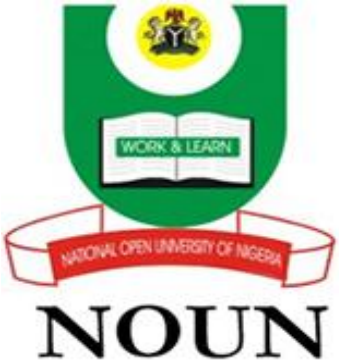

NATIONAL OPEN UNIVERSITY OF NIGERIA

ECONOMIC PLANNING II

ECO 448

SCHOOL OF ARTS AND SOCIAL SCIENCES

COURSE GUIDE

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CONTENT

Introduction

ECO 448 is designed to teach you and to build on your understanding of Economic planning as contained in the course material of Economic planning I. In this course, attention is given to the dynamics and workings of the techniques and models of economic planning as it relates to the functionality of the economy for desired Economic growth and development. It is primarily concerned with the explanations of the models and techniques of Economic planning that can be adopted by the central authority to exercise their conscious effort of achieving definite targets and objectives within a specified period of time. In this wise, Economic planning incorporate all aspect of human development aspirations to accelerate the pace of a country's social, economic and political development. More specifically, it is a study that shows the technique of deliberate control and direction of the economy , by a central authority through various tools and sub-systems within the main system, for the purpose of achieving definite targets and objectives within a specified period of time.

You will be taught the dynamics and workings of the techniques and models of economic planning as it relates to the functionality of the economy for desired Economic growth and development by the central planning authority to achieve desired set goals and objectives in Less Developed Countries of which Nigeria is one. It is also to provide a basic quantitative and qualitative understanding of how the models works to achieve medium and long-term economic aims which requires a blend of macroeconomic analysis and real life application in executing economic planning policies.

Course Content

This course builds on the exposure of students to Economic planning I . Topics covered include: Understanding techniques, model and requisites of economic planning, Input-output analysis in planning, Social accounting matrix, General equilibrium and computable general equilibrium models of economic planning, Linear programming technique and cost benefit analysis in planning.

Course Aims

There are Twelve (12) study units in the course and each unit has its objectives. You Should read the objectives of each unit and bear them in mind as you go through the unit. In addition to the objectives of each unit, the overall aims of this course include:

(i) To introduce you to the Understanding of Techniques and Models used in Economic Planning.
(ii) To teach you the concept of Input-Output Analysis in Plan Programming.
(iii) To expose you to the concept of Linear Programming Techniques in planning.
(iv) To give you the detailed analysis of how Social Accounting Matrix technique is used in Economic Planning..
(v) To show you the importance and limitations of General Equilibrium Models and Computable General Equilibrium Models in Economic Planning.
(vi) To teach you the workings of Cost Benefit Analysis and project selection techniques.

Course Objectives

To achieve the aims of this course, there are overall objectives which the course is out to achieve though, there are set out objectives for each unit. The unit objectives are included at the beginning of a unit; you should read them before you start working through the unit. You may want to refer to them during your study of the unit to check on your progress. You should always look at the unit objectives after completing a unit. This is to assist the students in accomplishing the tasks entailed in this course. In this way, you can be sure you have done what was required of you by the unit. The objectives serves as study guides, such that student could know if he is able to grab the knowledge of each unit through the sets of objectives in each one

The objectives of this course are:

- To instill in students the familiar models and techniques used in Economic Planning.
- To educate students on how economic integrated plan is executed using the common quantitative development models for Economic Planning of a country most especially developing countries by the planning authorities that is the Government.
- To educate learners on the usefulness, importance and problems of models and techniques of Economic Planning.

Working through This Course

To successfully complete this course, you are required to read the study units, referenced books and other materials on the course.

Each unit contains self-assessment exercises called Student Assessment Exercises (SAE). At some points in the course, you will be required to submit assignments for assessment purposes. At the end of the course there is a final examination. This course should take about 12weeks to complete and some components of the course are outlined under the course material subsection.

You have to work through all the study units in the course. There are Four modules and Twelve study units in all.

Course Materials

The major component of the course, What you have to do and how you should allocate your time to each unit in order to complete the course successfully on time are listed follows:

1. Course guide
2. Study unit
3. Textbook
4. Assignment file
5. Presentation schedule

Study Unit
There are 12 units in this course which should be studied carefully and diligently.
The breakdown of the four modules and twelve study units are as follows:

Module 1: Understanding Techniques, Models and requisites of Economic Planning.
Unit 1: Meaning of models in Economic Planning
Unit II: Rationale and prerequisite for successful planning
Unit III: Categories of development planning models in focus

Module 2: Input-Output Analysis in Planning.
Unit 1: Meaning of Input-Output technique
Unit II Input –Output model
Unit III: Uses, Limitations and importance of input-output analysis to planning

Module 3 Social accounting matrix, General equilibrium and computable general equilibrium models of economic planning
Unit 1 Social accounting matrix technique of economic planning
Unit II General Equilibrium model of economic planning
Unit III Computable General equilibrium model of economic planning
.
Module 4: Linear Programming Techniques and Cost-benefit analysis in Planning.
Unit 1: Introduction to the concept of Linear Programming technique
Unit 2: Linear Programming technique and its application in Planning
Unit 3: Project selection technique of cost-benefit analysis

Each study unit will take at least two hours, and it include the introduction, objective, main content, self-assessment exercise, conclusion, summary and reference. Other areas border on the Tutor-Marked Assessment (TMA) questions. Some of the self-assessment exercise will necessitate discussion, brainstorming and argument with some of your colleges. You are advised to do so in order to understand and get acquainted with historical economic event as well as notable periods.
There are also textbooks under the reference and other (on-line and off-line) resources for further reading. They are meant to give you additional information if only you can lay your hands on any of them. You are required to study the materials; practice the self-assessment exercise and tutor-marked assignment (TMA) questions for greater and in-depth understanding of the course. By doing so, the stated learning objectives of the course would have been achieved.

Textbook and References

For further reading and more detailed information about the course, the following materials are recommended:

Akosile, I. O., Adesanya, A. S. & Ajani, A. O. (2012). Management of development (A Nigeria perspective),1st edition Olas Ventures, Mushin, Lagos.Nigeria

Geanakoplos, J (1987). "Arrow-Debreu model of general equilibrium". *The New Palgrave: A Dictionary of Economics* **1**. pp. 116–124.

Grandmont,J.M (1977). "Temporary General Equilibrium Theory". *Econometrica* 45 (3): 535–572. JSTOR 1911674.

Jhingan,M.L. (2007).The Economics of development and planning, (39th Edition)Vrinda publications, India.

King, B. B.(1988), 'What is SAM?' in Pyatt, G. and Round, J. I. (ed.), Social Accounting Matrix:A Basis for Planning, Washington D.C: The World Bank.

Kubler, F(2008). "Computation of general equilibria (new developments)". *The New Palgrave Dictionary of Economics* (Second ed.).

Mansur, A& Whalley,J(1984). "Numerical specification of applied general equilibrium models: Estimation, calibration, and data", in Scarf, H.E., and Shoven, J.B. (Eds.), 1984, *Applied General Equilibrium analysis*, Cambridge, UK: Cambridge University.

Mitra-Kahn, B. H., (2008), "Debunking the Myths of Computable General Equilibrium Models", *SCEPA Working Paper* 01-2008

Olajide,O.T(2004) Theories of Economics development and planning, 2nd Edition,Pumark Nigeria Ltd. Lagos, Nigeria,

Otokiti,S.O (1999). Issues and strategies in Economic Planning, 1st edition, Bitico publishers, Ibadan.Nigeria

Todaro,M.P&Smith,S.C. (2011). Economic development, pearson education ltd, Edinburgh gate harlow, Essex, England.

Todaro, M.P (2000). Development planning, models and methods, Chapter 2-3,England.

Assignment File

Assignment files and marking scheme will be made available to you. This file presents you with details of the work you must submit to your tutor for marking. The marks you obtain from these assignments shall form part of your final mark for this course. Additional information on assignments will be found in the assignment file and later in this Course Guide in the section on assessment.

There are four assignments in this course. The four course assignments will cover:

Assignment 1 - All TMAs' question in Units 1 – 3 (Module 1)

Assignment 2 - All TMAs' question in Units 4 – 6 (Module 2)

Assignment 3 - All TMAs' question in Units 7 – 9 (Module 3)

Assignment 4 - All TMAs' question in Unit 10 – 12 (Module 4).

