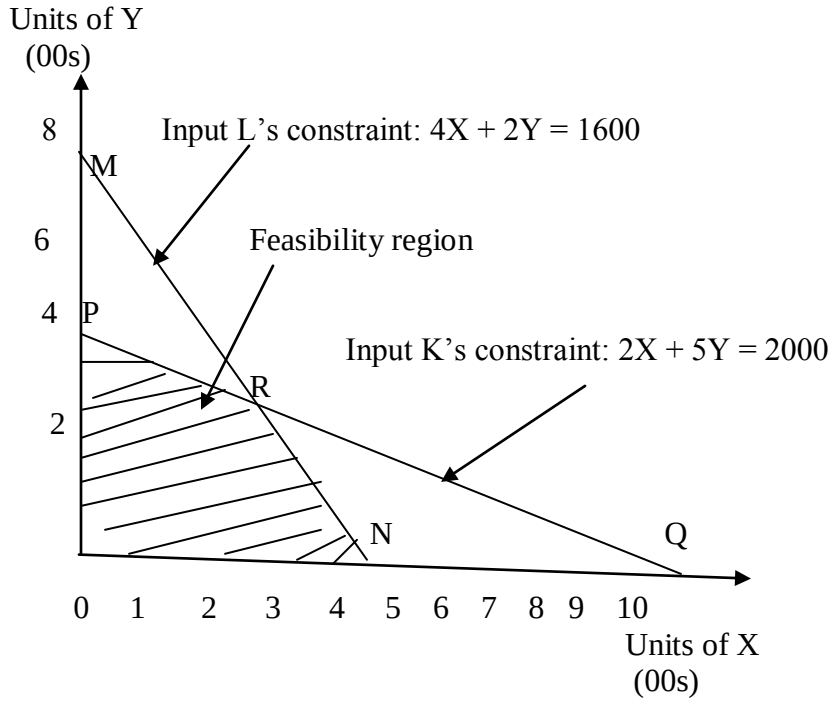
When Y = 0, 2X = 2000

X = 1000

Therefore, the X-intercept is 1000.

The sketches are as in figure (3.4.1) below:

Figure 3.4.1: Production Constraints and Feasibility Region



Observe that in figure 3.4.1, the line MN is formed by joining the Y- and X-intercepts for the labour (L) constraint equation, and that of PQ is formed by joining Y and X-intercepts for the capital (K) constraint equation. All the points on the line MN satisfy the constraint, $4X + 2Y \leq 1600$. The area under OMN is referred to as the feasibility space for the single input, L. This implies that any point within the feasibility space and on the border lines is a feasible point for this input.

Similarly, the area under OPQ is referred to as the feasibility space for for the single input, K. All the points on the line PQ satisfy the constraint,
$2X + 5Y \leq 2000$.

The shaded area under OPRN represent the feasible region, where you will obtain the feasible output choices. Each of these choices satisfies both the constraints and the stated non-negativity conditions. Only those points falling under the feasible region satisfy all the feasibility conditions. Any point to the right of the area marked MRP represents a combination of the commodities X and Y that cannot be produced within the limited availability of the inputs L and K. All the points marked by the area PMR satisfy only the constraint, $4X + 2Y \leq 1600$. Similarly, all the points within the area marked NRQ satisfy only the constraint, $2X + 5Y \leq$

2000. It follows that only the feasible area, OPRN, that meets the constraints and contains the point of solutions to the profit maximisation problem.

Your next step is to locate the point on the boundary of the feasible area. This point will represent the combination of the commodities X and Y that maximises profit. You can do this by graphing or sketching the objective function in the form of *isoprofi*t lines, for different output levels, and superimposing these over the feasible region.

Graphing of the objective function would require finding the slope of the objective function, which you can do as follows:

Given the objective function, $\Pi = 10X + 8Y$, you write it in terms of Y to get:

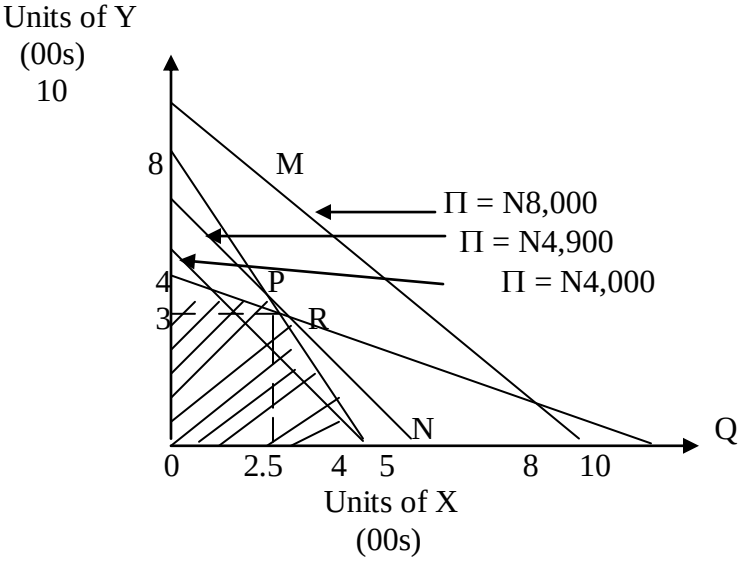
$Y = \Pi/8 - 10/8X = \Pi/8 - 1.25X$

where $\Pi = 0$,

$Y = -1.25X$.

The coefficient, -1.25 gives the slope of the isoprofit line. This means that 1.25 units of commodity Y would yield the same profit as 1 unit of X. With this slope, a series of isoprofit lines can be drawn and superimposed over the feasibility region, as you can observe in figure 3.4.2 below. Note that since profitability of the two commodities is constant, isoprofit lines are parallel to each other.

Figure 3.4.2: Graphical Solution of the Profit Maximisation Problem



Observe that the isoprofit line marked N8,000 is not possible because it lies very much above the feasibility space or region.The isoprofit line marked N4,000, passing under the feasibility space reflects an underutilization of inputs. It therefore, indicates a less than maximum profit. The

shaded area to the right of this line indicates the scope for increasing profit. The isoprofit line marked N4,900, which is tangent to the boundary of feasibility space at point R is the highest possible isoprofit line, representing the maximum possible profit given the resource constraints. The tangential point, R which represents a combination of X and Y (that is, 2.5(100) = 250 units, and 3(100) = 300 units), yields the maximum profit. Thus,

Maximum Profit (Π^*) = 10(250) + 8(300) = N4,900.

It follows that the profit maximising units of commodities X and Y are 250 units and 300 units, respectively.

3.4.2 The Simplex Method

Before you apply the simplex method, you need to introduce an additional variable, known as the slack variable. This slack variable is added to the constraints in the profit-maximising or cost minimising problems. The slack variable is meant to account for the amount of unused inputs at the point of solution. Slack variables are always non-negative since a negative slack variable would call for additional inputs, which will go against the production constraints.

By introducing slack variables, you will be converting inequalities of the constraint equations into equations. For example, after the introduction of the slack variables, S_a and S_b, the constraints represented by equations (3.3.5) and (3.3.6) are converted to the following equations:

$$4X + 2Y + S_a = 1600 \qquad (3.4.3)$$

$$2X + 5Y + S_b = 2000 \qquad (3.4.4)$$

where $S_a \geq 0$ and $S_b \geq 0$, and represent the unused quantities of the labour (L) and capital (K), respectively.

The introduction of slack variables also gives the following important information:

The maximum values of slack variables, S_a and S_b, are 1600 and 2000 respectively, when X = 0 and Y = 0.
If $S_a = S_b = 0$ at the optimum solutions, the inputs are fully used and excess capacity does not exist.
If $S_a > 0$ and $S_b > 0$, there exists excess capacity.

To solve equations (3.4.3) and (3.4.4), given the objective function in equation (3.3.1), you first determine algebraically the *corner* solutions. Consider the constraint equations first:

$4X + 2Y + S_a = 1600$

$2X + 5Y + S_b = 2000$

These equations contain four variables in all, these are X, Y, S_a, and S_b. You set the main variables, X and Y each equal to zero (conditions that exist at the corner points of origin). And when X = 0 and Y = 0, then from the constraint equations above, S_a = 1600 and S_b = 2000.

Substituting zero for X and zero for Y in the objective function, you will get:

Z = 10X + 8Y = 10(0) + 8(0) = 0

while S_a = 1600, and S_b = 2000 (as indicated above).

As indicated by the objective function, increasing the values or quantities of commodities X and Y will lead to increase in profit at the rate of 10 per unit of X, and 8 per unit of Y. Note that the values of X and Y can be increased to the limit determined by the constraints

Assume you decided to increase the value or quantity of Y. The limit to which you can increase Y is given by the constraint equations (3.4.3) and (3.4.4). The constraint equation (3.4.3), that is: $4X + 2Y + S_a = 1600$ allows you to increase the value of Y to the maximum of 800, when X = 0 and S_a = 0. Constriant (3.4.4), that is: $2X + 5Y + S_b = 2000$, similarly allows you to increase the value of Y up to 400, when X = S_b = 0.

Observe that Y = 800 satisfies constraint (3.4.3) and not constraint (3.4.4), because 800(2) = 1600. But Y = 400 satisfies both constraint (3.4.3 and constraint (3.4.4), since 400(2) = 800 {which is within constraint (3.4.3)}, and 400(5) = 2000 {which is also within constraint (3.4.4)}. It follows that the upper limit of Y is 400 and not 800.

Y = 400 is an adjacent point to the origin (a corner point), when X = 0, and substituting 400 for Y and 0 for X in the objective function, you get:

Z = 10(0) + 8(400) = N3,200.

The objective is however, not to find the total profit at any of the corner points, but to know whether the N3200 obtained is the maximum profit. You have two ways of knowing whether N3200 is the maximum profit.

First, you can calculate the total profit at all corner points and compare them with the above profit, N3,200.

Second, you can determine algebraically whether the total profit can be increased beyond N3,200.

The simplex method uses the second approach. Since Y has been determined to be at a maximum permissible under the given constraints, there is no scope for increasing profit by increasing the production of Y. It follows that the only available opportunity for increasing profit is to make X > 0. But given the input constraints, you can only increase the production of commodity X by reducing the production of commodity Y. Therefore, the change in profit will depend on the relationship between commodity X and commodity Y, and also on the slack

variables. You will be therefore required to express the profit or the objective function in terms of X and the slack variables. You will also be required to find the limit to which commodity X can be increased. The procedure for substituting X and S_b for Y in the profit function is exemplified as follows.

Using equation (3.4.4), you obtain:

$$5Y = 2000 - 2X - S_b$$

$$Y = 400 - 0.4X - 0.2S_b \qquad (3.4.5)$$

Substitute equation (3.4.5) for Y in the profit or objective function, you get:

$$Z = 10X + 8(400 - 0.4X - 0.2S_b)$$

$$= 10X + 3200 - 3.2X - 1.6S_b$$

$$= 3200 + 6.8X - 1.6S_b \qquad (3.4.6)$$

Equation (3.4.6) reveals the following important information:

At the point where $X = S_b = 0$, Profit ($\prod$) = N3,200
Increasing X will increase profit , since $X > 0$ (positive coefficient)
Increasing S_b will decrease profit, since $S_b < 0$ (negative coefficient)

These information reveals the main logic of the simplex method.

With this logic, you can now proceed to solve the profit maximisation problem, using the simplex method.

As noted, increasing X will increase the total profit, but up to the limit determined by the constraints. The constraint, $4X + 2Y + S_a = 1600$ indicates that X can be increased up to the limit of 400 units, when $Y = S_a = 0$. The constraint,
$2X + 5Y + S_b = 2000$ indicates that X can be increased up to the limit of 1000 units, when $Y = S_b = 0$. While the later satisfies only one constraint, equation (3.4.3), the former satisfies all the constraints, including equation (3.4.4). Thus, 400 is the upper limit of X when Y, $S_a \neq 0$. But since $S_b > 0$, the profit is not maximum because some units of the input, K, remain unused.

You are therefore, required to compute the profit at the point where $S_a = S_b = 0$. The profit function should therefore, be expressed in terms of S_a and S_b and equation (3.4.3) to be solved for X in terms of S_a and S_b as follows:

Substitute equation (3.4.4) for Y in equation (3.4.3), that is, $4X + 2Y + S_a = 1600$, you get:

$$4X + 2(400 - 0.4X - 0.25S_b) + S_a = 1600$$

$3.2X = 800 + 0.4S_b - S_a$

$X = 250 + 0.125S_b - 0.312\ S_a$ (3.4.7)

Substitute equation (3.4.7) for X in the profit or objective function (3.4.6), you will get:

$Z = (\prod) = 3200 + 6.8(250 + 0.125S_b - 0.312S_a) - 1.6S_b$

$= 3200 + 1700 - 0.75S_b - 2.12S_a$

$= 4900 - 0.75S_b - 2.12S_a.$ (3.4.8)

Equation (3.4.8) gives you the total profit at the corner points $S_a = S_b = 0$. For you to further increase profit, S_a or S_b must be increased. But in equation (3.4.8) the coefficients of S_a and S_b indicate that they are negative variables. Therefore, making $S_a > 0$ or $S_b > 0$ (that is increasing them) will actually reduce the profit. The maximum profit is therefore, N4,900, when $S_a = S_b = 0$.

By inspection, equation 3.4.7 implies that when $S_a = 0$ and $S_b = 0$, the value of X = 250 units. Substitute X = 250 and maximum profit $(\prod) = 4900$ into the objective or profit function, you get:

$4900 = 10(250) + 8Y$

$2500 + 8Y = 4900$

$8Y = 2400$

$Y = 300.$

You can now conclude that the profit maximising levels of output are 250 units of commodity X and 300 units of commodity Y. This gives you the final solution to the linear programming problem in this discussion.

Self-Assessment Exercise
Enumerate and discuss the basic assumptions of linear programming

4.0 Conclusion
This unit has made you to know that optimization basically implies profit and/or revenue maximisation or cost minimization. When optimization problems become complex, you should result to linear programming technique as the most efficient technique in solving the problems.

The unit has also exposed you to the necessary assumptions of linear programming, including: Linearity, continuity, independence and additivity, proportionality, and constant price. You learned the two important methods of solving linear programming problems: (i) the Graphical method, and, (ii) the Simplex method.

To put these methods in practice, the unit solve an optimization problem involving profit maximisation, where extension discussions on objective functions, constraints, and slack variables were presented. You also were meant to understand that the most feasible method of solving linear programming problems is the simplex method.

5.0 Summary

Linear programming can be viewed as a mathematical technique for solving maximisation and minimisation problems in business and economic decisions. It involves variables that have linear relationships with each other.

There are some important concepts of linear programming. These include in a nutshell: the objective function; constrained optimization; choice variables; non-negativity conditions; feasibility, and optimum solutions. The guiding assumptions of linear programming are: linearity, continuity, independence and additivity, proportionality, and constant price.

It is necessary to transform optimisation problems into the corresponding linear programming language before its applications. The following basic steps in this transformation need to be followed:

Step 1: Specification of the objective function
Step 2: Specification of the constraint inequalities
Step 3: Specification of the non-negative conditions.

Having transformed the optimisation problem to its linear programming equivalence, there exists two methods of solving it: (i) the Graphical method; and, (ii) the Simplex method.

Linear programming techniques remain the most efficient technique for solving complex real life optimisation problems in business. The current rapid increases in the use of computer technology may have, however, introduced faster and more accurate method of solving optimisation problems than linear programming techniques.

6.0 Tutor-Marked Assignments

Discuss the various ways in which linear programming might be used in helping business decisions.

A manufacturer produces two products, X and Y in two steps on machines A and B. The processing times for the two products on the two machines are given in the following table:

Product	Machine A	Machine B
X	4 hours	5 hours
Y	5 hours	2 hours

Machine A has 8 hours available and Machine B has 120 hours available. Product X has profit of N10 per 100 units, and product Y has profit of N5 per 10 units. There is no restriction on sales. Formulate the linear programming problem and use the simplex method to find out the number of units of products X and Y that must be produced for the manufacturer to maximise profit.

7.0 References and Further Readings

Dwivedi, D. N. (2002) "Linear Programming" *Managerial Economics, 6th edition,* New Delhi: Vikas Publishing House PVT Ltd

Francis, A (1998) "Linear Equations" *Business Mathematics and Statistics, 5th edition,* England: Ashford Colour Press

Nicholson, W. (1978) *Microeconomic Theory: Basic Principles and Extensions, 2nd edition* Illinois: The Dryden Press

MODULE FOUR: INCOME DETERMINATION, GENERAL EQUILIBRIUM, AND THEORIES OF MONEY

UNIT 1: THE SIMPLE MODEL OF NATIONAL INCOME DETERMINATION

Content

1.0 Introduction

The National Income Accounting is an important activity in macroeconomic analysis. It measures economic activity that has taken place in an economy over a period of time. The aim of this unit is to inform you of the tools for the determination of the national income and how the national income can change. The models to be discussed will be simple enough but capable of revealing much of the theoretical basis for modern thinking in macroeconomics.

2.0 Objectives

At the end of this unit, you will

1. Effectively identify the components of national income
2. Determine the national income of a country given the necessary data
3. Understand and use the concept of multiplier in macroeconomics
4. Apply the national income concept in business decision making.

3.0 Main Content

Let us look at the basic components of the simple model for determining the national income. The relevant components here include consumption and investment expenditures. In unit 3, you will be expanding your knowledge of the income determination through the inclusion of government expenditures. We begin with the consumption expenditure, followed by introduction to the savings function.

3.1 The Consumption Function

The consumption function appears to be one of the concepts in economics about which you may wonder why it is not thought of earlier as it is so simple and obvious. The function simply presents the idea that the amount of national income that goes into personal consumption is

principally determined by the amount of income flowing to households. Specifically, it is the amount of disposable income that is, income after taxes, that determines the amount of consumption expenditures.

In symbolic terms, you can write:

$$C = C(Y_d), \qquad (3.1)$$

Where C refers to the amount of consumption expenditure and Y_d refers to personal disposable income. We know there are other factors determining consumption expenditures, but disposable income has been regarded as the most important independent variable with the major influence.

With the assumption that the relationship between consumption expenditures and disposable income is linear, you can rewrite equation (3.1) as follows:

$$C = Co + cY \qquad (3.2)$$

Equation (3.2) is an expression for a straight line and you can interpret it as follows:
Co measures the amount of consumption expenditures at zero level of disposable income. It indicates that in the short run, there must be some minimal amount of consumption even if income is zero. Economists often refer to this minimal consumption expenditure as autonomous consumption expenditure or subsistence consumption expenditure, since it is independent of the level of income.

Mathematically, while Co refers to the consumption intercept, c which is the coefficient of Yd refers to the slope of the consumption line. It measures the extent of the change in consumption with respect to a unit change in disposable income, Y. In Keynesian terms, c is referred to as the marginal propensity to consume (MPC). It simply shows what portion of a change in income will be consumed. By definition,

$$c = \frac{\Delta C}{\Delta Y} = \frac{dC}{dY} = MPC$$

$0 < c < 1$, that is, MPC lies between 0 and 1.
Keynes believed the MPC to be positive but less than 1, implying that some portion of additional income will ordinarily be spent but not all of it. It follows that consumption expenditures must always be affected by a change in income.

The marginal propensity to consume relates to changes in consumption brought about by changes in income. If you want to know the proportion of a given level of income that will be devoted to consumption, you would have to use the concept called the average propensity to consume (APC). The average propensity to consume is defined by the expression:

$$APC = C/Y = \frac{Co + cY}{Y}$$

$$= Co/Y + c \qquad (3.3)$$

Mathematically, since c is a positive constant, the following relationships between APC and MPC will hold:

APC > MPC, since Co/Y + c > c; and,

as Y increases, APC will fall but MPC remains constant, since as Y increases, Co/Y falls.

3.2 The Savings Function

Economists assume that households can only do two things with their disposable incomes. The two things are (i) consume; and, (ii) save. Once either consumption or saving has been determined, the other will also be determined. It follows that the saving equations are complements to the consumption equations. In functional terms, savings can be represented by:

$$S = S(Yd) \qquad (3.4)$$

In a linear form and after dropping the subscript, d, equation (3.4) becomes:

$$S = -So + sY \qquad (3.5)$$

Note that the term –So, which represents the amount of savings at a zero income (autonomous saving), is exactly equal to Co, the corresponding amount of consumption in equation (3.2) above. The autonomous consumption came about through spending of past savings, so that –So measures the same amount of dissaving. The term s in equation (3.5) is referred to as the marginal propensity to save (MPS) and measures that amount of a change in income which the household saves. The marginal propensity to save is also a positive constant, which measures the slope of the saving function. Thus, as with the marginal propensity to consume, MPC,

s = MPS is always positive, and a constant;

$0 < s < 1$, implying that MPS lies between 0 and 1.

If you are interested in knowing the amount of saving as a proportion of a given level of income, then it is necessary you find the average propensity to save (APS), defined by S/Y.
Dividing equation (3.5) by Y yields the average propensity to save, APS:

$$S/Y = -So/Y + s \qquad (3.6)$$

As Y increases, APS rises.

And since households can only split up their incomes into consumption and saving, the following relationships will hold:

$$Y = C + S \qquad (3.7)$$

$$\Delta Y = \Delta C + \Delta S \qquad (3.8)$$

Any change in Y will give rise to changes in C and S, so that,

$$\frac{\Delta Y}{\Delta Y} = \frac{\Delta C}{\Delta Y} + \frac{\Delta S}{\Delta Y}$$

$$1 = MPC + MPS \qquad (3.9)$$

Similarly, any income level, Y must be divided up into consumption and saving and

$$1 = APC + APS \qquad (3.10)$$

3.3 The Simple Income Determination Model

In this simple model, activities of government and those of the foreign sector will be ignored for now. The emphasis will be on the private sector comprising of the households and the business firms. Our basic assumption is that all firms are sole proprietorships so that the owners receive all the profits and pay taxes as individuals. In the absence of government, corporations and foreign trade, there are no taxes or retained earnings, and the net national product, disposable income, and national income all become virtually the same and can be treated as identical. In this model, you may simply refer to income as Y.

The simplest assumption of this model is that all investment expenditures are autonomous, independent of the current income. This would mean that investment plans are fixed and geared toward long-run expectations and are not influenced by current economic conditions. Investment is simply a constant regardless of the level of income.

Under these basic assumptions, the private-sector economy becomes:

$$Y = C + I \qquad (3.11)$$

Aggregate demand (AD) is made up of consumption and investment. All income is paid out to individuals, and in the absence of government, personal income equals personal disposable income. Since we had assumed that consumers can only consume and/or save, we can write the following in place of equation (3.11), assuming that savings equal to investment, in Keynesian terms.

$$Y = C + S \qquad (3.12)$$

Since the two Ys in equations (3.11) and (3.12) are equal, you can equate (3.11) and (3.12) to get:

$$C + I = C + S \qquad (3.13)$$

It follows that at equilibrium national income, $I = S$ (3.14)

In the model that follows, you regard Y as aggregate supply and C + I as aggregate demand. Rewriting the consumption function and the investment function in accordance with equation (3.11), we get:

$Y = C + I$ (the equilibrium condition)
$C = Co + cY$

I = Io (since investment is assumed to be autonomous and constant).

Using the equilibrium condition, we obtain:

Y = Co + cY + Io, and solving for Y, you get:

$$Y^* = 1/(1 - c)\,[Co + Io] \qquad (3.15)$$

Equation (3.15) represents the equilibrium solution, and Y* can be regarded as the equilibrium level of national income. Equation (3.15) can be regarded as the model of simple income determination.

As an example, assume that Investment expenditures at a given period is N60 billion, and the consumption function is represented by:

C = 20 + 0.8Y, then,

Y = C + I (equilibrium condition)
C = 20 + 0.8Y
I = 60

By the equilibrium condition,

Y = 20 + 0.8Y + 60
Y – 0.8Y = 80
Y(1 – 0.8) = 80
Y* = 80/(1 – 0.8)
= 80/0.2 = 400

Thus the equilibrium level of national income in this example is N400 billion.

3.4 The Simple Multiplier

Refer back to equation (3.15), the expression, 1/(1 – c), is referred to as the income multiplier. In the above example, the income multiplier is 1/(1 – 0.8) = 1/0.2 = 5.
In symbolic form, you can simply define the simple income multiplier as

1/(1 – MPC) or 1/(MPS), since the constant, c, is the marginal propensity to consume, MPC. Recall our earlier assumption about the marginal propensity to consume, MPC:
1 > MPC > 0. It follows that the numerical value of the multiplier must be greater than 1. If the MPC = 1, the multiplier would be infinite, and if MPC = 0, the multiplier would equal 1. As you can deduce from above presentations, the numerical value of the simple multiplier can easily be calculated as the reciprocal of the marginal propensity to save, MPS.

To determine the effect of any change in investment expenditure or autonomous consumption on the equilibrium level of national income, you can simply apply the multiplier relationships:

$\Delta Y = 1/(1 - c)\,\Delta I$ (for a change in investment expenditure)

$\Delta Y = 1/(1 - c)\ \Delta Co$ (for a change in autonomous consumption expenditure).

Using our previous example as an illustration, if investment expenditures change by N50 billion ($\Delta I = 50$), then:

$\Delta Y = 1/(1 - 0.8)\ \Delta I$

$= 1/0.2\ (50) =$ N250 billion.

3.5 Income, Employment, and Aggregate Demand

This section is a brief discussion of the relationship between income, employment, and aggregate demand. In the simple income determination model, when aggregate demand , C + I, and aggregate supply, Y are not equal, or when savings is not equal to investment ($S \neq I$), the level of income would adjust until equilibrium is attained. The logical question would be, what would happen to the level of employment as the level of income changes? What relation, if any, can be shown between employment and the level of national income?

For an economy operating in the short run, we assume the followings hold: fixed capital and hence fixed productive capacity of the capital stock, unchanging technology, fixed quality and quantity of the labour force, and given natural resources. With these assumptions, the quantity of labour is free to fluctuate according to the use of the productive capacity in a given period. It follows that the supply side is given by the quantity of factors and their productivity; the productive capacity of the economy is determined, but need not be completely utilized. The following aggregate production function summarises these information:

$Qo = f(N, K, R, T),$ (3.16)

where Qo refers to the output capacity, N is the labour force, K is the capital stock, R is the given natural resources, and T is technology. Equation (3.16) merely states that output is a function of inputs and is analogous to the production function of a firm. The short-run assumptions transforms the production function as follows:

$Qo = f(N, K^*, R^*, T^*),$ (3.17)

and output becomes a function of labour input, with everything else held constant. It follows that the short-run aggregate production function can by represented by:

$Qo = f(N)$ or $Qo = Y = g(N).$ (3.18)

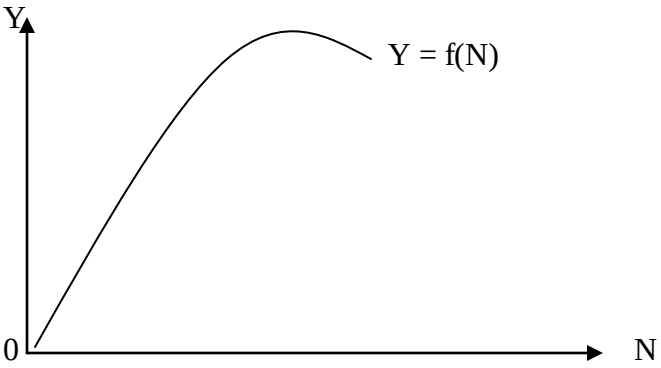
Since the productivity of labour is largely determined by the productivity of capital and the state of technology, it follows that the amount of labour employed in any one period measures to some extent the amount of the productive capacity utilised during that period.

The one-factor production function, $Y = f(N)$, as given by equation (3.18), can be illustrated in a manner similar to that of a firm in the short run. In figure 3.1 below, we illustrate this aggregate production function. The figure shows a typical production curve under the assumption of diminishing returns. It also illustrates the relationship between output and employment. Since

the level of output determines the amount of incomes created in a given economy, the level of income and the volume of employment also move together.

It follows that if aggregate demand increases, output, income and employment will also increase, and vice versa. The level of demand determines how much output and employment will be generated and to what extent productive capacity is utilized. The bias for the demand side emphasis comes from the Keynesian model, which appears to be the direct opposite of models that stress the supply side. The importance of aggregate demand in this model helps to explain the policy conclusions that are often deduced from macroeconomic analysis. An economy that fails to utilise its resources is assumed to be suffering from a deficiency of aggregate demand, which can be corrected.

Figure 3.1: The Aggregate Production Function



Self-Assessment Exercise
Discuss briefly how a given level of consumption expenditure affects the simple multiplier.

4.0 Conclusion
This unit has considered explicitly the simple income determination model, with consumption expenditures, savings and investment as the major variables. While consumption expenditures and savings are determined by the income level, the simple model assumes autonomous level of investment at a given accounting period. We also learned that national income and output are largely determined by the available labour force, and that an economy that fails to utilise its resources is assumed to be suffering from a deficiency of aggregate demand, which can be corrected using appropriate economic policies.

5.0 Summary
Our discussions on income determination were simply based on two of its relevant components, including consumption and investment expenditures. The inclusion of such other components as government expenditures and net exports is left for subsequent discussions. Using the consumption and saving functions, we derived the marginal propensity to consume (MPC), the average propensity to consume (APC), the marginal propensity to save (MPS) and the average propensity to save (APS). We observed that MPC + MPS = 1. o determine the national income in a given period, all you need is to use the equilibrium condition stating that aggregate supply (Y) equals aggregate demand (C + I). In Keynesian terms, at equilibrium national income, savings equals investments, that is S = I.

The simple income multiplier is defined as the reciprocal of either marginal propensity to consume (MPS) or the marginal propensity to save (MPS). Thus, income multiplier = 1/(MPC) = 1/MPS.

National income and output are largely determined by the available labour force, and an economy that fails to utilise its resources is assumed to be suffering from a deficiency of aggregate demand, which can be corrected using appropriate economic policies.

6.0 Tutor-Marked Assignment

Assume an economy that recorded N100 billion in investment expenditures, with a consumption function given by: $C = 200 + 0.75Y$ for a given accounting period. You are required to:

(a) determine the equilibrium level of national income, Y*; and,
(b) the equilibrium level of consumption, C*.

7.0 References

Campagna Anthony, S (1974) *Macroeconomics Theory and Policy* , Boston: Hougthon Mifflin.

Dornbusch, R and Fischer, S. (1981) *Macro-Economics, second edition,* United States: McGraw-Hill, Inc.

UNIT 2: GOVERNMENT, FOREIGN TRADE AND THE ECONOMY

Content

1.0 Introduction

In this unit, we recognise the fact that any economic model that omits the public and foreign sector appears unrealistic; government plays some important roles in our economic lives. The foreign sector is highly significant in the growth of an economy. It is the aim of this unit to expand the simple model of income determination to include both government expenditures and net exports. The unit will generate some appreciation for the impact of the government or public sector and the foreign sector on the economy.

2.0 Objectives

By the time you must have worked through this unit, you should have been able to:

1. Explain national income determination.
2. Enumerate the roles of the public and foreign sector in the development of an economy.
3. Define the balanced budget multiplier.
4. Explain the impact of marginal propensity to import on the income multiplier.

3.0 Main Content

3.1 Government Expenditures and Income Determination

Any time you discuss the public sector, all levels of government are included. You need to note that the aggregation problem can therefore, obscure some of the determinations of government expenditures, since various levels of government are guided by different sets of influences.

Government expenditures, G, is assumed to depend upon some or all of the following: population pressures, political ideology, social and cultural attitudes, tradition, natural catastrophes, and the like. This list would suggest that any attempt to explain government spending is likely to be complicated. It is not surprising therefore, that economists have not developed an aggregate theory to explain government expenditures. In economics, it is customary to treat government spending as being determined outside of internal economic system. Government expenditures is a type of variable called exogenous variable, not determined by or influencing other economic variables in the system. Government expenditures,

G, is therefore generally taken as given and included in the income determination model without explanation.

From the foregoing discussions, you can notice that all government spending is autonomous, so that G can be written as G = Go. The income determination with government contributing to aggregate demand becomes:

$$Y = C + I + G \quad (3.1)$$
$$C = Co + cY \quad (3.2)$$
$$I = Io \quad (3.3)$$
$$G = Go \quad (3.4)$$

Using the equilibrium equation (3.1) we solve as follows:

$$Y = Co + cY + Io + Go$$
$$Y - cY = Co + Io + Go$$
$$(1 - c)Y = Co + Io + Go$$

$$Y^* = \frac{Co + Io + Go}{1 - c}$$

$$Y = 1/(1 - c)\,[Co + Io + Go] \quad (3.5)$$

At given values the relevant variables, you can use equation (3.5) to solve for the equilibrium level of national income. For example, if:

$$C = 20 + 0.8Y$$
$$I = 60$$
$$G = 20, \text{ then}$$

$$Y^* = 1/(1 - 0.8)\,[20 + 60 + 20]$$

$$= 5(100) = 500$$

It follows from the example that the introduction of government expenditures of N20 billion into the model as resulted in N500 billion income level.

Notice that the same multiplier applies to government spending as to autonomous consumption and investment. Thus,

$$\frac{\Delta Y}{\Delta G} = 1/(1 - c) \quad (3.6)$$

A change in aggregate demand brings about a multiple change in the level of income. When government buys goods and services, it creates incomes that are respent, and the multiplier mechanism comes into effect.

3.1.1 Introduction of Government Taxes

In this sub-section, we extend the simple income determination model to include taxes. As with government expenditures, the treatment of taxes concentrates on the impact of taxes on the economic system only from the view point of their effect on the level of income, the fiscal policy aspect of taxation.

The form of taxation most comparable to the assumption of autonomous government spending would be an autonomous amount of taxes to be referred to as per capita tax or poll tax. This form of taxation is independent of the level of income or the economic situation in general. This is simply a tax per person or household.

This assumption of autonomous taxes will result in the following model:

$$Y = C + I + G \quad (3.7)$$
$$C = Co + c(Y - T) \quad (3.8)$$
$$I = Io \quad (3.9)$$
$$G = Go \quad (3.10)$$
$$T = To \quad (3.11)$$

Using the equilibrium condition in equation (3.7) and following the solution process, you will obtain the following expression for the equilibrium level of national income, Y*.

$$Y^* = 1/(1 - c)\,[Co + Io + Go - cT] \quad (3.12)$$

By inspection, you will observe from equation (3.12) that the introduction of taxes reduces the equilibrium level of income. Observe that the reduction of income caused by the tax is divided up between consumption (C) and saving (S). The consumption schedule and the aggregate demand schedule) falls by the reduction in C which you can determine as:

$$\Delta C = -c\Delta T \quad (3.13)$$

Since c is a fraction, the fall in consumption is less than the amount of the tax. The effect of taxes on the level of income can also be deduced by comparing the various multipliers.

You will observe from equation (3.12) that the tax multiplier is given by:

$$\Delta Y = -1/(1 - c)\,[c\Delta T] \quad (3.14)$$

Or,

$$\frac{\Delta Y}{\Delta T} = -c/(1 - c)$$

Observe that the numerator is a fraction (-c), which implies that the value of the tax multiplier is less than the value of the consumption, investment, and government expenditure multipliers.

In terms of our numerical example, the value of the consumption, investment, and government expenditure multipliers are 5 each while that of the tax multiplier is:

$-c/(1-c) = -0.8/0.2 = (-)4.$

It follows that the tax multiplier is exactly 1 less than the others, or 4 instead of 5.

3.1.2 The Balanced Budget Multiplier

Government expenditures multiplier has been found more powerful than the tax multiplier. This observation provides an interesting case for discussions in fiscal policy effects. If government expenditures are made equal to tax revenues so that the budget is balanced, we will be interested in the effect upon the level of national income. Many observers would assume that government has no effect on the economic system, that the government expenditure effect is neutral. We need to note that, even with a balanced budget, government effect is not neutral, but its actions are expansionary. Under the balanced budget condition, the level of income will increase by the amount of increase in government expenditure that equals the tae revenue. This is so because balanced budget brings about a "unit" multiplier. This observation can be proven by the following derivations:

The effect of government expenditure on national income is given by the expenditures multiplier,

$$\Delta Y = \frac{\Delta G}{1-c}$$

and the effect of the tax multiplier on the national income is given by

$$\Delta Y = \frac{-c\Delta T}{1-c}$$

The net effect of the government budget would be derived by combining the government expenditure and tax multiplier above in the following form:

$$\Delta Y = \frac{\Delta G}{1-c} - \frac{c\Delta T}{1-c} \qquad (3.15)$$

Since $\Delta G = \Delta T$ when the budget is balanced, you can substitute ΔG for ΔT in equation (3.15) and combine terms:

$$\Delta Y = \frac{\Delta G - c\Delta G}{1-c} = \frac{\Delta G(1-c)}{(1-c)} = \Delta G \qquad (3.16)$$

Or, $\Delta Y = \Delta G$, and,

$$\frac{\Delta Y}{\Delta G} = 1$$

3.2 Foreign Trade in the Determination of National Income

Until this section, we have treated the national economy as if it were a closed economy, having no interaction with the global economy. Since all economies trade, you need to gain some insight into how such trade affects the economic system. The extent to which an economy is affected by foreign trade depends on how much it depends on the production of others.

In this section, you will explore the effects of trade with other economies on the economic model we have been developing in our previous sections. The two variables that are important in the discussion of foreign trade are basically exports (X) and imports (M).
Exports are components of aggregate demand, but the source of the demand for the economy's production comes from residents of other countries. Imports represent the goods and services purchased from other economies by domestic residents. ***Imports*** are regarded in economics as leakages from the income stream, for incomes earned from the production of these goods accrue to foreigners, and the revenues from sale of these goods do not return to domestic producers but flow abroad.

In our general equilibrium model, we are interested in the aggregate demand for domestically produced goods and the amount of output actually received by domestic residents. We therefore subtract the amount of imports from the amount of exports to obtain our net export. Thus, the equilibrium condition on the inclusion of foreign trade becomes:

$$Y = C + I + G + (X - M) \qquad (3.17)$$

$C = Co + c(Y - T + R)$
$I = Io$
$G = Go$
$T = To$
$R = Ro$
$X = Xo$
$M = Mo + mY$
Mo = autonomous import
m = the marginal propensity to import.

Substituting the relevant variables into equation (3.17) gives the equilibrium level of income as:

$$Y^* = 1/(1 - c + m)\,[Co - cT + cR + I + G + X - Mo] \qquad (3.18)$$

By inspection, you can also write the condition for equilibrium level of income as:

$$I + G + X = S + T + M \qquad (3.19)$$

Equation (3.19) shows that he total leakages, S + T + M, must be offset by the spending of the components of aggregate demand, I + G + X.

You can observe that the marginal propensity to import, m, (or the marginal propensity to consume foreign goods) reduces the income multiplier, since the denominator of the fraction is increased:

Thus,

$$1/(1 - c) > 1/(1 - c + m)$$

For example, if m = 0.05 and MPC, c = 0.8, the numerical values of the multipliers become:

$$1/(1 - .8) > 1/(1 - 0.8 + 0.05) \text{ or } 5 > 4.$$

It follows that any change in aggregate demand that would have previously expanded the level of income by the multiplier of 5 would now, with imports in the model, increase income by lesser amount. Imports can have widespread repercussions in the economy beyond the immediate loss to the income stream. This is the first impression of the effect of foreign trade on the domestic economy.

Self-Assessment Exercise
Outline the differences between the simple income determination model and the expanded general equilibrium model.

4.0 Conclusion
This unit has expanded the simple income determination model to include government and the foreign sector. It points out that government expenditures and tax revenues are autonomous in the general income determination model. Imports are regarded as leakages to national income, and the marginal propensity to import reduces the income multiplier.

5.0 Summary
Government expenditures are assumed to depend upon the following: population pressures, political ideology, social and cultural attitudes, tradition, natural catastrophes, and the like. This suggests that any attempt to explain government spending is likely to be complicated. It is not surprising therefore, that economists have not developed an aggregate theory to explain government expenditures. In economics, it is customary to treat government spending as being determined outside of internal economic system. Government expenditures is a type of variable called exogenous variable, not determined by or influencing other economic variables in the system. Government expenditures, G, is therefore generally taken as given and included in the income determination model without explanation. These points indicate that all government spending is autonomous, so that government expenditures, G, can be written as G = Go.

Government expenditures multiplier has been found more powerful than the tax multiplier. If government expenditures are made equal to tax revenues so that the budget is balanced, the level of income will increase by the amount of increase in government expenditure that equals the tae revenue. This is so because balanced budget brings about a "unit" multiplier.

The two variables that are important in the discussion of foreign trade are basically exports (X) and imports (M). ***Exports*** are components of aggregate demand, but the source of the demand for the economy's production comes from residents of other countries. Imports represent the goods and services purchased from other economies by domestic residents. ***Imports*** are regarded in economics as leakages from the income stream, for incomes earned from the production of these goods accrue to foreigners, and the revenues from sale of these goods do not return to domestic producers but flow abroad.