Presentation Schedule

The presentation schedule included in your course materials gives you the important dates for this year for the completion of tutor-marking assignments and attending tutorials. Remember, you are required to submit all your assignments by due date. You should guide against falling behind in your work.

Assessment

There are two types of the assessment of the course. First are the tutor-marked assignments; second, there is a written examination.

In attempting the assignments, you are expected to apply information, knowledge and techniques gathered during the course. The assignments must be submitted to your tutor for formal Assessment in accordance with the deadlines stated in the Presentation Schedule and the Assignments File. The work you submit to your tutor for assessment will count for 30 % of your total course mark.

At the end of the course, you will need to sit for a final written examination of three hours' duration. This examination will also count for 70% of your total course mark.

Tutor-Marked Assignments (TMAs)

There are four tutor-marked assignments in this course. You will submit all the assignments. You are encouraged to work all the questions thoroughly. The TMAs constitute 30% of the total score.

Assignment questions for the units in this course are contained in the Assignment File. You will be able to complete your assignments from the information and materials contained in your set books, reading and study units. However, it is desirable that you demonstrate that you have read and researched more widely than the required minimum. You should use other references to have a broad viewpoint of the subject and also to give you a deeper understanding of the subject.

When you have completed each assignment, send it, together with a TMA form, to your tutor. Make sure that each assignment reaches your tutor on or before the deadline given in the Presentation File. If for any reason, you cannot complete your work on time, contact your tutor before the assignment is due to discuss the possibility of an extension.

Extensions will not be granted after the due date unless there are exceptional circumstances.

Final Examination and Grading

The final examination will be of three hours' duration and have a value of 70% of the total course grade. The examination will consist of questions which reflect the types of self-assessment practice exercises and tutor-marked problems you have previously encountered. All areas of the course will be assessed

Revise the entire course material using the time between finishing the last unit in the module and that of sitting for the final examination to. You might find it useful to review your self-assessment exercises, tutor-marked assignments and comments on them before the examination. The final examination covers information from all parts of the course.

Course Marking Scheme

The Table presented below indicates the total marks (100%) allocation.

Assignment	**Marks**
Assignments (Best three assignments out of four that is marked)	30%
Final Examination	70%
Total	**100%**

Course Overview

The Table presented below indicates the units, number of weeks and assignments to be taken by you to successfully complete the course, Economic planning II (ECO 448).

Units	Title of Work	Week's Activities	Assessment (end of unit)
	Course Guide		
Module 1 Understanding Techniques, Models and requisites of Economic Planning			
1	Meaning of models in Economic Planning	Week 1	Assignment 1
2	Rationale and prerequisite for successful planning	Week 2	Assignment 1
3	Categories of development planning models in focus	Week 3	Assignment 1
Module 2 Input-Output Analysis in Plannning			
1	Meaning of Input-Output technique	Week 4	Assignment 2
2	Input –Output model	Week 5	Assignment 2
3	Uses, Limitations and importance of input-output analysis to planning	Week 6	Assignment 2
Module 3 Social accounting matrix, General equilibrium and computable general equilibrium models of economic planning			
1	Social accounting matrix technique of economic planning	Week 7	Assignment 3
2	General equilibrium model of economic planning	Week 8	
3	Computable General equilibrium model of economic planning	Week 9	Assignment 3
Module 4 Linear Programming Techniques and Cost-benefit analysis in Planning			
1	Introduction to the concept of Linear Programming technique	Week 10	Assignment 4
2	Linear Programming technique and its application in Planning	Week 11	Assignment 4
3	Project selection technique of cost-benefit analysis	Week 12	Assignment 4
Total		**12weeks**	

How to Get the Most from this Course

In distance learning the study units replace the university lecturer. This is one of the great advantages of distance learning; you can read and work through specially designed study materials at your own pace and at a time and place that suit you best.

Think of it as reading the lecture instead of listening to a lecturer. In the same way that a lecturer might set you some reading to do, the study units tell you when to read your books or other material, and when to embark on discussion with your colleagues. Just as a lecturer might give you an in-class exercise, your study units provides exercises for you to do at appropriate points.

Each of the study units follows a common format. The first item is an introduction to the subject matter of the unit and how a particular unit is integrated with the other units and the course as a whole. Next is a set of learning objectives. These objectives let you know what you should be able to do by the time you have completed the unit.

You should use these objectives to guide your study. When you have finished the unit you must go back and check whether you have achieved the objectives. If you make a habit of doing this you will significantly improve your chances of passing the course and getting the best grade.

The main body of the unit guides you through the required reading from other sources. This will usually be either from your set books or from a readings section. Some units require you to undertake practical overview of historical events. You will be directed when you need to embark on discussion and guided through the tasks you must do.

The purpose of the practical overview of some certain historical economic issues are in twofold. First, it will enhance your understanding of the material in the unit. Second, it will give you practical experience and skills to evaluate economic arguments, and understand the roles of history in guiding current economic policies and debates outside your studies. In any event, most of the critical thinking skills you will develop during studying are applicable in normal working practice, so it is important that you encounter them during your studies.

Self-assessments are interspersed throughout the units, and answers are given at the ends of the units. Working through these tests will help you to achieve the objectives of the unit and prepare you for the assignments and the examination. You should do each self-assessment exercises as you come to it in the study unit. Also, ensure to master some major historical dates and events during the course of studying the material.

The following is a practical strategy for working through the course. If you run into any trouble, consult your tutor. Remember that your tutor's job is to help you. When you need help, don't hesitate to call and ask your tutor to provide it.

1. Read this Course Guide thoroughly.
2. Organize a study schedule. Refer to the `Course overview' for more details. Note the time you are expected to spend on each unit and how the assignments relate to

the units. Important information, e.g. details of your tutorials, and the date of the first day of the semester is available from study centre. You need to gather together all this information in one place, such as your dairy or a wall calendar. Whatever method you choose to use, you should decide on and write in your own dates for working breach unit.

3. Once you have created your own study schedule, do everything you can to stick to it. The major reason that students fail is that they get behind with their course work. If you get into difficulties with your schedule, please let your tutor know before it is too late for help.
4. Turn to Unit 1 and read the introduction and the objectives for the unit.
5. Assemble the study materials. Information about what you need for a unit is given in the `Overview' at the beginning of each unit. You will also need both the study unit you are working on and one of your set books on your desk at the same time.
6. Work through the unit. The content of the unit itself has been arranged to provide a sequence for you to follow. As you work through the unit you will be instructed to read sections from your set books or other articles. Use the unit to guide your reading.
7. Up-to-date course information will be continuously delivered to you at the study centre.
8. Work before the relevant due date (about 4 weeks before due dates), get the Assignment File for the next required assignment. Keep in mind that you will learn a lot by doing the assignments carefully. They have been designed to help you meet the objectives of the course and, therefore, will help you pass the exam. Submit all assignments no later than the due date.
9. Review the objectives for each study unit to confirm that you have achieved them. If you feel unsure about any of the objectives, review the study material or consult your tutor.
10. When you are confident that you have achieved a unit's objectives, you can then start on the next unit. Proceed unit by unit through the course and try to pace your study so that you keep yourself on schedule.
11. When you have submitted an assignment to your tutor for marking do not wait for it return `before starting on the next units. Keep to your schedule. When the assignment is returned, pay particular attention to your tutor's comments, both on the tutor-marked assignment form and also written on the assignment. Consult your tutor as soon as possible if you have any questions or problems.
12. After completing the last unit, review the course and prepare yourself for the final examination. Check that you have achieved the unit objectives (listed at the beginning of each unit) and the course objectives (listed in this Course Guide).

Tutors and Tutorials

There are some hours of tutorials (2-hours sessions) provided in support of this course. You will be notified of the dates, times and location of these tutorials. Together with the name and phone number of your tutor, as soon as you are allocated a tutorial group.

Your tutor will mark and comment on your assignments, keep a close watch on your progress and on any difficulties you might encounter, and provide assistance to you during the course. You must mail your tutor-marked assignments to your tutor well

before the due date (at least two working days are required). They will be marked by your tutor and returned to you as soon as possible.
Do not hesitate to contact your tutor by telephone, e-mail, or discussion board if you need help. The following might be circumstances in which you would find help necessary. Contact your tutor if.