In our general equilibrium model, we are interested in the aggregate demand for domestically produced goods and the amount of output actually received by domestic residents. We therefore subtract the amount of imports from the amount of exports to obtain our net export. It follows that imports serve as leakages from the equilibrium level of national income.

6.0 Tutor-Marked Assignment

Given the following information on a given economy:

$C = 200 + 0.8(Y – T)$

$I = 60$

$G = 20$

$T = 20$

$R = 0$

$X = 0$

$M = 40 + 0.05Y$

You are required to compute the equilibrium level of national income.

7.0 References and Further Readings

Campagna Anthony, S (1974) *Macroeconomics Theory and Policy,* Boston: Hougthon Mifflin.

Dornbusch, R and Fischer, S. (1981) *Macro-Economics, second edition,* United States: McGraw-Hill, Inc.

UNIT 3: THE MONEY MARKET EQUILIBRIUM, GENERAL EQUILIBRIUM, AND MONETARY EFFECTS OF FEDERAL GOVERNMENT BUDGET

Content

1.0 Introduction

This unit extends our discussions of the IS – LM model in unit 4. It completes the components of the framework necessary in the determination of national income. General equilibrium reflects the static nature of an economy and having attained an equilibrium state we can be able to discuss effects on the economy of changes in policy variables. The unit therefore focuses on the general equilibrium and economic effects of changes in money supply and budgetary policies.

2.0 Objectives

By the time you go through this unit, you will

1. Explain how an economy's equilibrium state is derived and how it can be used in policy analysis.
2. Explain the monetary effects of federal government budgets and how budget policies can be applied to business decisions.
3. Explain the liquidity trap.

3.0 Main Content

3.1 The Money Market Equilibrium

As you were informed in unit 4, the locus of points of equilibrium in the money market is referred to as the LM curve. At any point in time, the market for money is in equilibrium when the real value of money supply equals the demand for real money balances. The equilibrium representing the real supply of money (equation, 3.1) and demand for money balances (equation 3.2) are, respectively,

$$\frac{M_S}{p} = \frac{M_S}{p}(r); \qquad \frac{d\,(M_S/p)}{d\,r} > 0 \qquad (3.1)$$

and, $\frac{Md}{p} = \frac{Md}{p}(r, Y)$; $\frac{\partial (Md/p)}{\partial Y} > 0$ and $\frac{\partial (Md/p)}{\partial r} < 0$ (3.2)

It follows that the real supply of money is a positive function of the rate of interest (r), and the demand for real money balances is positively related to real output and negatively related to the interest rate.

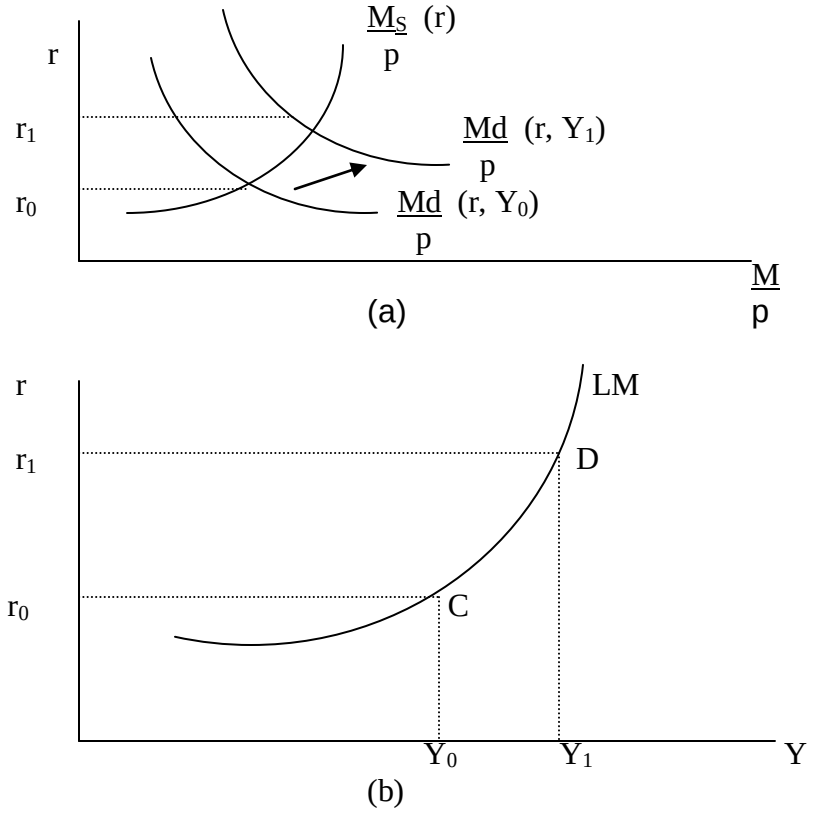
The equilibrium condition for the money market is,

$$\frac{M_S}{p}(r) = \frac{Md}{p}(r, Y) \qquad (3.3)$$

Part (a) of figure 3.1 below combines money supply and demand schedules of the above forms, for which the market-clearing, equilibrium interest rate is r_0.

This interest rate corresponds to the particular income level (Y_0) that determines the initial money demand curve, $\frac{Md}{p}(r, Y_0)$ in figure 3.1

Figure 3.1: Money Market Equilibrium



Point C in part (b) of figure 3.1 shows the income and interest rate combination (r_0, Y_0) that give rise to equilibrium in the money market.

If the level of real income rises from Y_0 to Y_1, the real money balances needed for transaction – precautionary purposes will rise, shifting the money demand curve outward, as shown in part (a) of figure 3.1. This shift reflects an excess demand for money which forces the interest rate upwards.

With the increase in interest rate, the supply of money rises and the demand for money falls until the market for money clears at the rate of interest r_1.
Point D in part (b) of figure 3.1 shows the interest rate and income combination
(r_1, Y_1) that provides a new equilibrium in the money market. With further increases in real output or income, the demand for money will increase, pushing the interest rate upward.
The curve showing the combination of interest rates and output levels that give rise to equilibrium in the market for money is upward sloping, reflecting a positive link between income and the interest rate. This curve is labeled the LM curve (because at equilibrium, liquid money demand, L, equals money supply, M).
The slope of the LM curve reflects the responsiveness of money supply to interest rate movements and of money demand to changes in both the interest rate and the level of real output or income.

The Commodity Market Equilibrium – IS Curve

The first task in the construction of the IS – LM model is the derivation of the commodity market equilibrium schedule (the IS – Curve). This curve shows all the combination of interest rates, which influence investment, and income levels, which influence consumption, that give rise to commodity market equilibrium.

Definitions:

Total planned spending, D, is given by

$$D = C (Y - T (Y)) + I (r) + G \qquad (3.1)$$

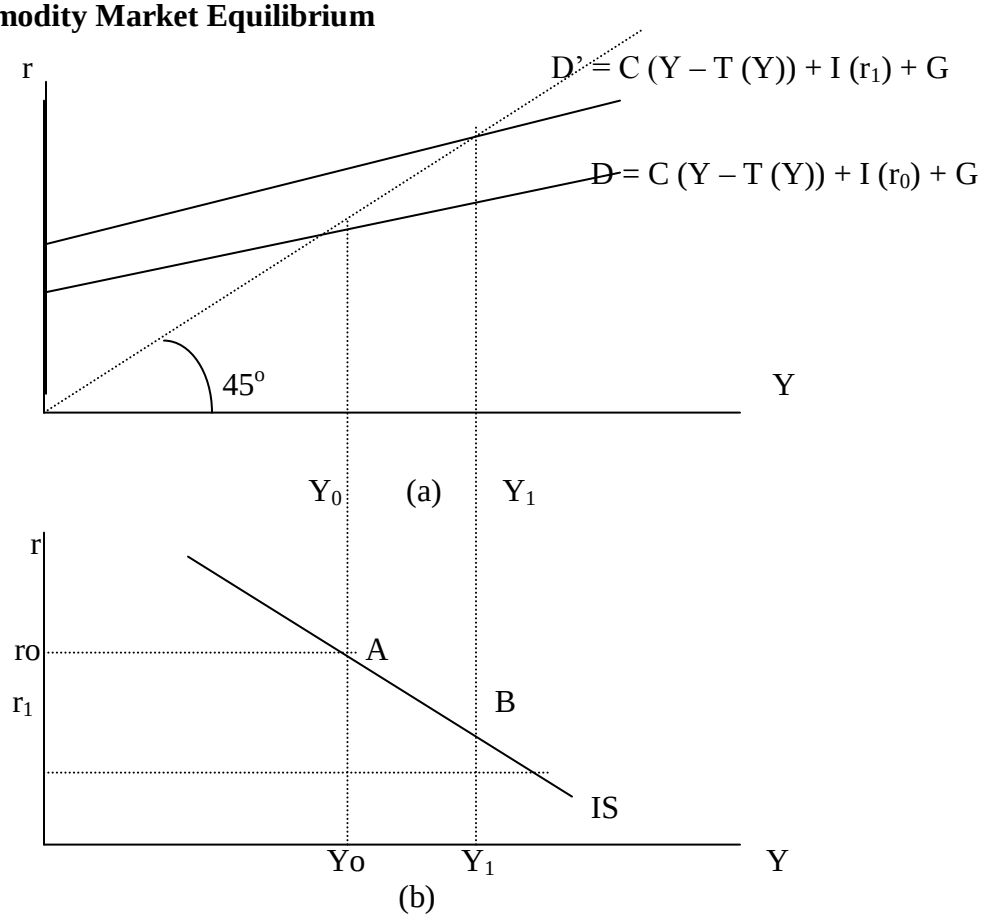
Equilibrium Income:

$$Y = D$$

$$\text{Or} \quad Y = C (Y - T (Y)) + (r) + G \qquad (3.2)$$

The equilibrium equation (3.2) is represented in part (a) of figure 3.1 below, indicating an initial commodity market equilibrium at income level, Y_0.

Figure 3.1: Commodity Market Equilibrium



The interest rate and income level combination, (r_0, Y_0), which gives the initial commodity market equilibrium is plotted as point A in part (b) of figure 3.1. The influence on aggregate demand of an interest rate reduction is illustrated in part (a) of figure 3.1 by the new aggregate demand schedule, D′, which corresponds to the reduced interest rate, r_1. This schedule also shows that the increase in aggregate demand raises equilibrium income to level, Y_1. The new interest rate and income level combination (r_1, Y_1), which gives a new commodity market equilibrium, is plotted as point B in part (b) of figure 3.1.

Thus, the schedule showing all the combinations of interest rate, r, and income level, Y, that yield equilibrium in the commodity market is the IS – curve in part (b) of figure 3.1. The steepness, or slope, of the IS – curve depends upon the strength of investment response to interest rate changes and of consumption's response to income changes.

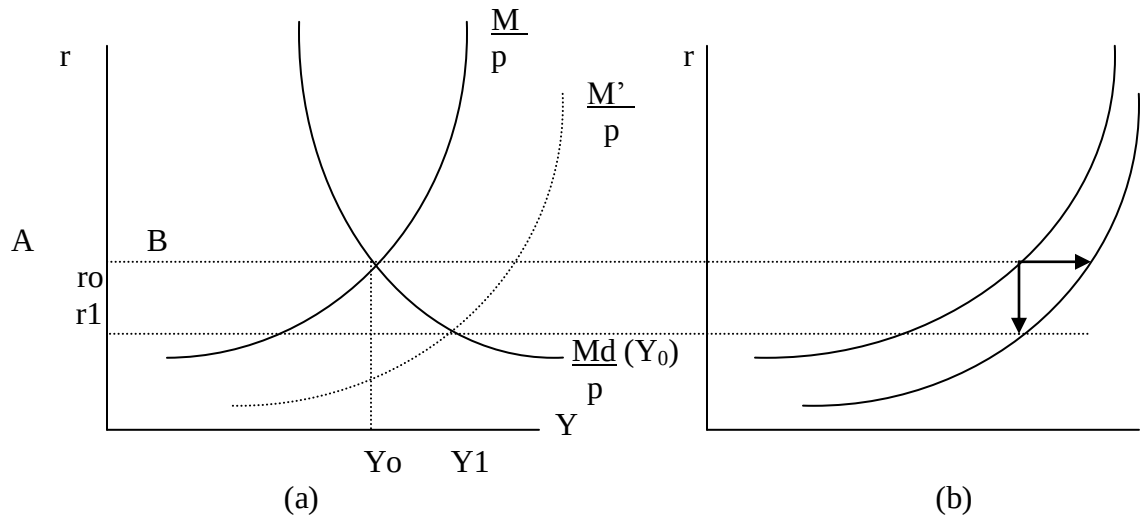
3.1.1 Shifts in The LM Curve

The LM curve shifts in response to changes in the underlying money supply or money demand functions. From an initial position in the money market equilibrium, represented by points (A) and (a) in figure 3.2 below, a Central Bank's purchase of securities, which raises the monetary base, shifts the money supply outward from say,

$\frac{M}{p}$ to $\frac{M'}{p}$ in figure 3.2,

creating an excess supply of money, AB, at the original combination of interest rate and income level (r_0, Y_0). To absorb the additional real money balances, there must be an increase in output or real income to Y_1, which would raise transaction – precautionary demand to clear the market for money at point B in part (a) of figure 3.2. A reduction in the rate of interest to r_1, which would raise speculative demand and possibly transactions – precautionary demand to clear the market for money at point C, or combination of both. That is, the LM curve, showing the combination of interest rate and income level that equates money supply and money demand, shifts rightward by an autonomous increase in the money supply, as indicated in figure 3.2

Figure 3.2: **A Shift in The LM Curve Due To Increase In Money Supply.**



Conversely, an autonomous reduction in the money supply would give rise to a leftward shift in the LM curve, since a higher interest rate, a lower output level, or a combination of both is then required to equate money supply to money demand.

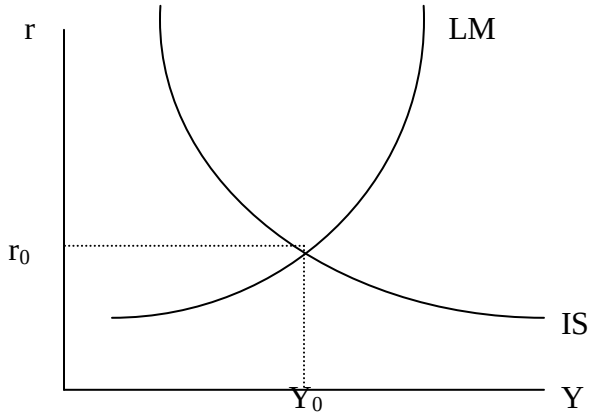
An autonomous increase in the demand for money results in an excess demand for money and shifts the LM curve to the left.

3.2 General Equilibrium and Monetary Effects of the Federal Government Budget

3.2.1 General Equilibrium.

General equilibrium requires simultaneous equilibrium in both the commodity market and the money market. By combining the equilibrium schedules for these markets (that is, the IS and LM curves) as in figure 3.3 below, we see that one combination of interest rate, r, and income level, Y, can simultaneously clear both markets. The general equilibrium occurs at (r_0, Y_0) combination of interest rate and income level that gives rise to equilibrium in both the commodity market and the market for money.

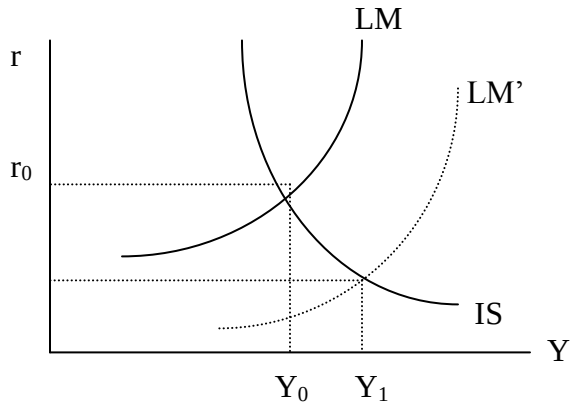
Figure 3.3: General Equilibrium



In the general equilibrium model, the price level, P, government purchases, G, and the tax schedule, T, are ***exogenous***, that is, they are determined outside the model. The income level, Y, the interest rate, r, and all other variables that depend on these are ***endogenous*** and hence include consumption expenditures, C, savings, S, investment, I, the real supply of and demand for money (M_S/p and Md/p), the nominal money supply, and total tax revenues.

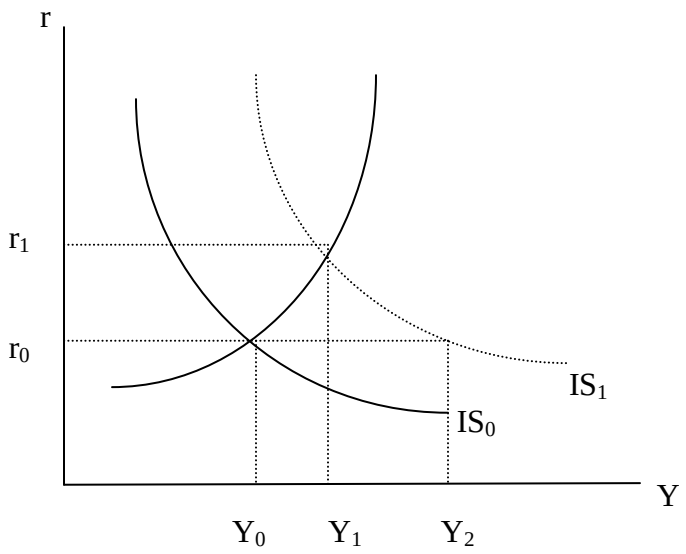
The general equilibrium model is used to analyze the impact of various economic disturbances on an array of important economic variables. To illustrate the use of this model, suppose there is an autonomous increase in the money supply, which immediately creates an excess supply of money, reduces the interest rate and stimulates investment spending. In figure 3.4, the increase in the money supply is represented by a rightward shift of the LM curve, from LM to LM', so that equilibrium is restored at a reduced interest rate, r_1, and a higher income level, Y_1. Since consumption and saving are positive functions of income, the values of both of these variables are greater in the new equilibrium point. Transactions demand for money also increases, due to the increase in income. The lower interest rate results in increased investment expenditures and a further increase in the demand for money, especially the speculative demand for money.

Figure 3.4: **A Change In General Equilibrium Due To A Shift In The LM Curve**



The general equilibrium is also disturbed by events that shift the IS curve. To illustrate, suppose that the initial equilibrium at the point (r_0, Y_0) in figure 3.5 is disturbed by an autonomous increase in investment. This disturbance shifts rightward the IS curve from IS_0 to IS_1. This results in higher equilibrium values for both interest rate and income level (that is, r_1 and Y_1). At the same time, the supply and demand for real money balances will rise, and consumption, saving, and tax revenues increases.

Figure 3.5: **Change In General Equilibrium from A Shift In The IS Curve.**

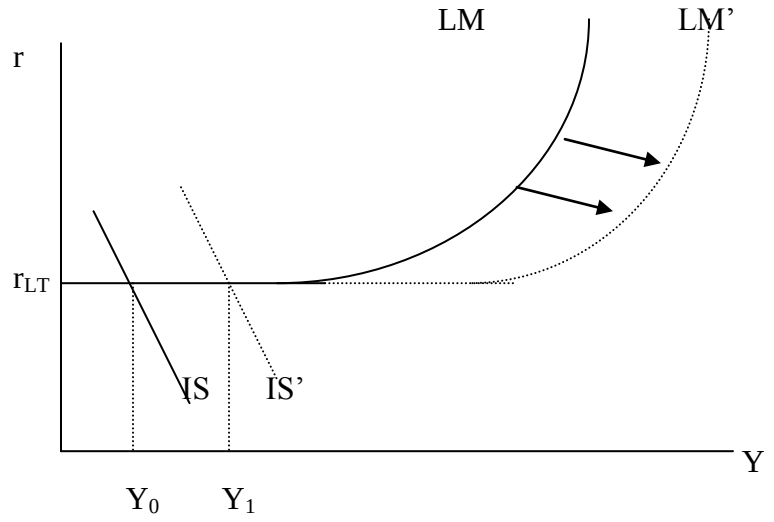


3.3 The Liquidity Trap

Suppose that interest rate falls to a level so low that everyone becomes convinced it cannot be lower anymore, so low that everyone expects higher interest rates in the future. In this case, no one will be willing to swap money for bonds, no matter how large one's money balances should become. In effect, the speculative demand for money and hence the money demand function would be ***perfectly interest-elastic*** at this low interest rate, as the public would willingly hoard unlimited volumes of money rather than exchange money for bonds, which are expected to fall in volume. This possibility was suggested by Keynes and was labeled the ***Liquidity Trap***.

The existence of liquidity trap during economic depression would make monetary policy powerless in stimulating the economy, as illustrated in figure 3.6 below.

Figure 3.6: Monetary and Fiscal Policies In A liquidity Trap.



With the economy at the depressed position, represented by interest rate, r_{LT}, and income level, Y_0, an increase in money supply would shift the LM curve to LM'. However, since there is no willingness to exchange money for bonds (an exchange that would ordinarily push bond prices upward and interest rates downward), the additional money balances would be hoarded, and the interest rate remains unchanged at r_{LT}. With no interest-rate reduction, the monetary policy action fails to stimulate investment, and equilibrium output remains unchanged at Y_0.

While monetary policy is regarded as being powerless in a liquidity trap, fiscal policy can be strong. Consider, for example, an increase in government spending or a cut in taxes that shifts the IS curve in figure 4.8 form IS to IS'. In this case, output can increase by the full amount of the horizontally measured rightward shift of the IS curve. There will be no monetary dampener effect, as the increase in spending is readily financed out of idle, surplus, hoarded money balances. On the basis of the assumption that demand for money is highly interest-elastic, some of the supporters of Keynesian analysis have favoured fiscal policy for stimulation of the economy and have dismissed monetary policy as weak and ineffective.

3.3.1 The Classical Region

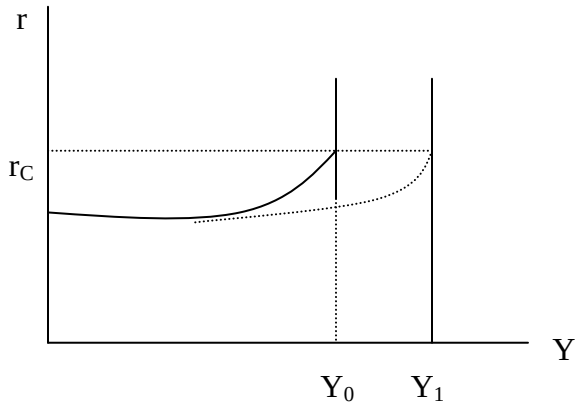
There exist also an interest rate so high as to convince everyone that rates will be lower (bond prices higher) in the future. In this situation, all wealth-holders would want to hold their speculative wealth in securities, and none in speculative money balances. Hence the speculative demand for money would be zero at or above this elevated interest rate.

Keynes's concept for speculative demand for money serves as the major distinction between his analysis of the money market and that of his classical predecessors, the classical view of money demand is relevant if interest rates are high enough to eliminate the speculative demand. According to the simple classical analysis, the demand for money depends basically on the level of output.

The LM curve is more interest-elastic (flatter), as money supply and money demand are more interest-elastic. If both supply of and demand for money respond weakly to interest-rate changes, the LM curve must be steeply sloped. As a matter of fact if neither money supply nor demand for money is sensitive to interest rates, the LM curve will be exactly vertical at the

output level that equates money supply and money demand: no changes in interest rate will directly disturb the equality of supply of and demand for money.
Figure 3.7 below, represents an economy with a vertical LM curve above interest rate r_C. Within the vertical segment of the LM curve, monetary policy is very effective and strong. An increase in the money supply will shift the LM curve form LM to LM', and income will expand from Y_0 to Y_1.

Figure 3.7: **Monetary Policy in the Classical Region.**



3.4. Monetary Effects of the Federal Government Budget

The IS – LM model is used as a tool for assessing the effects of monetary and fiscal policy actions. In this model, changes in money supply shifts the LM curve with no significant impact on the IS curve, while fiscal actions, such as changes in government expenditure, tax levies or both, shift the IS curve with no impact on the monetary base and therefore with no impact on the LM curve.
The standard operational methods by which the monetary authority alters the money supply provide pure monetary policy actions (shifts in the LM without effects on the IS curve), but fiscal actions often have an accompanying effect on the monetary base and hence on the position of the LM curve.
The potential monetary significance of the government's budget activities can be illustrated as follows:
Suppose the government spends ₦100,000 for the monthly salary of a presidential aide. That payment is made with a Treasury cheque, drawn on an account the Treasury maintains at the Central Bank. In turn, the presidential aide takes this cheque to his or her bank for deposit or for cash. Whether the aide deposits it in a current account or cashes it, the monetary base will be increased by ₦100,000 when the recipient bank has the cheque cleared through the Central Bank and receives ₦100,000 credit in its reserve account, and, correspondingly, the money supply is increased, shifting the LM curve to the right.
When the Treasury collects tax revenues and transfers them to its Central Bank's account, whether it collects in currency or cheques drawn on current accounts in commercial banks, the monetary base is reduced by the amount of tax collections. Consequently the effects on monetary base (and on the LM curve) of ₦100,000 government expenditure will be offset if the expenditure is tax-financed; a tax-financed fiscal operation is a pure fiscal operation.

Self-Assessment Exercise
Using the general equilibrium model, discuss briefly the effect of an increase in government expenditure on the market rate of interest.

4.0 Conclusion
Unit 5 discusses the importance of money market in the analysis of the macroeconomic effects of monetary policies. You learned that the LM curve (the locus of points of equilibrium in the money market) shifts in response to changes in the underlying money supply or money demand functions. General equilibrium requires simultaneous equilibrium in both the commodity market and the money market. The standard operational methods by which monetary authorities alter the money supply provide pure monetary policy actions (shifts in the LM without effects on the IS curve), but fiscal actions often have an accompanying effect on the monetary base and hence on the position of the LM curve.

5.0 Summary
At any point in time, the market for money is in equilibrium when the real value of money supply equals the demand for real money balances.
In the general equilibrium model, the price level, P, government purchases, G, and the tax schedule, T, are ***exogenous***, that is, they are determined outside the model. The income level, Y, the interest rate, r, and all other variables that depend on these are ***endogenous*** and hence include consumption expenditures, C, savings, S, investment, I, the real supply of and demand for money (M_S/p and Md/p), the nominal money supply, and total tax revenues.
The potential monetary significance of the government's budget activities can be illustrated as follows: When the Treasury collects tax revenues and transfers them to its Central Bank's account, whether it collects in currency or cheques drawn on current accounts in commercial banks, the monetary base is reduced by the amount of tax collections. Consequently the effects on monetary base (and on the LM curve) of a ₦100,000 government expenditure, for example, will be offset if the expenditure is tax-financed; a tax-financed fiscal operation is a pure fiscal operation.
The general equilibrium model is used to analyze the impact of various economic disturbances on an array of important economic variables.

6.0 Tutor Marked Assignment
Using the appropriate graphical illustrations, explain why the existence of liquidity trap may render monetary policy ineffective during the time of economic depression.

7.0 References and Further Readings
Campagna Anthony, S (1974) *Macroeconomics Theory and Policy,* Boston: Hougthon Mifflin

Dornbusch, R and Fischer, S. (1981) *Macro-Economics, second edition,* United States: McGraw-Hill, Inc.

UNIT 4: GOALS, INSTRUMENTS, TARGETS, AND PROBLEMS ASSOCIATED WITH MONETARY POLICIES

Content

1.0 Introduction

Having looked at the different models of demand for and supply of money, you are now in the position to refer to them as we discuss the goals, instruments, targets and problems associated with monetary policies in macroeconomic analysis. As a business decision maker, knowledge of goals and targets of any economic policy will aid in planning and control functions. This explains the reason for this unit.

2.0 Objectives

At the end of your activities in this unit, you will be able to:

1. Explain monetary policies, their goals, instruments and targets.
2. Explain business decisions under different monetary policies.
3. Explain those monetary targets that can affect the business environment and know how to account for them in business decisions.

3.0 Main Content

3.1 Goals of Monetary Policy

The basic goals of monetary policies include:

(i) ***High Employment.*** This is a worthy goal for two basic reasons: First, the alternative, high unemployment, causes much human misery, with affected families suffering financial distress, loss of personal self-respect, and increase in crime. Secondly, when unemployment is high, the economy not only has idle workers but also idle resources.

For important economic implications, the goal of high employment does not seek for an unemployment level of zero, but rather, a level above zero that is consistent with full employment at which the demand for labour equals the supply of labour. This level of unemployment is referred to as the natural rate of unemployment in economic terms.

(ii) ***Economic Growth.*** This goal is closely related to the high employment goal because businesses are more likely to invest in capital equipment to increase productivity and economic

growth when unemployment is low. Conversely, if unemployment is high and factories and other businesses are idle, it does not pay for a firm to invest in additional plants and equipments.

(iii) ***Stability of Financial Markets.*** One of the major functions of the monetary authorities is to promote a stable financial system. One way the Central Bank can promote stability in the financial system is by helping prevent financial panics, through its role as the lender of last resort.
The stability of financial markets can also be promoted by interest rate stability, since fluctuations in interest rates create uncertainty for financial institutions. An increase in interest rates gives rise to capital losses on long-term bonds and mortgages, losses that cause the failure of financial institutions holding them.

(vi) ***Stability in Foreign Exchange Markets.*** With increasing importance of the global market, the value of a country's currency relative to other currencies has become a major consideration for the monetary authorities. A fall in the value of Naira relative to other currencies, for example, will stimulate inflation in Nigeria. Preventing large changes in the value of naira makes it easier for firms and individuals purchasing or selling goods abroad to plan ahead.

3.2 Monetary Policy Instruments.
Monetary policy instruments are those variables under the control of monetary authorities and are used in controlling the affairs of the money and financial markets. These instruments can be ***direct*** or ***indirect***.

The ***Direct Instruments*** include:

- Aggregate Credit Ceilings
- Deposit Ceilings
- Exchange rate controls
- Restriction on the Placement of Public Deposits
- Special Deposits
- Stabilization Securities.

Indirect Instruments include:

- Open Market Operation (OMO)
- Cash Reserve Requirements
- Liquidity Ratio
- Minimum Rediscount Rate
- Parity Changes
- Selective Credit Policies.

For the specific case of Nigeria, direct controls were used not only to control overall credit expansion but also to determine the proportion of bank loans going to the preferred sectors; merchant banks' asset portfolio; proportion of bank loans to indigenous borrowers; proportion of

bank loans to small-scale indigenous enterprise; proportion of rural bank deposits granted as loans to rural borrowers; lid on interest rates, etc.

The three main monetary policy instruments used world wide are: Open Market Operations, changes in the reserve requirements and changes in the discount rate. In addition are the selective controls over specific markets, among which are the margin requirements and the ceiling on the interest rate commercial banks can pay on savings or time deposits.

The fractional reserve system is a convenient way to gain control over the money supply. By requiring banks to maintain a stated percentage of their deposits as reserves, it limits the ability of banks to lend out funds and thus their ability to create money. It follows that the prime target of monetary policy has been the level of bank reserves, and the strongest weapon to influence reserves is the required reserve ratio.

Open Market Operations refer to the buying and selling of government bonds or securities in order to influence indirectly the reserve position of banks. If the Central Bank buys bonds, the effect would be an increase in bank reserves, a possible increase in the money supply, and a possible fall in interest rates. These effects are potential stimulants to economic activity. Sales of government securities will produce the opposite effects. Open Market Operations is the most frequently used weapon or instrument of monetary policy.

The Discount Rate refers to the interest rate with which the Central Bank can lend money to commercial banks. By lowering or raising the discount rate, the Central Bank can encourage or discourage such borrowings. The Central Bank can also openly announce its intentions to be receptive or not to request for loans and advances.

3.3 The Use of Monetary Targets.

Apart from the use of the monetary policy instruments such as the open market operation, changes in discount rate, and changes in reserve requirements, the monetary authorities often choose a set of variables to aim for in its efforts to stabilize price and increase employment. These variables are referred to as ***intermediate targets***, such as the monetary aggregates (M_1, M_2, or M_3) or interest rate, which have a direct effect on employment and price level, unlike the use of the regular monetary instruments which have indirect effects. Other sets of variables to aim for are the so-called operating targets, such as reserve aggregates (that is, reserves, non-borrowed reserves, monetary base) or interest rates (the treasury bill rate), which are more responsive to monetary policy tools or instruments. Note that non-borrowed reserves refer to total reserves minus borrowed reserves.

3.4 Problems of Monetary Policy.

There are a number of limitations on the use of monetary policy for economic stability. These limitations include:

(i) ***The Uneven Incidence of Monetary Policy.*** Monetary policies have some uneven impacts on different groups within a given economy. Most notable is the restrictive monetary policy that raises market interest rates, which in turn reduces the flow of funds into the home mortgage market.

It is frequently argued that small businesses are particularly sensitive to altered credit conditions. Large-scale businesses tend to have ready access to several sources of funding and can borrow funds either from banks or by direct sale of security issues. Thus, under restrictive credit conditions, banks might feel it necessary to meet the needs of their large-scale business customers first and to limit the funds available to small-scale businesses.

(ii) ***Compliance with the Treasury.*** The conduct of monetary policy has also been seriously restricted through the Central Bank's efforts to serve the desires of the National Treasury.

(iii) ***Timing.*** There are many lags in the conduct of monetary policy. These lags can be broadly classified into two: ***inside lags*** and ***outside lags***. Inside lags refers to all the steps and time it takes to go form the first recognition that a problem exists to the point where the policy begins to affect the economy by its impact on aggregate demand and output.

Outside lags, on the other hand, are concerned with the response of the economy to the changed monetary conditions resulting from the monetary policy. Monetary authorities may react to a situation by altering money market conditions, but it is other economic units in the economy – consumers, firms government – that must alter their plans in the face of the changed conditions. This outside lag is of considerable importance, for until these economic units change their behaviour the economy will not be materially affected, and to that extent, monetary policy will not be effective.

(iv) ***Financial Intermediaries.*** One of the monetary policy problems can be found in financial intermediaries, including: saving and loan associations, insurance companies, pension funds, etc, which deal in "near money", the highly liquid deposits of the public. These financial intermediaries cannot create money like commercial banks but can affect the money supply indirectly through their actions, over which the monetary authorities have little or no control.

Self Assessment Exercise
What are the major benefits to, an entrepreneur, of understanding the goals and targets of monetary policy?

4.0 Conclusion

Among the important issued discussed in this unit is that of the monetary policy goals. In a nutshell, the monetary policy goals include: (i) high employment; (ii) economic growth; (iii) financial market stability; and, (iv) stability in the foreign exchange market. Also of importance in our discussions are the monetary policy instruments, which include those variables that are under the control of monetary authorities especial, the Central Bank of Nigeria. We also learned that monetary authorities have some intermediate targets classified as a set of variables aimed at stabilising prices and increasing employment. The variables include, among others, the monetary targets (M1, M2, and M3) or interest rates that have direct effects on employment and price level.

There are some limitations on the use of monetary policy which need to be noted. The limitations were discussed extensively as uneven incidence of monetary policy; compliance with the

Treasury which can restrict the monetary policy objectives; existence of time lags in the conduct of monetary policies; and, financial intermediation.

5.0 Summary

This unit focuses on four basic monetary policy goals which include (i) high employment; (ii) economic growth; (iii) financial market stability; and, (iv) stability in the foreign exchange market.

The unit exposes us to the monetary policy instruments. Monetary policy instruments are those variables under the control of monetary authorities and are used in controlling the affairs of the money and financial markets. These instruments can be ***direct*** or ***indirect***. The direct instruments are subsumed as: Aggregate Credit Ceilings; Deposit Ceilings; Exchange rate controls; Restriction on the Placement of Public Deposits; Special Deposits; and, Stabilization Securities. The indirect instruments include: Open Market Operation (OMO); Cash Reserve Requirements; Liquidity Ratio; Minimum Rediscount Rate; Parity Changes; and, Selective Credit Policies.

In Nigeria, direct controls are used not only to control overall credit expansion but also to determine the proportion of bank loans going to the preferred sectors; merchant banks' asset portfolio; proportion of bank loans to indigenous borrowers; proportion of bank loans to small-scale indigenous enterprise; proportion of rural bank deposits granted as loans to rural borrowers; lid on interest rates, etc.

The three main monetary policy instruments used world wide are: Open Market Operations, changes in the reserve requirements and changes in the discount rate. In addition are the selective controls over specific markets, among which are the margin requirements and the ceiling on the interest rate commercial banks can pay on savings or time deposits.

The major limitations on the use of monetary policy are (i) uneven incidence of monetary policy; (ii) compliance with the Treasury which can restrict the monetary policy objectives; (iii) existence of time lags in the conduct of monetary policies; and, (iv) financial intermediation.

6.0 Tutor Marked Assignment

Discuss briefly, how monetary policies can affect investment decisions.

7.0 References and Further Readings

Campagna Anthony, S (1974) *Macroeconomics Theory and Policy,* Boston: Hougthon Mifflin

Dornbusch, R and Fischer, S. (1981) *Macro-Economics, second edition*, United States: McGraw-Hill, Inc.

MODULE FIVE: INCOME, INFLATION, OUTPUT, AND UNEMPLOYMENT

UNIT 1: INCOME, EMPLOYMENT AND THE PRICE LEVEL

Content

1.0 Introduction

You have been introduced to the basic principles of equilibrium level of income in units 2, 3, and 4. We emphasized the role played by aggregate demand in income determination. The supply side of the process of income determination was largely ignored. In this unit, we attempt to emphasize aggregate supply, so that we can realistically include the behavioural variables for producers in the analysis of the model of income determination. As the supply side is made explicit, it will also be necessary for us to examine critically the relationship between output and employment. We will establish the link between output and employment. Since the link between output, price level, and employment are important, it would be too simplistic to constrain any one of the components of this network. The interrelationships between output, employment, and the price level appear so complex that no simple model can delineate all the intricacies. The models to be discussed in this unit are, therefore, meant to be suggestive rather than precise representation of reality. The models will be presented here for three basic reasons: first, the models will help to bring out the relations between output, employment, and the price level in a clear manner; second, the models will capture what many people have in mind as representing the interrelations involved; third, the models offer a transition to other works regarding employment and inflation.

2.0 Objectives

Having gone through this unit, you will be able to:

1. Explain the supply curve of a firm
2. Explain the aggregate supply and aggregate demand analysis in various perspectives
3. Explain the relationship between aggregate demand and the level of employment
4. Describe the interdependence between aggregate supply and aggregate demand, and the determination of the price level.

3.0 Main Content

3.1 A Firm's Supply Curve

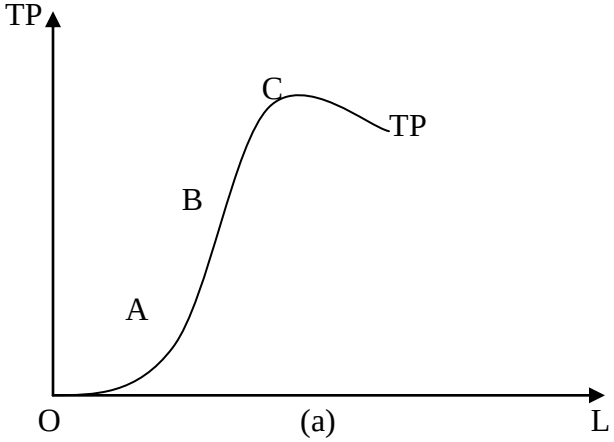
Theoretically, in the short run when a firm's productive capacity is held constant, its production function is given by:

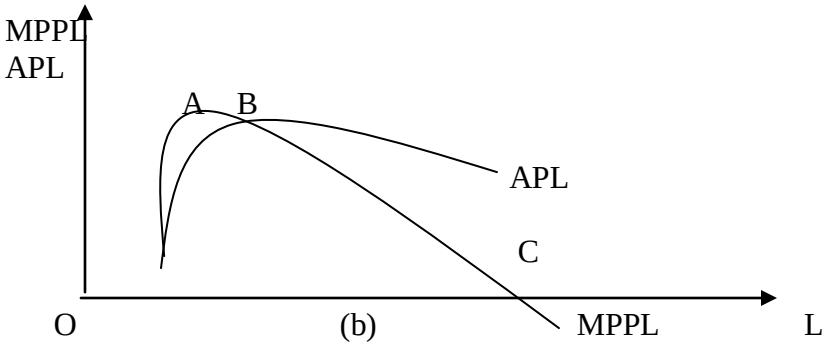
$$Q = Q(L, K), \qquad (3.1)$$

where Q is output level, L is labour input, and K represents capital stock.
Equation (3.1) informs you that in the short run, output depends on labour input, with capital and other things remaining the same; labour is the only variable input. It is also normal to assume that technology is constant in the short run and natural resources and raw materials are no problems for the firm. Under these conditions, output is assumed to vary directly with labour input. We also assume the existence of the law of diminishing returns, so that the way in which output varies with labour input can be specified. Note that the law of diminishing returns states that successive equal increments of a variable factor of production added to fixed factors do result in increasing output, but after some point the successive increases in output get smaller and smaller. Equation (3.1) can be sketched as in figure 3.1 below, assuming the law of diminishing returns.