- You do not understand any part of the study units or the assigned readings
- You have difficulty with the self-assessment exercises
- You have a question or problem with an assignment, with your tutor's comments on an assignment or with the grading of an assignment.

You should try your best to attend the tutorials. This is the only chance to have face to face contact with your tutor and to ask questions which are answered instantly. You can raise any problem encountered in the course of your study. To gain the maximum benefit from course tutorials, prepare a question list before attending them. You will learn a lot from participating in discussions actively.

Summary

The course, Economic Planning II (ECO 448), expose you to the field of economic development planning, in this course, attention has been given to the dynamics and workings of the techniques and models of economic planning as it relates to the functionality of the economy for desired Economic growth and development. It is primarily concerned with the explanations of the models and techniques of Economic planning that can be adopted by the central authority to exercise its conscious effort of achieving definite targets and objectives within a specified period of time. In this wise, Economic planning incorporate all aspect of human development aspirations to accelerate the pace of a country's social, economic and political development. More specifically, it is a study that shows the technique of deliberate control and direction of the economy ,by a central authority through various tools and sub-systems within the main system and also incorporate other technique like input-output analysis, social accounting matrix technique, linear programming technique, computable general equilibrium model and cost-benefit analysis for project selection, for the purpose of achieving definite targets and objectives within a specified period of time.
On successful completion of the course, you would have developed critical thinking skills with the material necessary for proper economic planning. However, to gain a lot from the course please try to apply anything you learn in the course to term papers writing in other economic planning development courses. We wish you success with the course and hope that you will find it fascinating and handy.

MODULE 1

Understanding Techniques, Models and Requisites of Economic Planning.

Unit 1: Meaning of models in Economic Planning
Unit II: Rationale and prerequisite for successful planning
Unit III: Categories of development planning models in focus

UNIT 1 Meaning of Models in Economic Planning.

CONTENTS

1.0 INTRODUCTION

You must have read the Course Guide. I also assume that you have familiarized yourself with the introductory comments in Module 1. This unit is the first among the three constituents units of this module. The main thrust of this unit is to introduce you to the meaning of 'Models of Economic Planning' as a concept and show its elements, highlight its various types. This unit is fundamental to the understanding of subsequent units and modules. This is simply because other units and modules will be discussed on the basis of the fundamental concepts explained here, hence, requires your maximum attention and understanding. Planning Model therefore is a series of mathematical equations which help in the drawing up of a plan for economic development. As a student of economics, you should know that a planning model specifies the relationships between endogenous and exogenous variables and aims at ensuring the consistency of the proposed plan for economic development. It is also meant to yield an optimally balanced collection of measures known as Model Targets which can help the planning authority in the drawing of an actual plan.

2.0 OBJECTIVES

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

- Define what economic planning models are as scholarly established and in your own words.
- Enumerate the elements of development planning models to actual development plan making.
- Identify the types of economic development planning models available.

3.0 MAIN CONTENT

3.1 What are Economic planning models?

Generally, our focus in this course is to understand the meaning of techniques and models of Economic planning, its applications to achieving set economic development targets of an actual plan, various types of models available for plan making, its importance and usefulness. It is important for you to know that planning is essential in whatever we do both at micro and macro level of human existence. Quantifying what we want to achieved as set targets and how to realize them given the limited resources at our disposal is of paramount importance to even the planning authorities that is the government for them to meet up with the set targets of developing the economy using available resources. This can only be done using quantitative equations which expresses relationships among economic variables to explain and predict past and future events under a set of simplifying assumptions known as Model. Planning models have been increasingly used in less developed countries of which Nigeria is one, for the drawing up of plans for economic development. To start with, I consider it important for us to examine what Planning models is all about. I believe this will provide a convenient platform for us to have a full grasp of the entire course content.

Let us begin our understanding of the models of economic planning by first defining the word 'Models'.

According to Jhingan M.L (2011), a model expresses the relationships among economic variables which explain and predict past and future events under a set of simplifying assumptions. In other words, a model consists of a series of equations each of which represents the association among certain variables.

Planning Model therefore is a series of mathematical equations which help in the drawing up of a plan for economic development. Jhingan M.L (2011).

On the otherhand, Otokiti S.O (1999) views an economic model as an organize set of relationships, that describes the functioning of an economic entity whether it concerns, the individual, house hold or firm, the local government system, the regional or national economies, or the world economy under a set of simplifying assumptions. He also posits that in the context of planning economic models provide a logically, systematic and internally consistent operational framework, based on structural inter-relationships of sets and participants in the economy under consideration. A planning model, in other words sets out the relationship between the crucial (key) variables in the process of planned economic development within the stipulated time horizon of the plan. You should also know that most planning models belong to the category of what are known as decision or policy models. In these models a set of plan objectives is specified, policy measures to achieve these objectives are isolated and their interrelationship worked out.

It is imperative to let you know that model may have endogenous and exogenous variables. Endogenous variables are those whose values are determined from within the system, examples of such are national income, consumption, savings, investment etc.

On the other hand, exogenous variable are determined from outside the system, Examples of such are prices, exports, imports, technological changes etc.

Therefore as a student of economics, you should know that a planning model specifies the relationships between endogenous and exogenous variables and aims at ensuring the

consistency of the proposed plan for economic development. It is also meant to yield an optimally balanced collection of measures known as Model Targets which can help the planning authority in the drawing of an actual plan. It is also important to let you know that there are important elements of development models

SELF-ASSESSMENT EXERCISE
Briefly discuss the meaning of the word economic planning models.

3.2 Elements In development planning model.

The following are the important elements of the development planning models.

a. Objectives
b. Instrument Variables
c. The functional Relationships

3.2.1 Objectives: In a development plan, there should be a focus on what the planning authority is aiming to achieve within the given time frame of the plan. For example the achievement of a certain rate of growth, a certain level of employment, or a certain balance of payment position should specifies in the plan as dependent variables of the model. Let us consider the vision (20 - 20 - 20) that is making Nigeria to be one of the best Twenty (20) economies by the year 2020. Part of the means of a achieving this objective is to maintain a steady economic growth rate of which if it is sustained at the current 6.5% growth rate may lead to the achievement of the objectives of the vision plan. Therefore objectives have to be specified by planning authorities in a given economic development plan.

3.2.2 Instrument Variables: Instruments are tools for achieving a definite plan. For example, hammer and jackplane are part of a carpenter's instrument that can be used for carpentry table making work. Instrument variables are regarded as the policy measures that would be necessary to achieve the objectives. For example the level of savings and investment in different sectors, the volume of imports and exports to be achieved, the supply of skills or workforce for projects to be built up or acquired, to mention but few, are the principal instrumental variables operatives in development planning models. Therefore, let it be known to you that instrumental variables are the independent variables of the model and it has to be specified and expressed in the plan.

3.2.3 The functional Relationship: This is the third element in development planning model that shows the relationship between the variables in the form of structural equations of the specified model. The dependent (endogenous) and the independent (exogenous) variables have to be functionally expressed in a related form of structural equations of the specified model. These functional or (casual) relationship would show the responded of the dependent variable when any design or expected change in the independent variables is specified. These functional relationships are expressed in the firm of co-efficient of the model.

Therefore, it is clear to say that in a policy model underlying a plan, the objectives to be achieved would be the dependent variables and given the values of the independent

variables i.e. (the policy instruments) and the coefficient, the outcome can be determined or the equations of the system worked out. You will understand this more when discussing different types of planning models.

SELF ASSESSMENT EXERCISE

The concepts of endogenous and exogenous variables are key in development planning elements. Discuss

3.3 Types of Planning Models

Having understood what economic planning models and the elements of development planning models are, It is important for us to discuss the various types of development or economic planning models. Most development plans have traditionally been based initially on some more or less formalized macroeconomic model. Such economy wide planning model can be divided into three basic categories.

1.Aggregate growth, Macroeconomic or Simple Models
2.Multi-Sector Models
3.Decentralised Models

3.3.1 Aggregate growth, Macroeconomic or Simple Models

The first category is the aggregate growth, macroeconomic or simple models which involves macroeconomics estimate of planned or required changes in principal economic variables. It deals with the entire economy in terms of a limited set of macroeconomic variables deemed most critical to be determined by levels and growth rates of national output; that is savings, investment, capital stock, exports, imports, foreign aid etc. The model provides a convenient method for forecasting output (and perhaps also employment) growth over a three to five year period. Harrod Domar and two gap models are of this type.

3.3.2 Multi-Sector Models

The second category is the multi-sector models. Multi-sector include input-output, social accounting and computable general equilibrium (CGE) models which ascertain among other things, the production, resources, employment and foreign exchange implication of a given set of final demand targets within an internally consistent framework of inter-industry product flows. It is a sophisticated approach to development planning in which the activities of the major industrial sectors of the economy are interrelated by a means of a set of simultaneous algebraic equations expressing the specific production processes or technology of each industry. All industries are viewed both as producers of outputs and users of inputs from other industries. For example, the agricultural sector is both a producer of output e.g. (wheat) and a user of input from the manufacturing sector e.g. (machinery, fertilizer), therefore there is interdependence of industry which could lead to direct and indirect repercussions of planned changes in the demand for the products of any one industry on outputs, employment, and imports of all other industries can be traced throughout the entire economy in an intricate web of economic interdependent. This inter-industry model can be used to determine intermediate material, import, labour and capital requirements with the result that a comprehensive economic plan with

mutually consistent production levels and resource requirements can in theory be achieved.

3.3.3 Decentralised Models

The third stage or category of planning models is the decentralized models. It is the type that have sector of project level variables which are used to prepare models for individual sectors or projects. This type of models are useful in the early stages of a country's economic development when information is available for only individual sectors or projects, project evaluation or project appraisal social cost benefit Analysis are techniques that fit into this category. The most important component of plan formulation is the detailed selection of specific investment projects within each sector through the decentralized models. You will be exposed in details to the workings of these models and their co-efficient in subsequent units and modules.

SELF ASSESSMENT EXERCISE

Discuss the basic models available in economic development planning formulation in less developed countries.

4.0 CONCLUSION

From our discussion so far on the Meaning of Models in Economic Planning, we can infer the following facts:

- For effective Economic development planning of any nation, it must possess a formidable development planning model upon which the plan is built.
- Planning authorities must have clear objectives with definite time frame, instrumental variables to achieve the policy objectives and functional relationship in the form of structural equations of the specified models
- The three stages or types of development planning models are aggregate or macroeconomic models, multi-sector or inter industry models and the decentralized models.

5.0 SUMMARY

In this unit, we have attempted to show various definitions on models and techniques of economic planning from various scholars of repute. Also, from the point of view of harmonization, you have learnt that all the definitions agreed to the fact that planning model is a series of mathematical equations which help in the drawing up of a plan for economic development. I believe your understanding of this unit has given you a basis for the understanding of the next unit and in fact subsequent modules. I expect you by now to be anxious of reading more about the need and rationale for planning in less developed countries which will be duly served in the next unit.

6.0 TUTOR-MARKED ASSIGNMENT

Discuss the meaning of economic planning models and the elements in development planning models.

7.0 REFERENCES/FURTHER READING

Akosile, I. O., Adesanya, A. S. & Ajani, A. O. (2012).Management of development (A Nigeria perspective), 1st edition Olas Ventures, Mushin, Lagos. Nigeria

Jhingan,M.L. (2007).The Economics of development and planning, (39th Edition)Vrinda publications, India.

Olajide,O.T(2004) Theories of Economics development and planning, 2nd Edition,Pumark Nigeria Ltd. Lagos, Nigeria,

Otokiti,S.O (1999). Issues and strategies in Economic Planning, 1st edition, Bitico publishers, Ibadan. Nigeria

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Todaro, M. P. (2000). Development planning, models and methods, Chapter 2-3,England

UNIT 1I Rationale and prerequisite for successful Economic Planning.

CONTENTS

1.0 INTRODUCTION

Having familiarized yourself with the explicit explanations in the first unit of this module which discusses what economic planning models are and what it entails. This unit is the second among the three constituents units of this module. The main thrust of this unit is to show the rationale and prerequisite for successful economic planning, It will also highlight the usefulness and importance of development models to actual economic planning. This unit is also fundamental to the understanding of subsequent units and modules. This is simply because other units and modules will be discussed on the basis of the fundamental concepts explained here, hence, requires your maximum attention and understanding.

2.0 OBJECTIVES

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

- Show the rationales behind a successful economic planning
- Enumerate the usefulness of development models to actual economic planning.
- Identify the need for planning in Less Developed Countries
- List with relevant examples the requirements for a successful planning in less developed countries of which Nigeria is one.

3.0 MAIN CONTENTS

3.1 Needs for planning in less developed countries

One of the principal objectives of planning in underdeveloped or less developed countries is to increase the rate of economic development. Let us consider the words of Gadgil (2002) a professor of economics in India, planning for development implies external direction or regulation of economic activity by the planning authority which in most cases identified as the government. As you know that LDC's are characterized with low level of savings, low level of income, what is prevalence in such countries are poverty ridden people. This visions economic circle can only be broken by planned development. This can be achieves through importing capital from abroad know as foreign direct investment (FDI) and localized force saving to support the level of industrialization.

Therefore, the rationale and the need for planning arises in such countries to achieve the following.

1. Strengthen the market mechanism

The market mechanism works imperfectly in LDC's because of the ignorance and unfamiliarity with it. This is so because the production factor, money and capital markets are not organized properly, thus the price system fails to bring about adjustments between aggregate demand and supply of good and services. Therefore, to remove market imperfection, to mobilize and utilize efficiently the available resources, to determine the amount and composition of investment and to overcome structural rigidities, the market mechanism is required to be perfected in LDC's through planning Using a workable planning model.

2. The necessity of removing unemployment.

Unemployment is a situation where resources are not fully utilized. Capital is scarce and labour is in abundance thereby creating the problem of providing gainful employment and resulting in absence of sufficient enterprises and initiatives. This required an urgent attention by the planning authority in LDC's immediately adopt a planning model that can salvage the situation.

3. The development of Agricultural sectors and industrial sectors.

Agricultural sector is known to produce food for household, raw materials for industries and foreign earnings to government when exported abroad. Industrial sector on the other hand utilizes the raw materials from the agricultural sector for the production of further finished goods that can be used for infrastructural development like roads, railways, power stations etc. Therefore there should be a conscious attempt by the LDC's planning authority to have a road map planning model towards the development of their agricultural and industrial sector.

4. The necessity of removing the nation's poverty.

The need for reducing inequalities income and wealth raising per-capital income, increasing employment opportunities, all round rapid development and national independence substance requires a careful ad conscious idea of planning targeted through a planning model that can achieve this. This was seen in the rapid development and transformation of USSR now Russia, a poor country at that time before target industrial planning was introduced.

To sum this up, in the words of Gadgil (2002), "Planning for economic development is undertaken presumably because the pace of direction of development taking place in the absence of external intervention is not considered to be satisfactory and because it is further held that appropriate external intervention will result in increasing considerable the pace of development and directly it properly.

SELF ASSESSMENT EXERCISE

Enumerate and discuss three needs for planning in less developed countries.

3.2 Usefulness of development models to actual economic planning.

By now, the relevance of development models to problem of economic planning must have been clear to you.

The following are the usefulness of development models to economic planning.

a. It provides a framework for checking of consistency or the optimality of the official plan targets.
b. It provides a framework for the actual setting of targets.
c. It provides a framework for the evaluation and selection of projects.
d. It provides an insight into the structure of the economy and its dynamics to help better policy decisions.
e. It assists in budget and budgeting control.
f. It helps the preparation of feasible plan.
g. It helps the projection and forecasting of measurable changes.
h. It helps in adjusting competing participants within available time path
i. It helps the planning authorities to know their objectives, instrument variables and the functional relationship of the variables in the desired plan and low to achieve it.
j. It gives the planner a clear direction to follow on a projected economic plan.

SELF-ASSESSMENT EXERCISE

Briefly explain five relevance of development models to economic planning of your Country.

3.3 Requirements for a successful planning.

The formulation and success of a plan requires the following

1. **Planning Commission:** The first pre-requisite for a plan is the setting of a planning commission which should be organized in a proper way and should consist of experts like economist, statistician, mathematician, engineer etc to deal with various aspects of the economy. In Nigeria, it is called National Planning Commission.