Figure 3.1 (a) shows the total product (TP) curve for a given firm in the short run. It shows increasing returns in the early stages of production and then diminishing returns after point A. Observe that output increases are smaller after point A until output reaches a maximum at point C. Thereafter, increments of labour reduce total output as the curve bends the other way as shown. As illustrated in figure 3.1 (b), the average product of labour (APL) is at a maximum at point B and declines thereafter.

Figure 3.1: A Firm's Short-Run Production Function





Economic theory asserts that it is the marginal or extra unit of labour that is significant. The marginal physical product of labour (MPPL) is derived from the total product (TP) curve by calculating and plotting the slope at chosen points on the curve. The slope being represented by the derivation, dTPL/dL. The marginal product of labour increases up to point A in figure 3.1 (b), where diminishing returns set in, and thereafter declines to a value of zero, where the total product is at a maximum, and finally becomes negative after point C. The average product of labour (APL) is derived from the TP curve by constructing rays from the origin to points on the TP curve, dropping perpendiculars from these points, and measuring the value of the tangent formed thereby. When plotted, these values yield the APL curve in figure 3.1 ((b). You can see that the rational range of operation for the firm would be at output levels between B and C.
In the short run only labour input is permitted to vary, so that it is only the price of labour that is of concern to the firm. In the short run, other factors are assumed not to be affected by labour market operations. Since labour is the only variable input, wages become the only variable cost, and additions of labour to the production process are the only changes in variable costs.

If we assume that the firm sells its products in a perfectly competitive market, and that its objective is to maximise profits, the profit-maximising condition is given as:

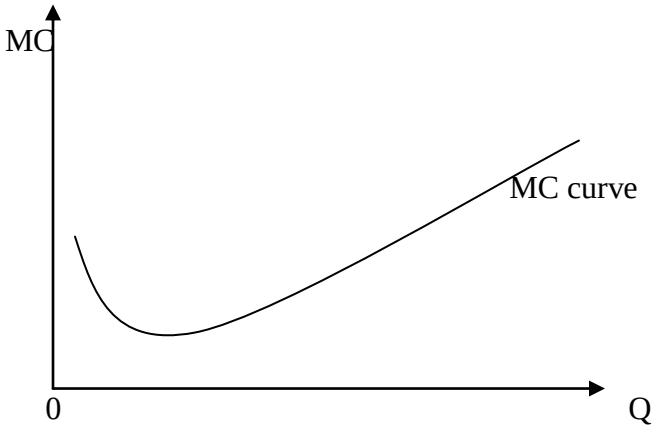
Marginal Cost (MC) = Marginal Revenue (MR) = Price (P) = W/MPL, (3.2)
where W is the wage rate,

or

W = P.MPL (referred to as the marginal revenue product of labour) (3.3).

It can be shown that the shape of the marginal cost (MC) curve is the inverse of the shape of the MPL curve, since the price of labour (the wage rate, W) is constant. Figure 3.2 illustrates the shape of the marginal cost curve.

Figure 3.2: The Short-Run Marginal Cost Curve

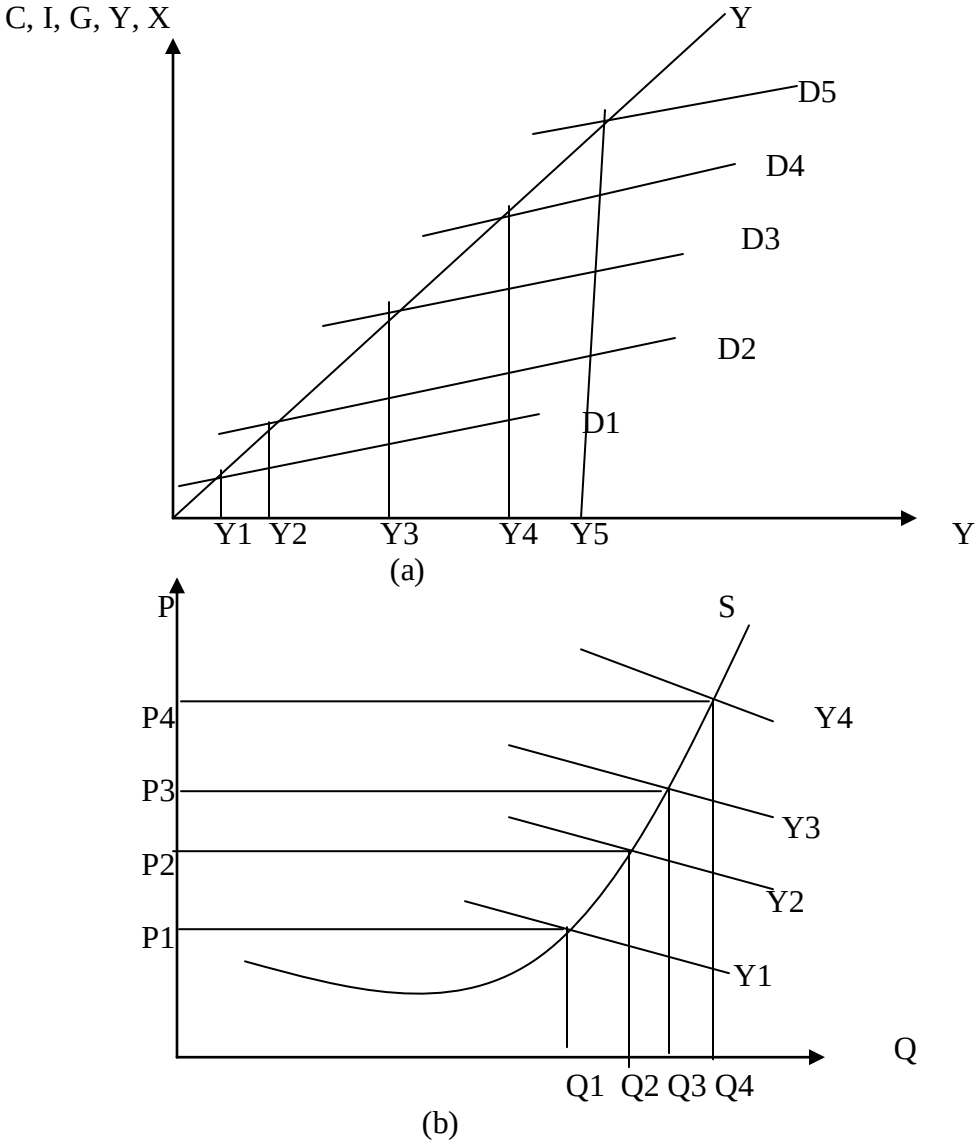


The law of diminishing returns is also evident in the shape of the MC curve, as costs fall in the early stages, reach some minimum, and then increase sharply. A firm faced with a rising MC curve and wishing to maximise profits must receive higher prices as output expands. It is the willingness of firms to produce more output as price rises that transforms the MC curve into the firm's supply curve. The individual supply curves can be aggregated into the industry supply curve, and by extension into the aggregate supply curve for the economy as a whole. The aggregate supply is the horizontal sum of all firms and industry supplies.

3.2 Aggregate Supply and Aggregate Demand Analysis

In this section, we relate the Keynesian income determination model, employing the 45-degree line, the aggregate supply curve, as discussed in unit 4 to the aggregate demand. Figure 3.3 below explains the transition from the income determination model to the present model, where we explicitly include prices. In this figure, the graph of the income determination model is same as before in panel (a). Aggregate demand, D1, D2, D3, …, D5, intersect aggregate supply, the 45-degree line at different points, given rise to the levels of income Y1, Y2, Y3, …. Y5. We look at the price level as stable during the period under consideration and transform the analysis into monetary terms. Figure
3.3 (b) shows that, on the aggregate, the amount of goods and services supplied varies with the price level, since producers must be compensated for increasing costs brought about as a result of diminishing returns.

Figure 3.3: Aggregate Supply and Aggregate Demand Analysis



Consider the aggregate demand curves as represented by the letter Ys in figure 3.3 (b). The demand curves show the familiar relationship between output and price such that lower levels of output can be expected to command higher prices and vice versa. Corresponding to D1 is Y1; to D2 is Y2; and so on. The aggregate demand spending as shown by figure 3.3 (a) can be reinterpreted in figure 3.3 (b) to determine the output and price levels that are consistent with the level of spending. For example, for the demand level D1, there is a corresponding output level Q1 and price level of P1, and so on. It is assumed that along any demand curve, Y in figure 3.3 (b), total spending is constant so that $Y = PQ^*$ for any point on the curve. This also implies that the same total expenditure will be made for all productions regardless of the price level, the condition of unitary elasticity. This assumption however, undermines the introduction of the price level as a contributing variable in our present analysis. If the price level cannot affect the level of demand, then we gain nothing by changing from the 45-degree diagram in figure 3.3 (a).

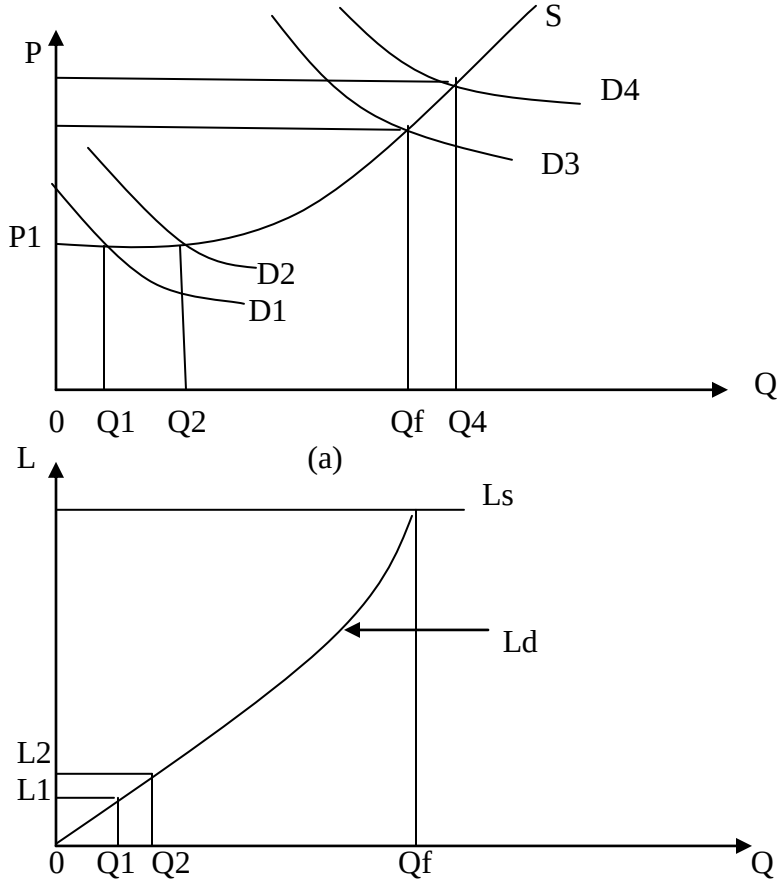
If the price and output level vary inversely in such a way that the total expenditure remains fixed, there is the presumption that the structure of demand remains unchanged and the price level changes do not disturb the expenditure on individual products, not only along any demand curve but also for shifts in the curves. This gives rise to aggregation problem making the simple model unable to handle the problems of relative prices as they affect substitutions or complements. This aggregation problem is always present and must be kept in mind.

3.3 Aggregate Supply, Aggregate Demand, and the Level of Employment

The relationship between the level of employment and the level of income can be explored by relaxing the assumption that the output demand curve is a rectangular hyperbola, one of unitary elasticity where total expenditure is constant along any one demand curve. Using an aggregate demand curve that is downward-sloping, the exploration can proceed. The modified aggregate demand and supply curves are shown in figure 3.4 (a) below. The output is measured on the horizontal axis and the price on the vertical axis. The intersection of the supply and demand schedules determines the output that will be sold and the price level, or the average price per unit of output. The economy's money income can be calculated as PQ and is equal to the area of the rectangle formed by dropping perpendiculars from the points of intersection of aggregate demand and aggregate supply. The employment side of economic activity is presented in figure 3.4 (b). The horizontal axis is the same as that of figure 3.4 (a), so that the relationship between output and employment can directly be seen. The supply of labour is represented by Ls and is assumed to be perfectly elastic, a horizontal line, meaning that the supply of labour offers no problem to the economy. All labour is assumed to be homogeneous and equally productive. These attributes of labour came from the assumption of a perfectly competitive labour market. Any labour of a given type or of equal productivity is also assumed to be available and willing to work.

The demand for labour is determined by its productivity, and the productivity of labour in the short run depends upon what is assumed about returns to scale; productivity varies with the level of output. The demand curve for labour is represented by Ld and shown in figure 3.4 (b). It follows the law of diminishing returns so that, in the beginning of the productive process, equal increments of labour yield equal increments of output (constant returns); eventually, equal increments of labour input result in smaller and smaller increments of output (the diminishing returns). Finally, at the level of output, Qf, the full employment level of output, no further increments of output are possible.

Figure 3.4: Aggr3egate Demand, Aggregate Supply, Output, and Employment



Connecting figures 3.4 (a) and 3.4 (b), you can begin to understand how income, employment, output, and the price level are related. In the early stages of the production process, returns to scale are assumed constant. This assumption can be seen from figure 3.4. As demand increases from D1 to D2 in the horizontal range of the aggregate supply curve, S, output increases from Q1 to Q2, but the price level remains constant at P1. The explanation for the constant price level can be observed in figure 3.4 (b). With constant returns to scale, the change in output from Q1 to Q2 requires the same change in labour input, L1 to L2. All labour input is assume equal in efficiency, and the productivity of laour remains constant in this range. Since labour is the only variable input in our analysis, the marginal cost of production, MC, also remains constant.

Self Assessment Exercise

Discuss briefly the compositions of aggregate demand and aggregate supply.

4.0 Conclusion

Beginning with the simple theory of a firm, this unit has attempted to present the relations among output, employment, income and prices. One of the major things learned is that at full employment, prices are relatively stable and no further increments of output are possible. Employment is basically a function of the level of output and national income.

5.0 Summary

The unit uses a simple model of the theory of firm to establish discussions on ggregate supply. This model reveals the followings:
First, it is the marginal unit of labour that is important. Secondly, the law of diminishing returns exists in any production process for which labour is the only variable input. Third, output depends on labour input in the short run. Fourth, the profit-maximising condition for a perfectly competitive firm requires that both marginal costs of production, marginal revenue product of labour and output prices must be equal.

The unit also informs us that the equilibrium level of national income occurs where aggregate demand equals aggregate supply. This is also the point for which full employment is attained. The production process is assumed to be efficient on attainment of full employment and the major determinant of employment is increments in output levels, assuming constant factor prices and stable output prices.

6.0 Tutor-Marked Assignment

Discuss in detail, with appropriate graphical illustrations, how output, income and price levels can affect the level of employment in a given economy.

7.0 References and Further Readings

Campagna Anthony, S (1974) *Macroeconomics Theory and Policy*, Boston: Hougthon Mifflin

Begg, D., Dornbusch, R and Fischer, S. (1981) *Macro-Economics, second edition*, United States: McGraw-Hill, Inc.

UNIT 2: INFLATION, OUTPUT AND UNEMPLOYMENT

Content

1.0 Introduction

This unit focuses on the behaviour of inflation, output, and unemployment. We will examine the rate of price changes as they relate to inflationary pressures. We attempt to develop a realistic framework for understanding the behaviour of the economy. Such basic macroeconomic questions as 'Why do inflation and unemployment often increase together?' will be analysed. This analysis is helpful in business decision making.

2.0 Objectives

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

1. Explain inflation and unemployment
2. Define the long run relationship between money supply and inflation
3. Explain inflation and output in the short run
4. Explain the expectations-augmented Phillips curve
5. Explain the relationship between aggregate demand and expected inflation

3.0 Main Content

3.1 The Long-Run Relationship Between Money and the Rate of Inflation

If the rate of growth of money and output is constant, prices tend to rise at exactly the rate at which the nominal money stock is increasing. This statement can be summarized as follows:

$m = \Delta M/M$, where m refers to the rate of growth of money stock,

and $\prod = \Delta P/P$ = the rate of inflation.

A central statement in macroeconomics is shown in equation (1) below:

$$\prod = m \qquad (1)$$

Equation (1) implies that in the long run, or better still, on the average, there is a link between growth in money stock and inflationary pressures. Put differently, in a stationary economy, the rate of inflation equals the rate of growth of the nominal quantity of money.

To establish the long-run relationship between inflation and rate of growth of money supply, we refer to the equilibrium condition in the money market (derived from the LM curve):

$$M/P = L(i,Y) \quad (2)$$

Where i = interest rate; and Y = equilibrium level of national income
Equation (2) can be transformed to become:

$$M = PL(i,Y) \quad (3)$$

While equation (2) states the money market equilibrium condition in terms of the real demand and supply of money, equation (3) state the condition in terms of the nominal demand and supply of money.

To maintain the long-run equality between the supply and demand for money, changes in the nominal money supply must be matched by corresponding changes in prices. For instance, if the stock of money increases by 5 percent per year, prices would have to be rising at the rate of 5 percent per year to maintain a constant real money supply, M/P, thus maintaining money market equilibrium. It again follows that, in the long run equilibrium, money and prices must grow at the same rate.

The economic argument that "inflation is always a monetary phenomenon" is simply an implication of monetary equilibrium. It follows that the real money supply that yields monetary equilibrium is equal to the real money demand. To maintain a constant real money supply, an increasing nominal money stock has to be matched by rising prices.

3.1.1 Output Growth and Long-Run Inflation

The relationship represented by equation (1) above needs to be adjusted to account for output growth. It is reasonable to note that growth in real income raises real money demand, rendering the assumption of constant demand for real balances inappropriate, especially when output is growing. With rising real demand for money, monetary equilibrium would require that the real money supply increases at that same rate. You will have to note that the growth rate in real money supply is the difference between the growth rate of the nominal money stock and the rate of inflation. For example, if the nominal money stock is increasing at 10 percent and the rate of inflation is 6 percent, the real money supply will be growing at 4 percent. In addition, if the money supply has to be growing at 2.1 percent to ensure monetary equilibrium, the rate of inflation should be 2.1 percent less than the rate of monetary growth. Symbolically, we have:

$$\Pi = m - 2.1 \text{ percent.} \quad (4)$$

Equation (4) states that the rate of inflation equals to the growth rate of money *less* an adjustment arising from real growth in income.

In summary, the long-run relationship between inflation and monetary growth requires that:

- In the long run, inflation is a monetary phenomenon.
- The higher the growth rate of the nominal money supply, the higher he rate of inflation.
- The rate of inflation is lower, the higher the growth rate of real money demand. Alternatively, the lower the rate of inflation, the faster the rate of growth of output, and the more real money demand rises with increased real income or output.

- If a country wants to reduce its average inflation rate, it must attempt to reduce the average growth rate of the money supply.

3.2 Inflation and Output in the Short Run

It has been noted that the behaviours of price level and output are closely related in the short run. In this section, we look at the inclusion of expected inflation in our analysis of inflation. The expected rate of inflation affects both aggregate demand and aggregate supply. In terms of aggregate supply, nominal wages adjust not only to unemployment, but also to expected inflation. Nominal wages adjust to expected inflation because both firms and workers are concerned with the real wages. If prices are expected to increase at, say, 10 percent during the course of a labour contract, then nominal wages will tend to increase at a rate of 10 percent over the course of the contract. Wage rises are translated into price rises. And the inflation rate thus reflects expected inflation.

In terms of aggregate demand side, expectations of inflation are important because different interest rates are relevant for spending decisions and for portfolio choices, for equilibrium to occur in goods and money markets.