2. **Statistical Data:** A prerequisite for sound planning is a through survey of the existing potential resources of a country together with its resources. To have a successful planning in a country statistical data and information with regard to the available material, capital and human resource are needed.

3. **Objectives:** There must be a clear objective of what the plan aims at achieving. The objectives might be to increase national and per capital income, to expand employment opportunities, to reduce inequalities of income and wealth, to raise agricultural production or to industrialize the economy etc to mention but few.

4. **Fixation of Targets and Priorities:** One of the Major requirements for successful planning is to fix targets and priorities well for achieving the objectives laid down in the plan. These targets should be global and sectoral. Priorities should be laid down on the basis of the short and long terms need of the economy keeping in view the available resources.

5. **Incorrupt and Efficient Administration:** It should be known to you that an incorrupt and efficient administration is a strong determinant of successful planning. This however is lacking in most less developed countries. Competent

administrative staff should be appointed into various ministries which should first prepare good feasibility reports of proposed projects before embarking on them. Therefore the secret of successful planning lies more in sensible politics and good administration.

SELF ASSESSMENT EXERCISE

Discuss at least three requirements for a successful planning in a nation.

4.0 CONCLUSION

From our discussion so far on the Rationale and prerequisite for successful Economic Planning. We deduce the following facts:

- Strengthening the market mechanism in the economy, removing market imperfections, utilizing available resources efficiently, removing poverty and unemployment, develop the agricultural and industrial sectors should be a model road map for economic planning and development.
- The usefulness of development models to actual economic planning involves a framework for consistency of the plan, actual setting of plan targets, evaluation and selection of projects, aids better policy decision.
- A successful planning requires a planning commission, proper statistical data gathering, have a clear plan objectives, fix priorities right and have a corrupt free economy.

5.0 SUMMARY

In this unit, we have attempted to show the need for planning in Less Developed Countries of which Nigeria is one, Usefulness of development models to actual economic planning and the requirements for successful planning. From the point of view of harmonization of all these rationale, you have learnt that all these are a good model road map for a successful economic planning and development. I belief your understanding of this unit has given you a basis for the understanding of the next unit and infact subsequent modules. I expect you by now to be anxious of reading more about the categories of development planning models in focus which will be duly served in the next unit.

6.0 TUTOR-MARKED ASSIGNMENT

Explain the relevance's of development models to economic planning of Nigeria.

7.0 REFERENCES/FURTHER READING

Akosile, I. O., Adesanya, A. S. & Ajani, A. O. (2012). Management of development (A Nigeria perspective),1st edition Olas Ventures, Mushin, Lagos. Nigeria

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UNIT III Categories of development planning models in focus

CONTENTS

1.0 INTRODUCTION

In our discussions so far with what planning models is all about and the rationale for planning, there is need for us to look critically at the categories of planning models and its broad explanation using available quantitative growth models. In this wise, we shall again be considering explicitly, aggregate or macroeconomic models, sectoral and subsectoral models and the inter-industry models of development planning. I will advise that you carefully follow the explanation for easy assimilation of the contents in this unit. This unit is the third among the three constituents units of this module. The main thrust of this unit is to show the explicit explanation of development planning models categories using algebraic and numerical notations for its explanations. Hence it requires proper concentrations

2.0 OBJECTIVES

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

- Show the quantitative workings of some growth models
- Do some quantitative workings on aggregate or macroeconomic models.
- Do some quantitative workings on sectoral and sub-sectoral models
- Show some quantitative workings on the inter-industry models.

3.0 MAIN CONTENTS

3.1 Aggregate or macroeconomic or simple models

In the earlier unit, this model was not explicitly explained but that will be done in this unit. As the very name implies, this type of models try to provide solutions to the development problems in terms of such aggregative variables like consumption, investment, savings, imports, exports, labour supply, balance of payment etc which you are familiar with in macroeconomic theory as macroeconomic variables. They are also regarded as simple in the sense that the complexities involved in sectoral distribution of resources are done away with. Such macro models are usually used to determine the value of the instrument variables when the target rate of growth of national output is given. In the exercise, the "constraints'' such as the availability of foreign exchange

skilled labour, taxable capacity etc may also be specified. A good example of this category of planning model is the Harrod Domar model which shows the determination of the relationship among the aggregative variables such as savings, investment, labour and capital productivity rate of growth of population etc which will determine the overall growth rate of the economy.

In the absence of economic planning in the LDCs, the independence or natural growth rate may be so slow to result to near stagnation prevalence situation. The task of the planners is therefore to intimate and influence the aggregative instrument variables in these economies and to ensure that the growth rate gets accelerated to a satisfactory and desired target.

Let us now consider the Harrod-Domar model, According to the model, the growth rate of an economy is determined by the level of net capital formation and its productivity. Although, the net capital formation and its productivity. Although, the net capital formation in LDC's is constrained by the amount of savings available, savings are a function of the level of income and productivity of capital is ascertained from the overall or the global capital output ratio.

Thus, if

$s = \frac{S}{Y}$ (The saving/ income ratio)

$k = \frac{I}{\Delta Y}$ (The Incremental Capital Output ratio)

$g = \frac{\Delta Y}{Y}$ (The growth rate of national income)

Then, if I= S i.e. Investment equals savings

$\frac{\Delta Y}{Y} = \frac{S}{Y} \quad \frac{I}{\Delta Y} = \frac{S}{Y} \cdot \frac{Y}{I} = (\frac{\Delta Y}{S} = I)$

$\therefore g = \frac{s}{k1}$ This is the growth equation of Harrod Domar Model.

In the above analysis, it shows that given the values of s and k and assuming them to be constant over the plan period, the growth rate of the economy would be determined by the ratio $\frac{s}{k}$.

When a near stagnant LDC starts its process of planned economic development, it saves 5 – 6% of its national products. That was infact the case when Nigeria first 5 year plan was launched in 1962, the process of its planned economic development saved about 5.6% of its national product. The (ICOR) Incremental capital output ratio of such an economy may be between 2% & 4%,; thus if the value of S is assumed to be 6% (0.06) and that of K= 3% (0.03), then growth rate= $\frac{\Delta Y}{Y} = 0.06 \times 100 = 2\%$

$\frac{}{Y} \quad 3$

For instance, if the annual growth rate of population ($\frac{\Delta p}{p}$) is also 2%, we will therefore have $\frac{\Delta Y}{Y} - \frac{\Delta p}{p} = 0$

This implies that the growth of per capita income would be zero. I want you to know that it is here planning model would realize that if no effort is made to change the variable of the system suitably, there would be hardly any improvement in economic welfare and standard of living of the people. While using this model for plan formulation , it is natural that changes would have to be made in the strategic variables so as to produce a plan which would make some visible impacts on the standard of living of the people.

SELF-ASSESSMENT EXERCISE

If the value of s is assumed to be 8% and k to be 4%. Calculate the growth rate of the economy.

3.2 Sectoral and sub-sectoral model of development planning.

The macroeconomic models provide only the first approximations to the problems of plan formation. They yield the broad aggregative targets and the values of the aggregative instrument variables. However, in order to make the plan an operational document, sectoral models are presented.

The sectoral models may be Single Sector Project Model (SSPM) or complete main sector planning models (CMSP).

a. In the case of the former, (SSPM) plan formulation starts from the project levels. Individual projects are appraised for inclusion in the plan and thus, the aggregative requirements of the plan are built up through the summation of projects. For instance, if the saving, investment, imports and skill requirements of all appraised projects come to an aggregative figure that is not feasible or difficult to achieve some projects are excluded. Such an approach was followed in Nigeria and few other developing countries in their earlier plan. Although, such models are capable of producing an internally consistent and co-ordinated plan but the danger is that they may yield a plan which is only a collection of sundry projects.
b. The Complete Main-Sector Planning (CMSP) Models, are some sophisticated form of sectoral models, which divide the whole economy into a few main or broad sectors, such as public and private sectors, consumption and investment goods sectors, domestic and exports sectors, agricultural and none agricultural sectors etc. The investment skills, foreign exchange requirements etc, are worked out for each main sector and consistent targets are set for each of them.

The analysis that follows is a presentation of a simple main sector planning models.