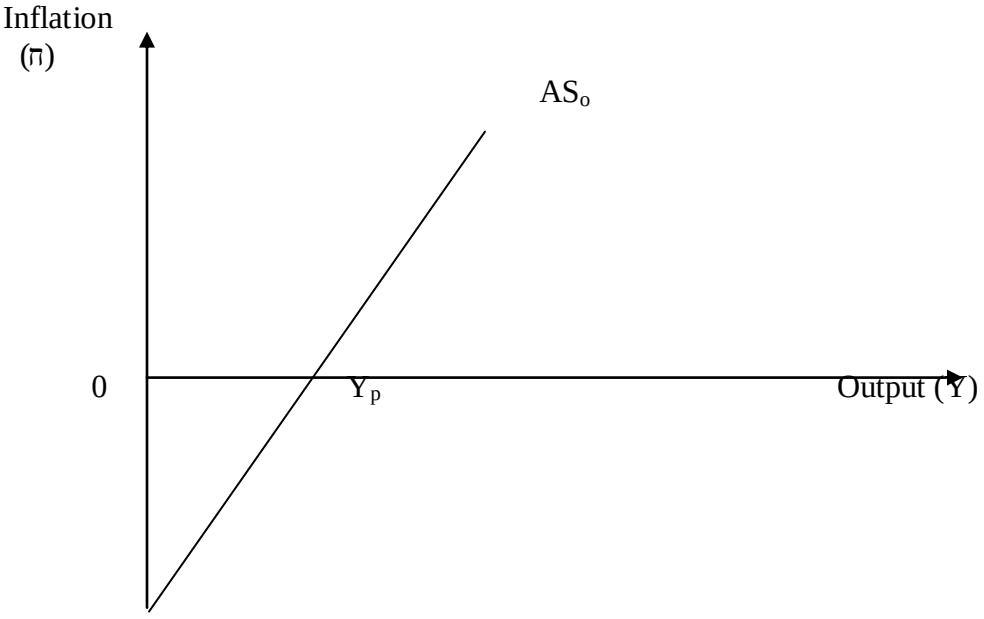
In the final analysis, the intersection between the aggregate demand and supply curves will determine the short run inflation rate and level of output. The movements of aggregate demand and aggregate supply curves over time tend to determine how the inflation rate and output adjust to changes in monetary and fiscal policy variables.

The aggregate demand and supply curves have been used to establish the following facts:
1. In the long run, increases in the rate of growth of money supply affect only the inflation rate, and not output.
2. The short-run equilibrium of the economy is determined by the current and last period's expected inflation rates.
3. The short-run response to an increase in the growth rate of money is typically a rise in both output and inflation. The response to an expansionary change in the fiscal policy variable is similar.
4. The behaviour of expectations is crucial to the dynamic adjustment of the economy to changes in monetary and fiscal policy.

3.3 The Expectations-Augmented Phillips Curve

In this section, we examine the relationship between inflation, aggregate supply, and inflationary expectations. Note that wage and price adjustment in response to the level of over-or underutilisation of labour and other economic resources would imply a positive relationship between inflation and gap in the gross national product (GNP). If output is above normal, wages and costs in general will be rising and firms will pass on such increasing costs into higher prices. Conversely, when output is below normal, declining costs would lead to falling prices. These arguments can be summarised by figure 3.3.1 below, discounting inflationary expectations.

Figure 3.3.1: Inflation and Normal/Full employment level of Output



The line, AS_o, above shows the inflation rate associated with each level of output in the economy. At full employment output, Y_p, inflation rate is zero. With actual output above the full employment output, wages and prices are rising, or there is inflation. With actual output below the full employment output, there is deflation, or wages and prices are falling.

The extent to which gap in GNP affects inflation rate can be summarised using the slope of the aggregate supply schedule, AS_o. The steeper the aggregate supply schedule, the more adverse the inflation-output tradeoff; that is the more inflation we get from a given expansion in output and employment.

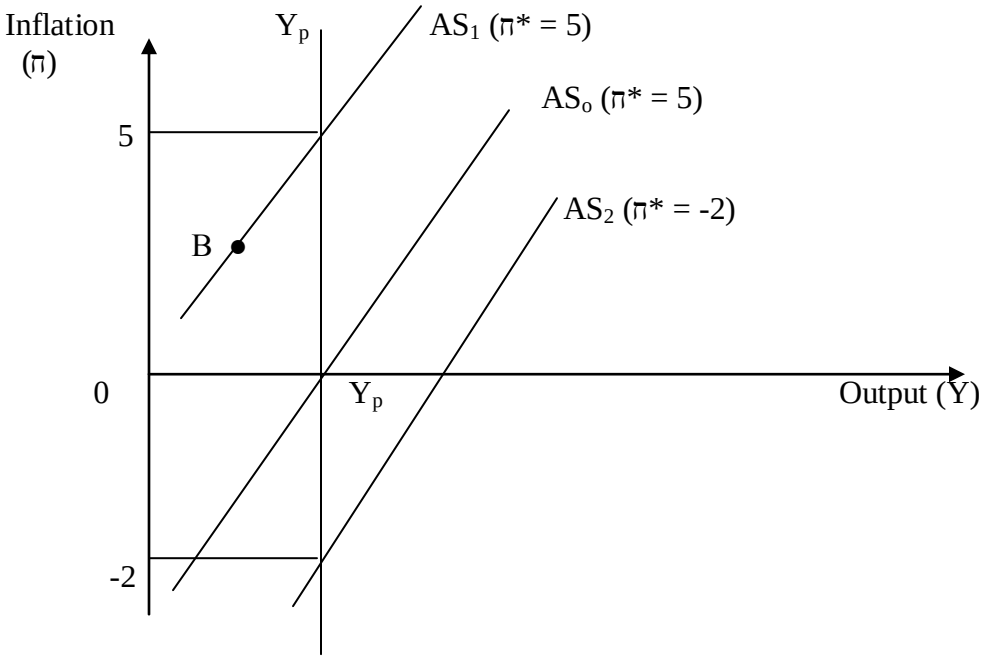
The role of inflationary expectations in influencing wage formation is central to an understanding of the inflation process. Because labour contracts fix nominal wages for a given period ahead, labour unions will be concerned about real wages over the period of the contract. A given money wage rate negotiated today will have less purchasing power some years from now if the inflation rate is 10 percent than if it is zero percent. When inflationary expectations are slow to adjust, monetary and fiscal policies will have serious effects on the level of output and relatively little effects on the inflation rate. There seems to be no generally accepted way of modeling inflationary expectations. Traditionally however, inflationary expectations have been regarded as some average of past inflation rates.

3.3.1 Inflationary Expectations and Aggregate Supply

Because both firms and workers are assumed to be concerned with real wages, nominal wages attempt to adjust for expected inflation, as well as in response to the state of the labour market. The resulting wage increases are then passed on into prices. In figure 3.3.2, we show the role of expectations in aggregate supply. According to the figure, an increase in the expected rate of

inflation from, say, zero to 5 percent, will raise the aggregate supply schedule from AS_o to AS_1, so that at full employment we would observe a 5 percent rate of inflation. Conversely, a reduction in expected inflation below zero rate, an expected deflation, would shift the aggregate supply schedule downwards from ASo to AS2. This new schedule, AS2, reflects the expectation of prices falling at the rate of 2 percent. Higher rates of expected deflation will result in further downward shifts in the aggregate supply schedule.

Figure 3.3.2: Aggregate Supply and Expected Inflation



Inflation depends on the state of the labour market, measured in this discussion by the GNP gap. Inflation also depends on inflationary expectations. Inflation is higher, the higher the actual output relative to potential output, and the higher the expected inflation.

Point B on figure 3.3.2 represents the existence of inflation and unemployment. This arises when the expectation of inflation causes wages and prices to rise, given that unemployment does not exert sufficient dampening pressure on wage settlements to restore full employment. This was the situation in the 1970s when persistent unemployment appeared together with inflation.

Self-Assessment Exercise
Discuss briefly the reason expected rate of inflation affects the position of aggregate supply schedule at any given point in time.

4.0 Conclusion
In This unit, you were exposed to the basic principles of, and relationships among inflation, output, and unemployment. You were also informed that the argument that inflation is a monetary phenomenon is simply an implication of monetary equilibrium, and to maintain a constant real money supply, an increasing nominal money stock must be matched with rising

prices. We noted that the bahaviours of price level and output are closely related in the short run. In addition, the expected rate of inflation affects both aggregate demand and aggregate supply.

5.0 Summary

If the rate of growth of money and output is constant, prices tend to rise at exactly the rate at which the nominal money stock is increasing.

To establish the long-run relationship between inflation and rate of growth of money supply, we use the equilibrium condition in the money market (derived from the LM curve):

$$M/P = L(i,Y)$$

Where i = interest rate; and Y = equilibrium level of national income

Or, in real terms of the nominal demand and supply of money:

$$M = PL(i,Y).$$

Because inflation is always a monetary phenomenon, the real money supply that yields monetary equilibrium is equal to the real money demand. To maintain a constant real money supply, an increasing nominal money stock has to be matched by rising prices.

It follows that the long-run relationship between inflation and monetary growth requires that:

- In the long run, inflation is a monetary phenomenon.
- The higher the growth rate of the nominal money supply, the higher he rate of inflation.
- The rate of inflation is lower, the higher the growth rate of real money demand. Alternatively, the lower the rate of inflation, the faster the rate of growth of output, and the more real money demand rises with increased real income or output.
- If a country wants to reduce its average inflation rate, it must attempt to reduce the average growth rate of the money supply.

Wage and price adjustment in response to the level of over-or underutilisation of labour and other economic resources would imply a positive relationship between inflation and gap in the gross national product (GNP). If output is above normal, wages and costs in general will be rising and firms will pass on such increasing costs into higher prices. Conversely, when output is below normal, declining costs would lead to falling prices.

Finally, the role of inflationary expectations in influencing wage formation is central to an understanding of the inflation process. Because labour contracts fix nominal wages for a given period ahead, labour unions will be concerned about real wages over the period of the contract. A given money wage rate negotiated today will have less purchasing power some years from now if the inflation rate is 10 percent than if it is zero percent.

6.0 Tutor-Marked Assignment

Using the aggregate supply and demand schedules (or curves), show how, in a steady state, the aggregate supply and demand functions would rise over time in such a way as to keep output constant.

7.0 References and Further Readings

Dornbusch, R. and Fischer, S. (1981) ***Macro-Economics***, United States: McGraw-Hill, Inc.

Campagna Anthony, S (1974) *Macroeconomics Theory and Policy*, Boston: Hougthon Mifflin

MODULE SIX: THEORIES OF DISTRIBUTION AND WELFARE

UNIT 1: DISTRIBUTION OF INCOME, RESOURCE ALLOCATION, AND THE THEORY OF WELFARE ECONOMICS

Content:

1.0 Introduction

In any market economy, the distribution of income or goods is determined simultaneously with the allocation of resources. Governments often attempt to affect the way after-tax income is finally distributed, but the market acts as the principal distribution mechanism. In this unit, we will be interested in both how the market distributes income and resources and in the development of a framework for re-distributional policy incase of market failures.

Welfare economics is generally concerned with examination of all resources that are feasible in the production of goods and services needed by the society, as well as establishment of criteria for selecting among alternative resources. The basic question often raised by welfare economists is "What is the best allocation of resources from a social point of view?" Welfare economics is the most normative branch of microeconomics. The aim of this unit is to examine the intrinsic difficulties inherent in questions of social welfare and to demonstrate important conceptual issues.

2.0 Objectives

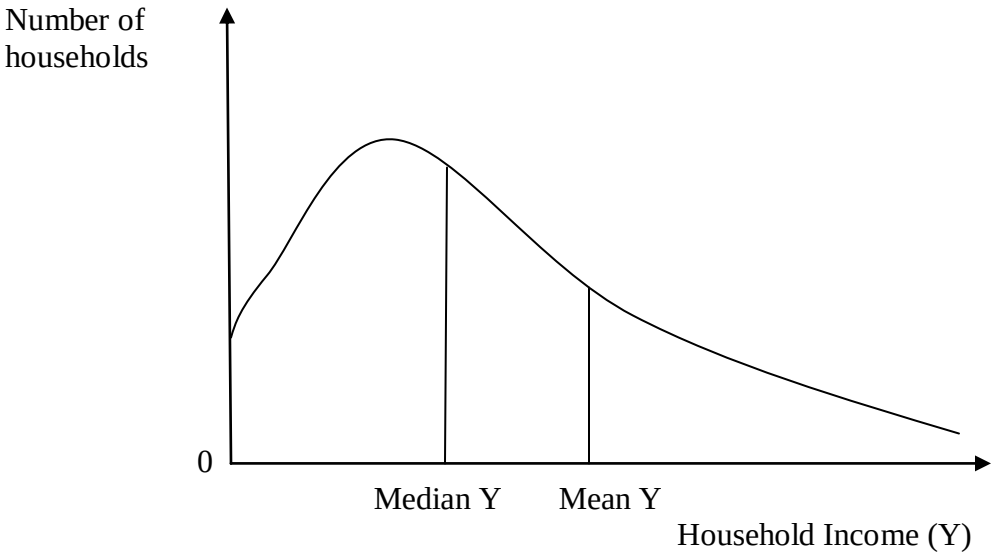
Having gone through the activities of this unit, you should be able to:
1. Explain the theory of income distribution
2. Enumerate the factors responsible for income inequality

3. Enumerate and explain alternative income re-distribution programmes available to governments.
4. Define welfare economics and the welfare criteria in an exchange economy.
5. Explain the social welfare function.
6. Enumerate the methods of attaining social welfare in an economy.

3.1 Theory of Income Distribution

A typical shape of the income distribution curve is presented in figure 3.1 below. The figure presents income levels on the horizontal axis and the number of households with such income levels on the vertical axis.

Figure 3.1: Typical Distribution of Income for a Developed Economy



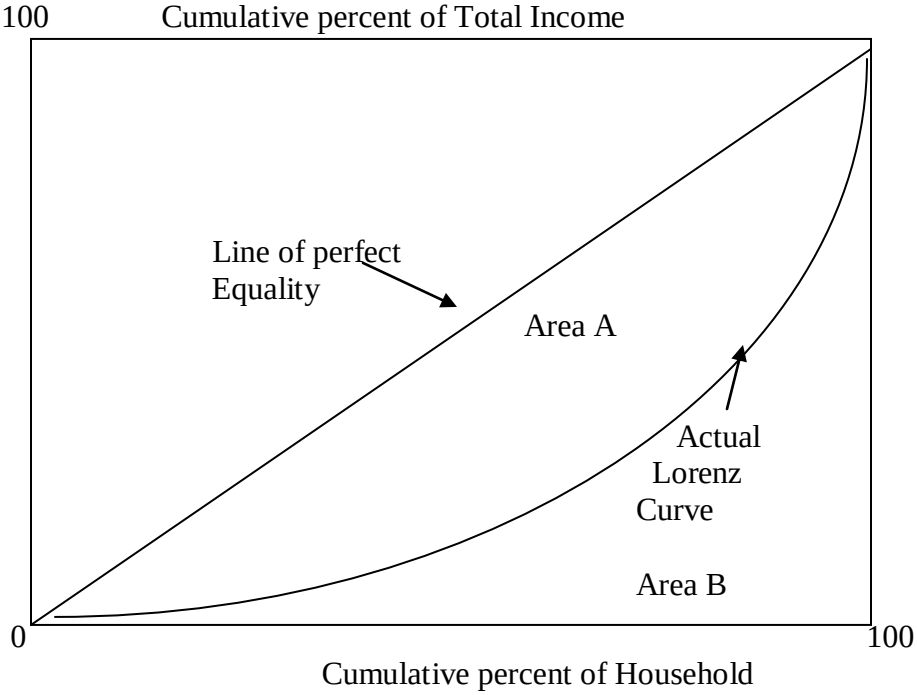
Three general features of the above income distribution curve can be highlighted. First, there are large number of households in the middle income ranges. As many economists have pointed out, many developed economies are numerically dominated by the middle class. Another observation is that the income of households outside of the mid-range are not symmetrically distributed so that, the income distribution curve is skewed to the right. The implication is that there are some households with very high incomes (you may want to reflect on the income distribution of the Nigerian society). For such skewed distributions, the mean or average income will exceed median income that is, the income level that divides the population into two equal-size groups. This has been the case because the existence of very high incomes will affect the location of the mean but not of the median incomes. The last observation is that, for income levels above the mean income, the income distribution declines smoothly in an exponential form.

3.1.1 Measurement of Income Inequality

Figure 3.1 illustrates the hypothesis that most countries exhibit considerable inequality in the distribution of income. With an appropriate income distribution data, a country's income distribution can be presented in a graph through the use of ***Lorenz curve***, as illustrated in figure 3.2 below. The Lorenz curve is a plot of the cumulative percentages of the population (or

households) along the horizontal axis, and cumulative percentages of total income received by households (starting with the lowest income) along the vertical axis. If income were perfectly equally distributed, the Lorenz curve would be a diagonal straight line showing that, for example, 10 percent of the population receives 10 percent of total income. Inequality in the actual income distribution is indicated by the curve being bowed below the diagonal. The more unequal the income distribution, the more extensive will be the bowed effect.

Figure 3.2: The Lorenz Curve of Cumulative Income Distribution



A measure of the inequality, derived from the Lorenz curve is the ***Gini Coefficient*** defined by:

$$\text{Gini Coefficient} = \frac{\text{Area A}}{\text{Area(A+B)}}$$

Hypothetically, the Gini coefficient ranges from 0 (perfect equality) to 1 (absolute inequality, that is, one person gets all income).

Though modern income distribution theory continues to make a distinction between income from labour (earnings) and income from capital (interest, dividends, rents and the like). To summarise, sources of income are discussed below:

3.1.2 Sources of Income

A household's total income (Y) can be disaggregated as labour income (Y_L) and income from capital (Y_K):

$$Y = Y_L + Y_K \qquad (3.1)$$

Labour income is usually expressed as the product of wage rate (w) and the number of hours worked by the household member (L) so that,

$$Y_L = wL \quad (3.2)$$

Similarly, income from capital is expressed as the product of rental rate of capital (r) and the quantity of capital owned by the household (K) so that,

$$Y_K = rK \quad (3.3)$$

Each household's income can thus be written as:

$$Y = wL + rK \quad (3.4)$$

Observe intuitively that differences in incomes among households can arise from differences in any of the four variables, w, L, r, and K in equation 3.4, or from inequalities caused by the relationships among these variables. It is therefore important to examine the possible economic determinants of each of these principal variables.

1. ***Distribution of the wage rates (w):*** The wage dispersion existing in hourly wage rates or salaries, as the case may be, is probably the principal determinant of overall inequality in households income. If wage rates are determined according to the productivity of labour, note that productivities may differ among workers because of differences in formal education, training, on-the-job experience, or physical and mental ability.

2. Distribution of Hours worked (L): Hours worked by households vary. This can be because of differences in the number of individuals in a given household and because of variability in hours worked by individual household members. In recent times, households have attempted to increase the number of hours worked in the family by increasing the labour force participation through either married women participating in the labour force or participation of children of adult age.

3. Distribution of rent (r): It is probable that rental rates earned on capital investments differ relatively slightly among households. The differences can be explained by the following factors: First, because capital market is mobile, the market tends to equalize rates of return as capital owners reallocate their resources form low- to high-yielding investments. A number of factors may prevent this, however. Some capital owners may be able to command a monopoly rent. Some investments may be available only to those with substantial assets. Secondly, differences in rental rates may arise because some individuals are more willing to take risks than are others.

4. Distribution of Capital Ownership (K): The distribution of the stock of capital owned by households has been noted as highly unequal among households. Because it appears there are only two ways in which capital stocks may be obtained (gifts and inheritance or accumulated savings), distribution of capital ownership may differ due to variations among individuals blessed with these methods of capital acquisition. Conventional opinion suggests that inheritance is a principal cause of differences in capital ownership among households.

Savings behaviour is also important in the determination of distribution of capital ownership. Households with high propensity to save are more likely to be rich in capital accumulation than those with low propensity to save.

3.2 Income Redistribution Programmes

To address the problem income inequality among households, governments often design some re-distributional programmes. The activities undertaken by governments with express purpose of improving the distribution of income has been classified into two different groupings: (i) market-oriented programmes; and, (ii) tax-subsidy programmes. This section examines these activities one at a time.

3.2.1 Market-Oriented Programmes

Government's activities aimed at promoting equal opportunity in hiring practices is one example of market-oriented programmes. Many regulatory functions of government, such as actions against monopolistic practices, also have important re-distributional effects. Additionally, government can adopt educational and work training programmes with the aim of equalizing wage rates. These traditional government programmes are aimed at getting the market to produce an equitable distribution of income.

3.2.2 Tax-Subsidy Programmes

In addition to impacting on the determinants of income, governments often change household's income directly through tax or subsidy programmes. To illustrate the effects of such programmes, you can rewrite total households income as:

$$Y = wL + rK - T(w, L, r, K, \ldots), \qquad (3.5)$$

where the function T(w, L, r, K, …), expenditure on taxes, may depend on the absolute level of household income, the consumption expenditures, and size of the household. A positive value for T would indicate that the household pays taxes, wheras a negative value would indicate that the household receives subsidy.

3.2.3 Benefits and Costs of Re-distributional Programmes

The principal benefit of re-distributional programmes is, naturally, decreased inequality in income distribution. If the entire population desires equality, this benefit will be of a substantial value. Market-oriented re-distributional programmes do have the additional benefit of improving the operation of various labour markets and perhaps raising the productivity of some workers, especially the less privileged workers. Such programmes may therefor, not only ensure that output of the economy is distributed more equitably but also increase the total output and income to be distributed.

The costs of re-distributional programmes do not actually represent the naira costs of such programmes. The naira costs represents transfers from one member of the society to another and therefore not costs from the social point of view. This is not to say however, that re-distributional programmes are costless. Tax levies with which to finance transfer programmes can induce important distortions into the allocation process. If lump-sum taxes could be imposed so as to decrease the purchasing power of the individual that is being taxed without biasing

decisions, those distortions might be minimized. As income tax affects the wage rate or salary relevant to an individual's decision income taxes will cause a reaction in individual's labour-leisure choices. It may be the case that progressive income tax rates needed to carry out adequate re-distributional programmes will encourage the most highly paid, and possibly more productive workers, to prefer more leisure than work. The resulting reduction in output due to withdrawal from the labour force would be the true cost of any transfer programme. The following section examines specifically the work disincentive effect of government income transfer programmes.

3.2.4 Work Disincentive Effect of Government Income Transfer Programmes

The issue of whether or not individuals will reduce their work effort or even withdraw from the labour force when they receive an income guaranteed by the government has been a major issue of interest in labour economics. This section therefore discusses such issue, since this issue can illustrate many of the principles of individual behaviour. We shall begin by analyzing the effect of a guaranteed income in a static context. This will be followed by simple dynamic view of individual behaviour that is capable of raising some doubts about the conclusions of the static theory in economics.

Basic Features of Transfer Programmes

All simple income transfer programmes can be characterized by two basic features: income guarantee (G); and, the reduction rate (t) (also referred to as the tax rate). The parameter, G, represents the amount the government undertakes to pay an individual with no other income. G is often referred to in advanced economies, such as the United States, as unemployment benefit. The Total income or individual beneficiaries can never fall below G. The parameter, t, the reduction rate indicates how governmental payments are to be reduced as the individual's other incomes (from labour earnings) rises. For example, suppose the G is set at N10,000 per year and that the reduction rate is 50 percent. If an individual has no other income, he/she will therefore receive N10,000 from the government. If the individual earned the amount, say, N6,000 during the year, he/she will receive (N10,000 – 0.5 x N6,000) = N7,000. That is, the government grant is reduced by 50 percent of what the individual earned. Government grants will decline as earnings increase.

More formally, let E be the individual's earning during the year and suppose that income from capital is zero. Government payments or grant to the individual becomes:

$$P^* = G - tE \qquad (3.6)$$

Generally, P* cannot be negative, so that $P^* = 0$ for $tE \geq G$

Total income earned by the individual now becomes:

$$Y^* = P^* + E = G + (Y^* - t)E \qquad (3.7)$$

Equation (3.7) becomes the basic budget constraint we will be investigating while trying to determine the work disincentives brought about by the government transfer programme.

The Disincentive Effects of Transfer Programmes

In our discussions, the term "work disincentive" should be taken to mean a decrease in an individual's hours of work. We are interested in how an individual's hour of work will change when he/she faces the budget constraint given by equation (3.7) above.

Assume that the individual is able to earn a wage rate, w, per hour. Then earnings will be given by:

$$E = wL \qquad (3.8)$$

where L = the number of hours worked.

In the theory of labour supply, economists formulate an individual's demand for hours of leisure per year (H) as follows:

$$H = T - L, \qquad (3.9)$$

where T = total available time per year
L = hours of work per year

Consequently, from equation (3.8),

$$E = w(T - H) \qquad (3.10)$$

Equation (3.10) implies that the individual earns income for those hours he/she works instead of taking leisure.

It can be shown that the result of implementation of a governmental transfer programme is to cause the individual to demand more leisure and reduce hours of work.

Let us compare the individual's budget constraint with and without a transfer programme. Without the transfer programme, the individual's only source of income is earnings. Thus the budget constraint is given by:

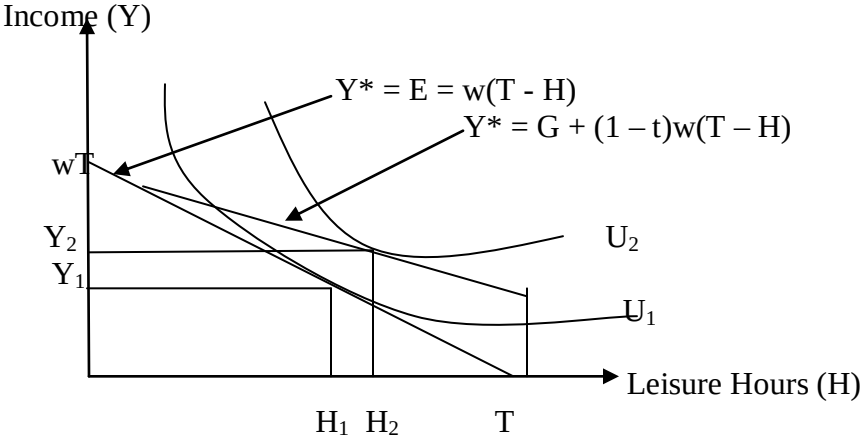
$$Y^* = E = w(T - H) \qquad (3.11)$$

Under the transfer programme and using equation (3.11), total income and hence the new budget constraint is given by:

$$Y^* = P + E = G + (1 - t)E = G + (1 - t)w(T - H) \qquad (3.12)$$

Sketching the two budget constraints, equations (3.11) and (3.12), and using the utility maximizing principle, you can illustrate the disincentive effects of a transfer programme as follows:

Figure 3.3: Disincentive Effects of a Transfer Programme



As indicated by figure 3.3, the result of implementation of a governmental transfer programme is to cause the individual to demand more leisure and reduce the number of hours put to work. In the absence of a transfer programme, the individual's utility-maximising choice between leisure (H) and income (Y) (working hours) is Y_1, H_1. The new budget constraint introduced by the programme will cause the utility-maximising point to shift to Y_2, H_2, where more leisure is demanded at the expense of working time.

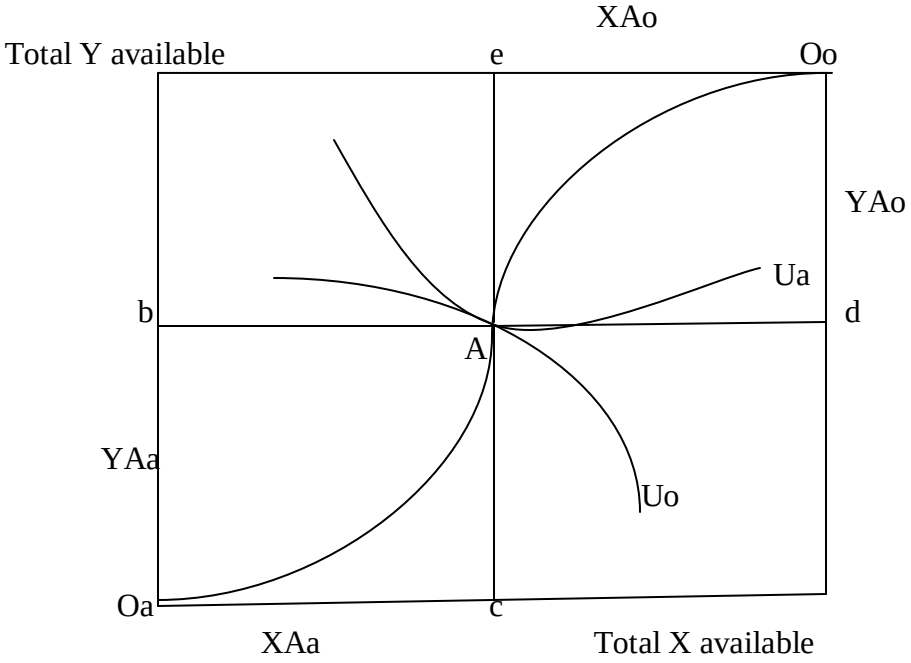
3.3 The Theory of Welfare Economics

In a nutshell, we define welfare economics as a field that focuses on the optimal allocation of resources. In the sections that follow, we examine the basic tool for optimal allocation of resources.

3.3.1 Establishing the Welfare Criteria in an Exchange Model

Consider the Edgeworth box in figure 3.1. The box illustrates the social welfare of two individuals, Obi and Adamu. Only those points on the curve 0a, Oo, referred to as the contract curve, are possible points for a social optimum. Points outside the contract curve are dominated by points on the curve because both Obi and Adamu can be made better off, and by so doing, social welfare could be improved. Along the contract curve, the utilities of the two individuals represented vary, and these utilities are directly competitive. Obi's utility can be increased only by decreasing that of Adamu.

Figure 3.4: Edgeworth Box Diagram of Exchange



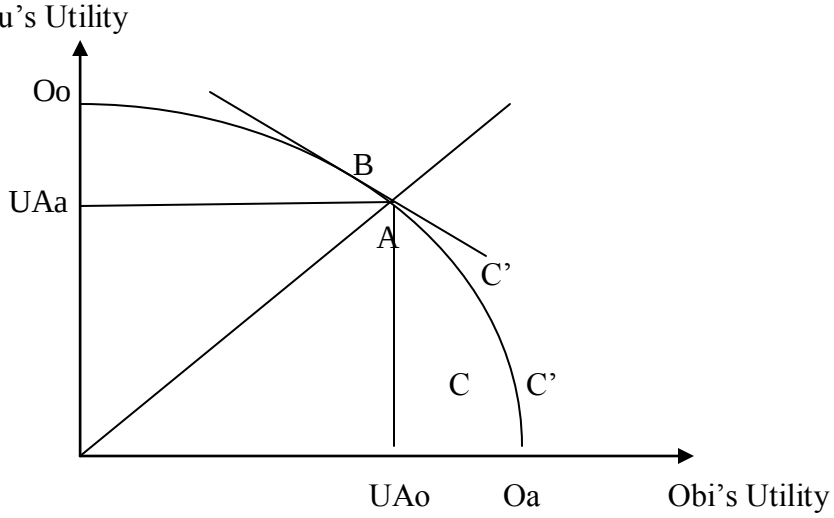
Given this set of efficient allocations, we want to discuss the possible criteria for choosing among them. We Assume that utilities are measurable and that they may be compared on a common scale. Making this assumption will permit us to conceptualise certain problems. From the assumption of measurability, it is possible to use utility combinations along the contract curve, Oa, Oo to construct the utility possibility frontier (UPF), shown in figure 3.2 below.

The utility curves Ua and Uo are those of Adamu and Obi, respectively. Point A, the point of intersection of the contract curve (Oa, Oo), Ua, and Uo is the utility maximizing point for Adamu and Obi. Two goods, X and Y are used in this illustration. As indicated, the total available quantity of Y is represented on the Y-axis, and that of X is represented on the X-axis. At point A XAo units of good X is available for Obi, and XAa units of X is available for Adamu. Similarly at point A, Yao units of Y is available for Obi and YAa units of Y is available for Adamu.

The curve Oa, Oo in figure 3.2 records those utility levels for Adamu and Obi that are obtainable from the fixed quantities of goods Y and X that are available. Any utility combination, such as point C, that lies inside the curve Oa, Oo is efficient in the sense that utilities could be unambiguously improved (for example by movingto any point on the arc C'C'); This is just a reflection of the way in which the contract curve is constructed.

Using the utility possibility frontier, economists can replace the problem of welfare economics as being the development of criteria for choosing a point on this frontier.

Figure 3.5: The Utility Possibility Frontier



The Welfare Criteria

Two simple criteria for choosing a point on the utility possibility frontier, Oa, Oo, can be shown on figure 3.2 above. The ***first criterion*** requires complete equality: Adamu and Obi should be able to enjoy the same level of welfare. This is a social welfare criterion that would necessitate choosing ***point A*** on the utility possibility frontier above. Since point A corresponds to a unique point on the contract curve, the social optimum allocation of goods X and Y has been determined by this choice. Observe that in figure 3.1 (the previous figure), this allocation requires that Adamu gets XAa units of good X and YAa units of Y. And Obi gets XAo units of X and YAo units of Y. Note that in this analysis, the goods X and Y are not necessarily distributed equally. We are concerned with the equality of utilities. If individuals have rather different tastes, as is usually the case, for two goods, the goods could be very unequally distributed at point A above.

The ***second criterion*** would be to choose that point on the utility possibility frontier for which the sum of the individual utilities is the greatest. This requires that the optimal point, **point B** on the utility possibility frontier be chosen to maximise (Ua and Uo), subject to the constraint implied by the utility possibility frontier.

Methods of Attaining the Social Optimum

The above two criteria are simple notations of social welfare. If the society had decided that it should operate by one of these principles, the criteria provide one method of findings the socially optimal allocation of goods. The question facing economists has been on the exact method of allocating the specific goods in the socially optimal way. ***One method*** of achieving the optimal allocation is to directly allocate all gods by the government. This would however, require perfect knowledge about individual tastes. The ***second method*** would be to allocate one of the goods "*correctly*" for instance, Give Adamu XAa and Obi XAo and let them trade only in the other good, good Y, until they arrive at the contract curve. It has been noted that this approach will work even when more than two goods are involved. The ***third*** and more practical method of achieving the optimal and efficient allocation presented by point A on figure 3.2, it will be necessary to ensure that initial endowments are appropriate. If the government wishes to ensure

equity, as well as efficiency, it would find it necessary to engage in some transfers of initial endowments before trading among individuals begins. That is, the government should transfer income among citizens in order to ensure that an equitable distribution of utilities is attained.

3.3.2 Social Welfare Functions

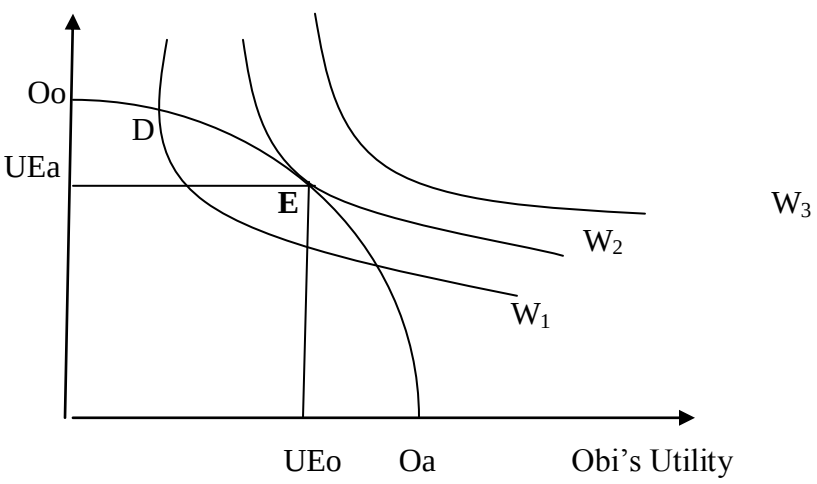
A more general and mathematical approach to social welfare is to use the concept of ***a social welfare function***. Continuing with the two individuals, Adamu and Obi, we can formulate a social welfare function of the form:

Social Welfare, W = W(Ua, Uo), (3.1)

assuming the individual's tastes are important.

The society's problem becomes that of allocating goods X and Y between Adamu and Obi, for example, so as to maximise the welfare, W. This process can be illustrated as in figure 3.3 below. The curves, W_1, W_2, and W_3, represent different ***social indifference curves.*** These assume that the society is indifferent about which utility combination on a particular curve is chosen.

Figure 3.6: Determination of the Optimum Social Welfare



The indifference curves for the function, W, exhibits a diminishing rate of substitution of Obi's utility for that of Adamu. This assumption is made with the belief that the society is less willing to make Adamu better off at the expense of making Obi worse off. Point E is the optimal point of social welfare, because this is the highest level of welfare achievable with the given utility possibility frontier.

Enumerate and discuss in detail the factors responsible for differences in income distribution among households in Nigeria.

Self-Assessment Exercises

1. Enumerate and discuss, with simple examples, two methods of ensuring optimum societal welfare in Nigeria.
2. Assume an economy with just two individuals, A and B, explain the results of exchange in the following situations:
(a) Perfect competition in which individuals A and B accept prices as given by the "market".
(b) Individual A is a monopolist and can set any price he/she chooses.
Does each of these situations lead to a pareto efficient solution? Use an Edgeworth box Diagram to explain this.

4.0 Conclusion

This unit discusses in detail the theories of income distribution, resource allocation, and welfare economics. Specific emphasis were on the measurement of income inequality, using the Lorenz curve; composition of the household total income, labour income and income from capital; factors associated with differences in income distribution; and, income redistribution programmes and their disincentive effects.

We also have learned that welfare economics deal with all feasible resources in the production and distribution of goods and services. The discussions also outlined the following:
(1) The welfare criteria in an exchange model;
(2) The utility possibility frontier (UPF); and,
(3) The methods of attaining optimal social welfare.

5.0 Summary

The unit began with a brief presentation of the general income distribution curve. We noted that there are three general features of the income distribution curve which can be highlighted as follows: First, there are large number of households in the middle income ranges in most developed countries. As many economists have pointed out, many developed economies are numerically dominated by the middle class. Another feature is that the income of households outside of the mid-range are not symmetrically distributed so that, the income distribution curve is skewed to the right.

The unit also observes that, with an appropriate income distribution data, a country's income distribution can be presented in a graph through the use of ***Lorenz curve***, as illustrated in figure 3.2 below. The Lorenz curve is a plot of the cumulative percentages of the population (or households) along the horizontal axis, and cumulative percentages of total income received by households (starting with the lowest income) along the vertical axis. If income were perfectly equally distributed, the Lorenz curve would be a diagonal straight line.

A household's total income (Y) can be disaggregated as labour income (Y_L) and income from capital (Y_K):

$$Y = Y_L + Y_K \quad (3.1)$$

The major determinants of principal variables in the household income included distribution of the wage rate, distribution of hours of work, distribution of rent, and distribution of capital ownership. These determinants can affect the income distribution in a given economy.

Another important issue bordering on income distribution is the government programmes aimed at reducing the income inequality among household. There are two major income re-distribution programmes available to governments, including: market-oriented programmes and tax-subsidy programmes. Each of these programmes do however, have disincentive effects. The most noticeable among these effects is the tendency of beneficiaries to demand more leisure.

Using the Edgeworth diagram of exchange, and the utility possibility frontier (UPF), we outlined the welfare criteria in an exchange model as including:
1. Complete equality in social and economic welfare; and,
2. Choosing that point on the utility possibility frontier for which the sum of the individual utilities is the greatest.

The unit also enumerated the suggested methods of attaining social welfare as:
(1) Direct allocation of goods and services by the government;
(2) Allocation of one of the goods or services correctly to one among individuals in the society, and letting the other(s) trade only in the other goods or services; and,
(3) Transfer of income to citizens by the government.
We learned that one general and mathematical approach to social welfare is to use the concept of ***a social welfare function***, which can be defined as the sum of utilities of all citizens in the economy.

6.0 Tutor-Marked Assignments
1. Suppose an individual seeks to maximise a utility function of the form:
$U = U(Y, H) = Y1/3H2/3$,
where Y = total income received, and H = hours of leisure.

(a) If the individual can earn a wage of N4 per hour and has no other source of income, how many hours will he/she choose to work out of a typical 24-hour day? What will total income and utility be in this situation?

(b) Suppose now that a negative income tax that provides a guarantee rate (G) of N200 per day is implemented, with an implicit tax rate (t) of 50 percent. Payments are thus given by:
$P = (1 – t)wL + G = 0.5wL + 200$, for $G \geq twL$, $P = 0$ otherwise. What will be the individual's utility maximizing Y and H in the given situation?

2. There are 200 kilograms of a food item in an Island that must be allocated between two marooned sailors. The utility function of the first sailor is given by:

$U1 = U_1(F) = \sqrt{F_1}$
where F_1 is the quantity of the food item consumed by the first sailor.

The utility function of the second sailor is given by:

$U_2 = U_2(F) = ½(\sqrt{F_2})$
where F_2 is the quantity of the food item consumed by the second sailor.