SIMPLE MAIN SECTOR MODEL: In a simplified main sector model, one, can suppose that the entire economy is sub-divided into two main sectors, namely (i) the consumption goods sector and (ii) the investment goods sector.

The two sectors has a total product functions, which is represented with x_1 and x_2 where;

x_1 =the total product of the consumption goods sector.

x_2 = the total produced of the investment goods sector and

GDP = the Gross Domestic Product of the economy.

C = denotes, the marginal (and average) propensity to consume.

S = denotes the propensity of save (and closely related to investment thus, S = I (I – C)

From the equations, a summation of x_1 and x_2 results to the Gross Domestic Product of the economy.

Thus, $x_1 + x_2$ = GDP and if $\frac{x_1}{x_2} = \frac{C}{I-C}$ and C =0.6, then $\frac{0.6}{0.4} = \frac{3}{2}$.

Now, if the value of C remains constant during the plan, the outputs of the two sectors will grow at these relative rates $\frac{3}{2}$. Consequently, the planner would try to lower the value of C, so that by saving more, the investment goods sector could grow at a faster rate.

For example: lowering the value of C would imply.

(1) $\frac{C}{1-c}$ and C = 0.6 then= $\frac{x_1}{x_2} = \frac{0.6}{0.4} = \frac{3}{2}$

(2) $\frac{C}{1-c}$ and C = 0.5 then = $\frac{x_1}{x_2} = \frac{0.5}{0.5} = 1$

(3) $\frac{C}{1-c}$ and C = 0.4 then = $\frac{x_1}{x_2} = \frac{0.4}{0.6} = \frac{2}{3}$

Meaning that, the planner would require in the third example, 2 units in total product of consumption goods sectors to obtain 3 units in investment goods sector.

SELF ASSESSMENT EXERCISE

Examine and discuss the sectoral and sub sectoral models available to economic planners.

3.3 THE INTER – INDUSTRY MODELS:

You may have heard about the input – output technique which will be elaborately discussed in the next module. The inter – industry models, make use of the technique and some of them make use of even linear programming.

As it will be observed in the next module, the input – output table gives a synoptic view of the inter – industry relations and transaction. It is however, necessary for building up input- output tables that two conditions are satisfied as pre –requisites, and they are:

i. That a country should have developed at least a few manufacturing industries, so that the inter – industry transactions are quite substantial.
ii. That sectoral data should be available so as to facilitate the construction of input – output tables. Thus, only those LDCs satisfying these conditions should rely upon inter – industry models in their plan formulation.

Whenever it is practicable to build inter – industry models (using input – output technique), these turn out to be the most elaborate ones and can be really termed as multisectoral models. The entire economy is divided into as many sectors or industries for as many as the requisite data can be mustered.

3.3.1. THE STATIC PLANNING MODEL:

Let us look at a static planning model meant to achieve a definite plan target. The objective of such a model may be to ensure consistency among sectoral output at a future date, say, end of the five years plan period, (t+x). Using the input – output technique which you will be familiar with and its table happens to be the centre piece. If you look at table that will be presented, you will notice that each sectorial row gives a relationship of this type.

$$X_1 = \sum x_{ij} + X_1C + X_1I + X_1X$$

Where
X_1 = total output of sector i
$\sum X_{ij}$ = is the total delivery of goods from i sectors
J =1 (which are 4 in number)
X_1C = use of sector's output for consumption.
X_1I = use of sector's output for investment and
X_1 = exports of i sector's output.
Such a disposal of sectorial outputs can be expressed for all the n sectors that would be there in a table.
Now, as stated above, if the objective of constructing such a model is to ensure consistency in sectoral outputs in a target year (t + x), we can proceed like this.

- Given that the input coefficients of different sectors is already known (from the input output table of the base year).
- The deliveries of goods from one sector to the other can be related in the year as follows
  $X_{ij} = {}_{aij}X_j$
  Where
  aij is the input coefficient of j sectors and expresses the unit of i goods needed to produce one unit of j goods.
  Now, $\sum_{j=i} x_{aij} + X_1C + X_1IX_1X$ (I = 1.2 …….. n) ….(iii)
  Equation (ii), therefore, shows that if X_1C, X_1I and X_1X are exogenously (independently) determined, then the output of sectors i needed for inter – industry deliveries (X_{ij}) in year t+x can also be determined. This equation, therefore, becomes a system of n simultaneous equations (each equation for a sector) in n unknown variable which can be solved. With the help of such a static model, the planner can explicitly lay –down production targets in such industry and sectors. Other models like the input output model, social accounting matrix and computable general equilibrium model will be explicitly discussed in the next modules.

SELF ASSESSMENT EXERCISE

Briefly discuss the term "inter-industry model".

4.0 CONCLUSION

From our discussion so far on the categories of development planning models in focus**.** We can conclude as follows:

- That the aggregative or simple models try to provide solutions to the development problems in terms of such aggregative variables like consumption, investment, savings, imports, exports, labour supply, balance of payment etc dealing with complexities of sectoral distribution and that Individual projects are appraised for inclusion in the plan and thus, the aggregative requirements of the plan are built up through the summation of projects.
- That a country should have developed at least a few manufacturing industries, so that the inter – industry transactions can be quite substantial and that sectoral data should be available so as to facilitate the construction of input – output tables.

Thus, only those LDCs satisfying these conditions should rely upon inter – industry models in their plan formulation.

5.0 SUMMARY

In this unit, we have attempted to show the categories of development planning models comprising Aggregate or macroeconomic or simple models, Sectoral and sub-sectoral model of development planning and the Inter- industry Models of development planning. You have learnt that all these model are useful and important in making a viable road map for a successful economic planning and development. I belief your understanding of this unit has given you a basis for the understanding of the next unit and infact subsequent modules. I expect you by now to be anxious of reading more about the input - output analysis which will be critically treated in the next module.

6.0 TUTOR-MARKED ASSIGNMENT

Discuss your understanding of Single Sector Project Model (SSPM) and the Complete Main-Sector Planning (CMSP) Models to actual economic planning.

7.0 REFERENCES/FURTHER READING

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MODULE 2
INPUT- OUTPUT ANALYSIS IN PLANNING

Unit 1: Meaning of Input-Output technique
Unit II Input –Output model
Unit III: Uses, Limitations and importance of input-output analysis to planning

UNIT 1 MEANING OF INPUT-OUTPUT TECHNIQUE

CONTENTS

1.0 INTRODUTION

Our discussion in the first module of this course was too general and aggregative in nature. Similarly, we referred to the necessity of a plan being consistent. Therefore our task in the present module would be to look at the process of plan formulation at a disaggregated level. For the above reasons, we shall familiarize ourselves with the methods that are usually adopted at the operational level to make physical as district from financial targets of the plan consistent with each other, so that both surpluses and shortages could be avoided. It is therefore intended to introduce you to what input-output analysis in plan programming is all about, its essential feature, assumptions and its usefulness and importance in planning.

2.0 OBJECTIVES

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

- State what input-output technique is all about.
- Show the essential features of input –output technique.
- Understand the assumptions of the input –output technique.

3.0 MAIN CONTENTS

3.1 What is input-output technique.

In considering what input-output analysis is all about, we must consider its genesis and how it originated. Input-output is a novel technique invented by Prof.Wassily .W.Leontief a nobel prize winner in economics in 1951

It is a technique used to analyse inter-industry relationship in order to understand the inter dependencies and complexities of the economy and thus the conditions for maintaining equilibrium between supply and demand. It is also known as inter-industry analysis.

According to Todaro and Smith (2011), input-output is defined as a formal model dividing the economy into sectors and tracing the flows of inter industry purchases (input) and inter industry sales (output). Before analysing the input-output method, Let us understand what the terms input and output means. According to Hicks (1979), an input is something which is bought for the enterprise, while an output is something which is sold by the enterprise. An input is obtained but an output is produced. This input represents the expenditure of the firm while output is receipts accrued to the firm. The sum of the money values of inputs is the total cost of a firm and the sum of the money values of the output is its total revenue. The input –output analysis tells us that there are industrial inter relationships and inter dependencies in the economic system as a whole. Let it be known to you that the inputs of one industry are the outputs of another industry and vice versa, so that untimely their mutual relationships lead to equilibrium between supply and demand in the economy as a whole for example, coal is an input for steel industry and steel is an input for coal industry, although both are the outputs of their respective industries. A major part of economic activity consists in producing intermediate goods (inputs) for further use in producing final goods (outputs).There are flows of goods between different industries. The supply side consists of large inter-industry flows of intermediate products and the demand side of the final good. In essence, the input-output analysis implies that in equilibrium, the money value of aggregate output of the whole economy must equal the sum of the money values of inter-industry inputs and the sum of the money values of inter-industry outputs. The quantitative step by step of this analysis shall be considered and discussed in the subsequent unit of this module.

SELF ASSESSMENT EXERCISE:-
Briefly explain what input-output analysis is all about in planning technique.

3.2 Essential features of input –output technique.
Features as you know are related to the characteristics of a particular thing under observation. It is the visible identify or identification associated with what one is considering or looking out for. The following are the visible and main features of the input- output technique as it relates to economic planning and development. The input – output analysis is the finest variant of general equilibrium which has the following main elements.

i The input –output analysis concentrates on an economy which is in equilibrium.
ii The input- output analysis is not applicable to partial equilibrium analysis.
iii. The input –output analysis does not concern itself with the demand analysis.
iv. Input- output analysis deals exclusively with technical problems of production.
v. Input –output analysis is based on empirical investigation.

SELF ASSESSMENT EXERCISE:
Highlight the basic features of input –output technique that you know.

3.3 Assumptions of the input –output technique.

This analysis is based on the assumptions highlighted as follows :

i. The whole economy is divided into two sectors i.e. inter- industry sector and final demand sector both being capable of sub-sectorial division.
ii. The total output of any inter- industry sector is generally capable of being used as inputs by other inter-industry sectors, by itself and by final demand sectors.
iii. No two products are produced jointly that is each industry produces only one homogenous products.
iv. Prices, consumer demands and factors supplies are given.
v. There are constant return to scale.
vi. There are no external economies or diseconomies of production.
vii. The combinations of inputs are employed in rigidly fixed proportions.
viii. The inputs remain in constant proportion to the level of output.
ix. There is no substitution between different materials and no technological progress.
x. There are fixed input coefficients of production.

SELF ASSESSMENT EXERCISE:

Highlight the main assumption of input-output technique known to you.

4.0 CONCLUSION

From our discussion so far on the meaning of input-output technique

We can conclude as follows:

- Input-output is defined as a formal model dividing the economy into sectors and tracing the flows of inter industry purchases (input) and inter industry sales (output). It is also known as inter-industry analysis.
- The input –output analysis concentrates on an economy which is in equilibrium. It is not applicable to partial equilibrium analysis and does not concern itself with the demand analysis.

5.0 SUMMARY

In this unit, we have attempted to show the meaning of input-output technique, covering what is input-output technique is all about, showing the essential features of input –output technique and highlighting the assumptions of the input –output technique. You have learnt that input-output model is also known as inter-industry model which rely solely on available industries for its workability. Your understanding of this unit should encourage you to be familiar more with the topics in this module as you read ahead against the next unit.

6.0 TUTOR-MARKED ASSIGNMENT

Discuss briefly the meaning and features of input-output technique.

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UNIT II INPUT – OUTPUT MODEL.

CONTENTS

1.0 INTRODUCTION

It is good that we have familiarized ourselves with what input-output analysis, technique or model is all about in the preceding unit which provides a basic foundational platform that we shall be looking at in this unit. In this unit, we shall be looking at the input-output model table, feasibility and consistency of the plan, input-output coefficients, the Leontief solution, the dynamic input- output model. An in-depth explanation of the above topics shall be provided. It is advisable that you critically concentrate as we move along with explanations that will be given.

2.0 OBJECTIVES

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

- Interprete, draw and decode the input-output table .
- Understand the Feasibility and consistency in planning .
- Understand the Matrix of technical coefficient of production calculations and the Leontief solutions.

3.0 MAIN CONTENTS

3.1 INPUT-OUTPUT TABLE.

The input- output table relates to the economy as a whole in a particular year. The table shows the values of the flows of goods and services between producstive sectorsd especially inter –industry flows. For proper understanding, a three (3) sector economy is taken in which there are two inter –industry sectors, agriculture and industry and one final demand sector. Look at the table below, it is called the input- output table which provides a simplified picture of such economy.

Table 2.1.

INPUT – OUTPUT TABLE.				
(in value terms) ("m").				
PURCHASING SECTORS				
SECTORS	Input in Agric	Input in Industry	Final Demand	Total Output/Revenue
Agriculture	50	150	100	300
Industry	100	250	150	500
Value added =N=	150	100	0	250
Total input or total cost	300	500	250	1050

Source: The Economics of Development and Planning, Jhingan M.L (2007)

Value added refers to payments to the factors of production.

In the above table 2.1, the total output of the industrial, agricultural and household sectors is set in rows and divided into the agricultural, industrial and final demand sectors. The inputs of these sectors are set in columns. Take a look at the first row total which shows that altogether the agricultural output is valued at 300 million per year. Out of this total 100 million go directly to final consumption i.e. individual household and government as shown in the third column of the first row. The remaining output from agriculture goes as inputs, 50 back to agriculture and 150 to industry .similarly, the second row shows the distribution of the total output of the industrial sector values at 500 million per year. Columns 1,2, and 3 show that 100 units of manufactured goods go as inputs to agriculture, 250 unit to industry itself and 150 unit for final consumption to the household sector. Let us take the columns "read it downward", the first column describe the input or cost structure of agriculture industry. Agricultural output valued at 300million is produced with the use of agricultural goods worth 50million, manufactured goods worth 100 and labour or management services valued at 150. In other words, it cost 300 million to get a revenue of 300million from the agricultural sector.(50+100+150 = 300). Similarly, the second column explains the input structure of the industrial sector i.e (150+ 250 +100 =500). The third column corresponding to this column is the final demand column which shows what is available for consumption and government expenditure. The third row corresponding to this column indicated zero. This implies that household sector is simply a spending (consuming) sectors that does not sell anything to itself. This means that labour is not directly consumed.

SELF ASSESSMENT EXERCISE:

Construct and briefly explain an input- output table showing a three sector inter industry flow of a three sector economy.

3.2 FEASIBILITY AND CONSISTENCY IN PLANNING.

It should be noted that a plan should have a level of feasibility and consistency for it to survive. An economy behaves and assumes a certain pattern of flows of resources in two ways which are:

1. The internal consistency or balance of each sector of the economy i.e. survival within the economy.
2. The external stability of each sector or inter- sectoral relationship i.e. survival outside the sector. This according to Leontief is regarded as "fundamental relationship of balance and structure". It is also known as "balance equations" and "structural equation"when expressed mathematically.

If the total output of say X_i of the ith industry is divided into various number of industries, 1,2,3, n, then we have the balance equation:

$X_i = x_{i1} + x_{i2} + x_{i3} + \text{------} x_{in} + Di$ ---------- (1)

and if we take into consideration, the amount say Yi absorbed by the "outside sector", the balance equation of the ith industry becomes.

$X_i = x_{i1} + x_{i2} + x_{i3} + \text{-------} x_{in} + D_i + Y_i$

OR

$\sum_{J=i} xij + Y_i = X_i$ ---------- (2)

It is to be noted that Y_i stands for the sum of the flows of the products of the ith industry, to consumption, investment exports and net of imports etc. It is also called the "final bill of goods" which is the function of the output to fill. The balance equation shows the conditions of equilibrium between demand and supply. It shows the flows of outputs and inputs to and from one industry to other industries and vice versa.

Let it be known to you that the system of balance equations in the analysis presents the conditions of internal consistency of a plan. The plan would not be feasible without them because if these equations are not satisfied, there might be excess of some goods and deficiency of others. Since x_{i2} stands for the amount absorbed by industry 2 of the ith industry, it follows that xij stands for the amount absorbed by the jth industry of ith industry. Thus the "input or technical coefficient" of the ith industry is denoted by:

$aij = \frac{xij}{Xj}$ --------- (3)

Where xij is the flow from industry I to industry j, xj is the total output of industry j and aij as already indicated above as a constant called technical coefficient shows the number of units of one industry's output that are required to produce one unit of another industry's output.

Equation (3) is called a structural equation which tells us that the output of one industry is absorbed by all industries so that the flow structure of the entire economy is revealed.