(a) If the food is to be allocated equally between the two sailors, how much utility would each receive?
(b) How should the food item be allocated between the two sailors in order to ensure equality of utility among them? (Use the Edgeworth diagram).
(c) How should the food item be allocated so as to maximise the sum of the sailors' utilities? (Use the utility maximizing principle of the theory of consumer behaviour)

7.0 References and Further Readings

Henderson, J. M. and Quandt, R. E. (1980) *Microeconomic Theory: A Mathematical Approach,* USA: McGraw-Hill, Inc.

Nicholson, W. (1978) *Microeconomic Theory: Basic Principles and Extensions, 2nd edition,* Illinois: The Dryden Press

UNIT 2: THE EFFICIENCY OF PERFECT COMPETITION

Content

1.0 Introduction

Achieving efficiency and choosing among efficient allocation of goods and services among citizens has often been regarded by economists as a purely physical problem in relating societal tastes to available productive technology. Presumably, it can be said that a desirable allocation of resources can be brought about by a central government. All that would be needed by the government is complete information about individuals' tastes and the productive possibilities of all firms in the economy. However, even if it were possible to gather such information on individuals' tastes, it would be undoubtedly be prohibitively costly to do so. Consequently, alternative, less costly or efficient allocation methods would have to be sought. The allocation method that has received the greatest attention by economists is the price or competitive system. By relying on the self-motivation of productive decision makers, the price system has been noted to permit the decentralisation of allocation decisions. Relative to perfect central planning, an interconnected market system provides a method for relating individual tastes and productive technology in a low-cost way. It is assumed that the natural working of the market mechanism can generate information about tastes and technology in the form of prices. The question this unit attempts to investigate is whether in a market economy the price system can allocate resources efficiently, and how this can be done.

2.0 Objectives

Having worked through this unit, you will be able to:

1. Define a perfectly competitive market system
2. Explain equilibrium conditions in a perfectly competitive market.
3. Explain economic efficiency and efficiency in exchange.
4. Explain optimal allocation of resources.

5. Enumerate the causes of failure in a competitive market system.

3.0 Main Content
We examine the principles of perfectly competitive price system and what economists regard as efficient allocation through perfect competition.

3.1 The Perfectly Competitive Price System
Economists believe that a perfectly competitive price system yields an efficient allocation of resources. There appears to be exact correspondence between a Pareto optimal allocation of resources and a perfectly competitive price system: every perfectly competitive allocation is Pareto optimal; and every Pareto optimal allocation has an associated perfectly competitive set of prices. Thus, the allocation problem and the establishment of competitive prices are dual problems.

However, not every Pareto optimal allocation is a social welfare optimum. Consequently, though a competitive price system may bring about an efficient allocation of resources, care should be taken in assessing the social desirability of such allocation. In addition, you should be extremely careful in drawing policy conclusions from the formal theorem of equivalence between perfect competition and Pareto optimality. Many of the theoretical requirements of a perfectly competitive price system may not be attainable in the real world situation. Two of the basic theoretical assumptions or requirements include equilibrium prices and behavioural assumptions concerning economic agents.

3.1.1 Equilibrium Prices
In a perfectly competitive price system, we assume the number, n, of well-defined, homogeneous goods in a given economy. Included in the list of available goods are consumption items, factors of production, and intermediate goods. Each of these goods has an equilibrium price established by the equality of supply and demand in the markets for the n goods. It is assumed that there are no transaction or transportation charges and that individuals and firms have perfect knowledge of the equilibrium prices, so that a given good trades at the same price regardless of who buys it or who sells it.

3.1.2 The Behavioural Assumptions
Given the prices of n goods, economic agents react to them in specific ways:
1. Each individual takes all n goods prices as given, and he/she adjusts behaviour *so as to maximise utility*, given the prices and budget constraints.

2. In making input and output choices, firms are assumed to operate *so as to maximise profits*. The firms treat all prices as fixed parameters in their profit-maximising decisions. Individual firms have no effects on market prices.

3.2 Prices and Economic Efficiency
The basic conditions of efficiency for a perfectly competitive environment require that the rate of trade-off between any two goods, X and Y, for instance, should be same for all economic agents. The ratio of the price of X to the price of Y provides the common rate of trade-off to which all agents adjust. Because prices are treated as fixed parameters in both individuals' utility-

maximising decisions and firms' profit-maximising decisions, all trade-off rates between X and Y will be equal to the rate at which X and Y can be traded in the market, that is, P_X/P_Y. We examine one at a time: the efficiency in exchange; efficiency in production; and, efficiency in production and exchange.

3.2.1 Efficiency in Exchange

Efficiency in exchange requires that the marginal rate of substitution (MRS) for any two goods, say, X and Y, should be same for all individuals. But recall that utility maximization requires that individuals equate their MRS of X for Y to the price ratio, P_X/P_Y. By so doing each individual equates the rate at which he/she is willing to trade good X for good Y to the rate at which these can be traded in the competitive market. Since every individual faces the same price ratio, the utility-maximising decision of each individual will lead to the establishment of conditions for efficient exchange. In mathematical terms, let us consider two individuals, each of which faces the price ratio, P_X/P_Y, and chooses X and Y such that:

$MRS_1 = P_X/P_Y$ (for individual 1) (3.1)

$MRS_2 = P_X/P_Y$ (for individual 2) (3.2)

It follows that: $MRS_1 = MRS_2 = P_X/P_Y$ (3.3)

Equation (3.3) becomes the condition for efficient allocation of goods X and Y for the two individuals.

3.2.2 Efficiency in Production

It is an economic belief that perfectly competitive prices will lead to efficiency in production. This belief can be substantiated by three allocation rules:

Allocation Rule 1 requires that a firm has identical rates at which it can trade one input for another, that is, the rate of technical substitution (RTS), in all outputs it produces. This rule can only be assured by the existence of perfectly competitive market for inputs. In its cost-minimising behaviour, the firm equates the RTS between any two inputs, say labour (L) and capital (K), to the ratio of their competitive rental prices, w/r. By so doing, the firm will be led to adopting efficient input proportions in a decentralized and low-cost manner.

Allocation Rule 2 requires that every firm producing a particular good, say X, has identical marginal productivities of labour in the production of good X (MP_L^X). As a rule, a profit-maximising firm will hire additional labour up to the point at which the marginal value product ($P_X \cdot MP_L^X$) of labour equals the competitive wage rate (w): $w = P_X \cdot MP_L^X$). Since both P_X and w are determined by the market, each firm will equate its MP_L^X to w/P_X. Consequently, every firm will have the same marginal productivity of labour in the production of good X. Again, the market has been able to bring about an efficient allocation.

Allocation Rule 3 requires that the rate of product transformation (RPT) – the rate at which one output can be traded for another in the production process- between any two goods, say, X and Y, be same for all firms. This implies that the rate of product transformation (of X and Y),

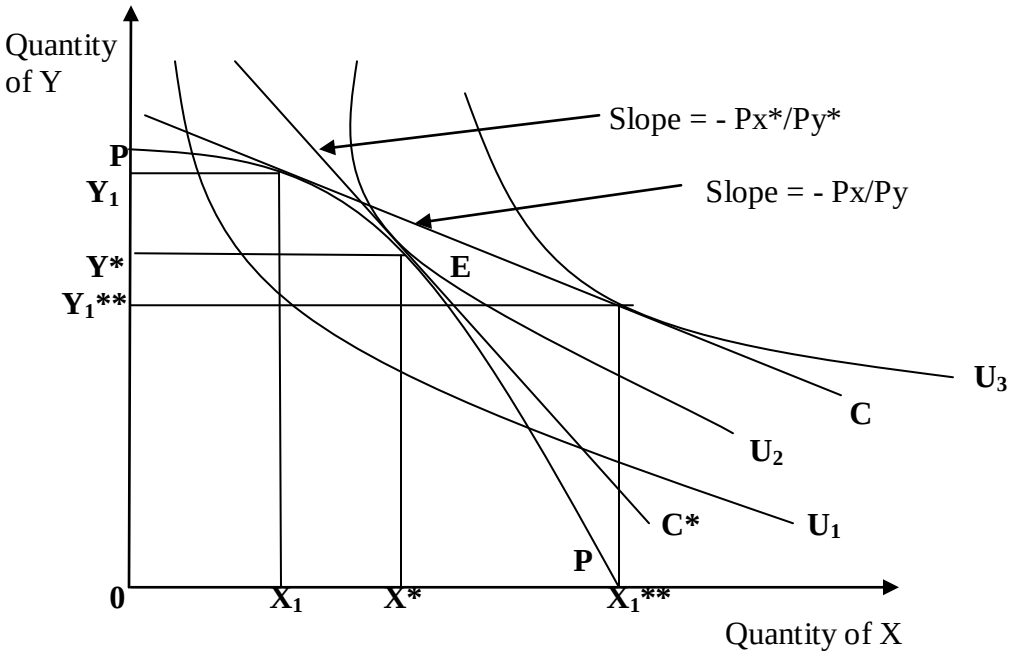
RPTxy, would be equal to the ratio of marginal cost of X (MCx) to that of Y (MCy). Each profit-maximising firm would produce that output level for which marginal cost equals the market price.. Therefore, for every firm in the perfectly competitive environment, Px = MCx, and Py = MCy, and hence, MCx/MCy = Px/Py for all firms. In this situation, the allocation rule 3 will be satisfied.

The above discussions demonstrate that the profit-maximising, decentralized decisions of many firms can achieve efficiency in production without any central direction. Competitive market prices act as signals in unifying multitude of decisions that firms make into coherent, efficient pattern.

3.2.3 Efficiency in Production and Exchange

Efficiency in production and exchange is attained at the point where the consumers' marginal rate of substitution (MRS) is identical to firms' rate of product transformation (RPT). This is true for any pair of goods. Once this condition is satisfied at any given point in time, an efficient mix of goods will be produced and exchanged. Note two important functions performed by the market prices. First, market prices assure that supply and demand will be equalized for all goods. If a particular good is produced in excess, a market reaction will set in to cut back on production of the good and shift resources into other uses or employment. The market can react by ensuring that the price of the good in excess production falls. The equilibrating nature of demand and supply in the market assures that there will be neither excess demand nor excess supply. In the second important function, equilibrium prices provide market trade-off rates for both firms and individuals to use as parameters in their decisions. Because these trade-off rates are identical for both firms and individual consumers, they help in assuring efficiency.
The above principles can be illustrated according to figure 3.1 below. The figure shows the production possibility frontier for a two-good economy, represented by the curve PP. The set of indifference curves represents individuals' tastes for the two goods.

Figure 3.1: Perfectly Competitive Prices and Economic Efficiency



We first consider the price ratio Px/Py. The negative of this price ratio, -Px/Py, represents the slope of the budget constraint, line C. At this price ratio, firms will choose to produce output combination: X_1, Y_1. It is only at this point of the PP curve will price be equal to marginal cost for both goods. On the other hand, given this budget constraint, line C, individuals will demand X_1**, Y_1** units of goods X and Y, respectively. By inspection of figure 3.1, you will observe that with this budget line C, there is an excess demand for good X (X_1** > X_1 **),** and excess supply of good Y (Y_1 > Y_1** **).** The working of the market place will therefore, raise the unit price of good X and reduce that of good Y. Consequently, the price ratio, Px/Py rises causing the price line to take on a steeper slope. Firms will respond to these price changes by moving clockwise along the production possibility frontier, PP. By so doing, they will increase the production of good X and decrease that of good Y. At the same time, individuals will respond to the changing prices by substituting good Y for good X in the consumption choices. Actions of both firms and individuals will then serve to eliminate the excess demand for good X and the excess supply of good Y as market prices change

Equilibrium position is reached at point E, with quantities, X*, Y* traded at the price ratio of Px*/Py*. With this price ratio, supply and demand are equilibrated for both good X and good Y. In maximizing output, given Px* and Py*, firms will produce X* and Y*. Similarly, with the budget constraint now given by the line, X* units of good X and Y* units of good Y.

3.3 Failure to Achieve Efficiency by the Market System

The effectiveness of a perfectively competitive price system depends on the assumptions underlying the competitive model. Outside the confines of the competitive model, and in our examination of the real-world allocation problems, certain difficulties become apparent. This section examines some of the impediments preventing the free-market system from generating an efficient allocation. A number of such impediments have been enumerated, but we can just present the classifications. The classifications have been taking from real-world occurrences, including: imperfect competition, externalities, and public goods.

3.3.1 Imperfect Competition

The term, imperfect competition is used to refer to situations in which economic agents exert some market power in the determination of prices. Specific markets that are in this category include monopolistic, oligopolistic, and monopsonistic markets. The special aspects of such markets is that marginal revenue (or marginal expense in the case of monopsony, on the demand side) is different from the market price, as opposed to the case of perfect completion where the market price equals the marginal revenue at equilibrium. A profit-maximising firm, by equating marginal revenue to marginal cost, will not be willing to produce at the point where price equal to marginal cost. Such behaviour of firms will lead to a situation where relative prices will no longer reflect relative marginal costs, and the price system will no longer ensure efficiency in production and distribution.

By creating a divergence between price ratios and technical trade-off rates, the imperfect competitor, such as a monopolist, will cause a failure in efficiency of the price system. In such situation, individuals and firms no longer equate their rates of trade off to the same market-determined magnitudes. Under conditions of perfect competition, it is the marginal revenue that

is relevant to firms' decisions and price that is relevant to individuals' decisions. But under conditions of imperfect competition, firms and individuals will differ in their decision variables.

A market power by an agent will always create a divergence between market price and the marginal figure that is relevant to the agent's decision. Because of this divergence, market prices will not carry the appropriate information about relative marginal costs. The workings of the price system will be 'short-circuited,' and an optimal allocation of resources will not be feasible. Under perfect competition, P = MC, so that individuals are willing to pay for a good at exactly what it costs to produce that good. When the equality of price (P) and marginal cost (MC) fails to hold, demands and productive technologies will no longer be properly tied together, consequently, resources will no longer be allocated in an efficient manner.

3.3.2 Externalities

The price system can also fail to allocate resources efficiently where there are interactions among firms and individuals that are not adequately reflected in market prices. One common example of such occurrence is the case of a firm that pollutes the air with industrial smoke. Such is an example of *production externality*. This is an example of an interaction between the firm's level of production and the individuals' utilities that is not accounted for by the price system.

Let us look at why the presence of such non-market interactions interferes with the ability of price system to allocate resources efficiently. Recall that efficiency in production and exchange is attained at the point where the consumers' marginal rate of substitution (MRS) is identical to firms' rate of product transformation (RPT). We redefine this condition in a 'social' sense when we recognise the possibility of externalities. We can assert that, for there to be an efficient or optimal allocation of resources, the *social rate of product transformation*, SRPT (that is, the rate at which society can transform one good into another) must equal to the *social marginal rate of substitution*, SMRS (that is, the rate at which society is willing to trade one good for another). The problem arising from the presence of externalities is reflected in the fact that economic agents pay attention to only *private* rates of transformation and substitution in their production and consumption decisions. If private and social rates diverge, the perfectly competitive price system will not be able to generate an efficient allocation.

To see this logic much clearer, let us imagine two goods in an economy, say, steel and balloons. Assume on one hand, the private marginal cost of balloons (MC_b) is identical to the social marginal cost (SMC_b), and that there are in other words, no externality in balloon production. On the other hand, suppose that the production of steel entails water and air pollution thereby imposing costs (such as having pollutants in drinking water) on society in addition to production costs. In this way, the social marginal cost of steel (SMCs) exceeds the private marginal costs of steel (MCs). The social rate of product transformation of steel for balloons (SRPT) is then defined as:

$$SRPT = \frac{SMCs}{SMC_b}$$

In principle, the rate at which society can transform balloons into steel is given by the ratio of these goods' social marginal costs. It is easy to observe that this rate will exceed the private rate of product transformation (RPT). Thus,

$$SRPT = \frac{SMCs}{SMC_b} > RPT = \frac{MCs}{MC_b}, \qquad (3.4)$$

because of the externalities associated with steel production (SMCs > MCs). Equation (3.4) indicates that the rate at which society can trade steel for balloons exceeds the rate at which they can be traded privately. It follows that, in given up 1 ton of steel production, additional resources for balloon production come from two sources: those resources that were previously used in steel production and those that were used in combating the effects of air and water pollution.

3.3.3 Public Goods

A third possible failure of the price system to yield an optimal allocation of resources in an economy arises from the existence of goods that must be provided on a "nonexclusive" basis. Such goods or services include national defense, inoculations against infectious diseases, criminal justice, and pest control. The distinguishing feature of these goods or services is that they can provide benefits to all individuals: once such goods are produced, it is impossible or very costly to exclude any individual from benefiting from them. Consequently, there is the likelihood that individuals will adopt to the position of a "free rider" by refusing to pay for the good in the hope others will purchase it and thereby provide benefits to all. The pervasive nature of this incentive will ensure that resources are under-allocated to nonexclusive goods. To avoid this under-allocation, countries may decide to have the government produce nonexclusive goods and finance this production through compulsory taxation. For this reason, nonexclusive goods are referred to as *public goods*.

Self-Assessment Exercise

Assume an economy with just two individuals, A and B. Explain the results of the following situations:

(a) Perfect competition in which individuals A and B accept prices as given by the "market".

(b) Individual A is a monopolist and can set any price he/she chooses.

Does each of these situations lead to a pareto efficient solution? Use an Edgeworth Diagram to explain this.

4.0 Conclusion

The unit examined the process of achieving efficiency in production and distribution through efficient allocation of goods and services. We learned that efficiency in resource allocation can be more feasible through adherence to the principles of perfectly competitive pricing system. The principles operate on two basic behavioral assumption: first is that individuals or consumers strive to maximise utilities; and the second is that firms strive to maximise profits. For efficient allocation of resources, these assumptions are as important as the corresponding allocation rules presented in the unit. The unit also identified the major reasons market fails in efficient allocation of resources, including: imperfect competition; externalities; and, public goods.

5.0 Summary

Economists believe that a perfectly competitive price system can yield an efficient allocation of resources. They believe there is exact correspondence between a Pareto optimal allocation of resources and a perfectly competitive price system: every perfectly competitive allocation is Pareto optimal; and every Pareto optimal allocation has an associated perfectly competitive set of prices.

In a perfectly competitive price system, we assume a well-defined, homogeneous goods in a given economy. Included in the list of available goods are consumption items, factors of production, and intermediate goods.

It was observed that the basic conditions of efficiency for a perfectly competitive environment require that the rate of trade-off between any two goods should be same for all economic agents. We also observed that perfectly competitive prices will lead to efficiency in production and allocation of resources. This observation was substantiated by three allocation rules:

Allocation Rule 1 which requires that a firm has identical rates at which it can trade one input for another, that is, the rate of technical substitution (RTS), in all outputs it produces.

Allocation Rule 2 which requires that every firm producing a particular good, say X, has identical marginal productivities of labour in the production of good X (MP_L^X). As a rule, a profit-maximising firm will hire additional labour up to the point at which the marginal value product (P_X . MP_L^X) of labour equals the competitive wage rate (w): $w = P_X$. MP_L^X).

Allocation Rule 3 which requires that the rate of product transformation (RPT) – the rate at which one output can be traded for another in the production process- between any two goods, say, X and Y, be same for all firms. This implies that the rate of product transformation (of X and Y), RPTxy, would be equal to the ratio of marginal cost of X (MCx) to that of Y (MCy). Each profit-maximising firm would produce that output level for which marginal cost equals the market price.. Therefore, for every firm in the perfectly competitive environment, Px = MCx, and Py = MCy, and hence, MCx/MCy = Px/Py for all firms.

6.0 Tutor-Marked Assignment

Consider an economy with one technique available for the production of each good, Food and Cloth. The available inputs are labour and land, as represented below:

Good:	Food	Cloth	**Total**
Labour per unit of output	1	1	**2**
Land per unit of output	2	1	**3**

(a) Suppose that land is unlimited but labour equals 100 units, formulate and sketch the production possibilities frontier (PPF).
(b) Suppose that labour is unlimited but land equals 150 units, formulate and sketch the production possibilities frontier (PPF).
(c) Suppose that labour equals 100 units and land equals 150 units, formulate and sketch the production possibilities frontier (PPF).

Hint: Identify the intercepts of the PPF in each case and consider when land is fully employed, when labour is fully employed, and when land and labour are fully employed.

7.0 References and Further Readings

Henderson, J. M. and Quandt, R. E. (1980) *Microeconomic Theory: A Mathematical Approach*, USA: McGraw-Hill, Inc.

Nicholson, W. (1978) *Microeconomic Theory: Basic Principles and Extensions, 2nd edition* Illinois: The Dryden Press