SELF ASSESSMENT EXERCISE:

Explain the term "consistency planning" with detailed example

3.3 MATRIX OF TECHNICAL COEFFICIENT OF PRODUCTION.

The matrix of technical coefficient of production for any input – output table with (n) sectors would consist of nXn elements. In our example, there are two sectors, which means a 2x2 technical coefficients of the matrix would be arranged symbolically as follows. Look at the table below

TABLE 2.2

TECHNOLOGY MATRIX A.		
	Agriculture	Industry
Agriculture	a_{11}	a_{12}
Industry	a_{21}	a_{22}

Source: The Economics of Development and Planning, Jhingan M.L (2007)

If we use equation (3) to calculate the aij for our example of the above two sector input- output table in 2.1, we will get the following technology matrix.

TABLE 2.3

TECHNOLOGY COEFFICIENT MATRIX A		
	Agriculture	Industry
Agriculture	50/300 = .17	150/500 = .30
Industry	100/300 = .33	250/500 = .50

Source: The Economics of Development and Planning, Jhingan M.L (2007)

To get these input coefficients, we will divide each item in the first column of table 2.1 by its row total, and each item in the second column by the second row and so on. You should understand that each column of the technological matrix reveals how much agricultural and industrial sectors require from each other to produce a naira's worth of agricultural output requires inputs worth 33 kobo from industries and worth 17 kobo from agriculture itself.

3.3.1 THE LEONTIEF SOLUTION

This is a solution that can be used to measure the direct and indirect effects on the entire economy of any sectoral change in total output of final demand. For the purpose of elaborate explanation, the above table can be utilized to measure these effects. We have the following.

Again using equation (3)

$$aij = \frac{xij}{x_i}$$

When you cross multiply we will have

$$xij = aij.\ X_i$$

By substituting the value of xij into equation (2) and transposing terms, we will obtain the basic input – output system of equations as follows.

$$x_i - \sum_{i=1} aij\ xj = Y_i$$

In terms of our two –sectors economy, there would be two linear equations that could be written symbolically as follows.

$x_1 - a_{11} x_1 - a_{12}x_2 = Y_1$

$x_2 - a_{21}x_1 - a_{22}x_2 = Y_2$

The above symbolic relationship can be shown in matrix form as follows

$X - [A]X = Y$

$X[I-A] = Y$

Where matrix (I-A) is known as the Leontief matrix

$(I-A)^{-1}(I-A)X = I(I-A)^{-1}Y$

$X = (I - A)^{-1} Y \; [\; (.: I - A)^{-1} (I - A)]$

Thus, we can have the identify matrix as follows i.e. I

$I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Hence, $[X_1] = [1\ 0] - [A]^{-1} [Y_1]$

$[X_2] = [0\ \ 1] \qquad [Y_2]$.

Therefore, to have a numerical solution, we will make use of our technology matrix table 2.3 thus

$A = \begin{bmatrix} .1 & .3 \\ .3 & .5 \end{bmatrix}$ and $Y = \begin{bmatrix} 100 \\ 150 \end{bmatrix}$

$(I - A) = \begin{bmatrix} .9 & -.3 \\ .3 & -.5 \end{bmatrix}$

The value of inverse = $\frac{\text{Adjoint}}{\text{Determinant}} = \frac{\text{Adj}}{[A]}$

$[Aij] = \begin{bmatrix} .5 & .3 \\ .3 & .9 \end{bmatrix}$

By transposing we will have:

$Aij = \begin{bmatrix} .5 & .3 \\ .3 & .9 \end{bmatrix}$

The value of determinant will now be

$= .9(.5) - (-.3)(-.3)$

$= .45 - .09 = .36$

Hence $[X1] = \frac{1}{.36} \begin{bmatrix} .5 & .3 \\ .3 & .9 \end{bmatrix} \begin{bmatrix} 100 \\ 150 \end{bmatrix}$.

Thus, the total of agricultural sector (x_1) will be equal to

$= .5x100 + .3x150 / .36 = 264.$

The total output of industrial sector (x_2) as well will be

$= .3x100 + .9x150/.36 = 458.$

SELF ASSESSMENT EXERCISE:

Explain your understanding of the Leontief solution using any numerical values for your explanations.

4.0 CONCLUSION

From our discussion so far on the input-output table analysis

We can conclude as follows:

- Value added refers to payments to the factors of production. From the table , the total output of the industrial, agricultural and household sectors are set in rows while the agricultural ,industrial and final demand sectors inputs of these sectors are set in columns.
- A plan should have a level of feasibility and consistency for it to survive. An economy behaves and assumes a certain pattern of flows of resources through internal and external consistency or balance of each sector of the economy.

5.0 SUMMARY

In this unit, we have seen the input-output technique table `, the Feasibility and consistency in planning and the Matrix of technical coefficient of production calculations and the Leontief solutions.

You have learnt the workings of input-output model using matrix algebral. Your understanding of this unit will usher you into the next unit which discuss the uses, limitations and importance of input-output technique to economic planning. I expect you to read ahead against the next unit.

6.0 TUTOR-MARKED ASSIGNMENT

Discuss your understanding of Feasibility and consistency in planning.

7.0 REFERENCES/FURTHER READING

Akosile, I. O., Adesanya, A. S. & Ajani, A. O. (2012). Management of development (A Nigeria perspective),1st edition Olas Ventures, Mushin, Lagos. Nigeria

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UNIT III USES, LIMITATIONS, AND IMPORTANCE OF INPUT –OUTPUT TO PLANNING.

CONTENTS

1.0 INTRODUCTION

In this unit, attention will be given to the uses of input- output analysis technique in planning, limitations of the input- output technique to planning and the importance of input-output technique to the planning of less developed countries like Nigeria.

2.0 OBJECTIVES

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

- Know the uses of input-output analysis in plan formulations .
- Highlight the limitations and problems of input-output analysis .
- Understand the significance of input-output model in development planning as listed by the United Nations.

3.0 MAIN CONTENTS

3.1 Uses of input – output models in development planning formation.

The following are the uses of input –output analysis.

1. They provide for individual branches of the economy's estimates of production and import levels. That are consistent with each other and with the estimates of final demand.
2. The solution to the model aids in the allocation of the investment required to achieve the production levels in the programme and it provides a more accurate test of the adequacy of available investment resources.
3. Since inputs are considered proportional to outputs, this technique helps in determining the amount of inter- industry flows of goods and services in less developed countries.
4. It helps in reducing the need for collecting and computing vast statistical data since constant flow and capital coefficients has been assumed.
5. It helps in identifying a moving equilibrium of outputs

6. It helps the planner to see more clearly the implications of raising the level of investment in a particular sector given the requirements of inter –sectoral balancing.
7. It is also used for national economic planning of a nation.
8. It provides the necessary information about the structural coefficients of the various sectors of the economy during a period of time which can be utilized for the optimum allocation of the economy's resources towards a desired end.
9. The dynamic model is particularly helpful in a developing economy to determine the impact of different growth rates of the various sectors of the economy and thus choose the most desired one.

SELF ASSESSMENT EXERCISE:
Mention at least seven uses of input-output model to economic development planning of a nation.

3.2 Limitations and problems of input - output Analysis.

There is no useful model that does not have its own limitations or short comings. So is the case of input-output model as well. The following are the limitations and short comings or problems of input-output model.

1. Its framework rests on Leontief's basic assumption of constancy of input co-efficient of production which was split up above as constant returns to scale and technique of production which holds good in a stationary economy and constant technique of production in stationary technology.
2. It does not treat the inter- industry analysis dynamically.
3. It tells us nothing as to how technical coefficients would change with changed conditions.
4. Some industries may have identical capital structures, some may have heavy capital requirements while others may use no capital, such variations make the assumption of constant co-efficients of production unrealistic.
5. The assumption of fixed co-efficients of production ignores the possibility of factor substitution.
6. The assumption of linear equations, which relates outputs of one industry to inputs of others, appears to be unrealistic, since factors are mostly indivisible, increase inputs.
7. The input- output model cannot reflect increasing costs due to its rigidity bottlenecks.
8. It does not tells us why the inputs and outputs are of a particular pattern in the economy because of its restriction on production side of the economy.
9. It fails to utilize all the factors proportionately or need more than their available supply.
10. There is no mechanism for price adjustment in the input/output analysis which makes it unrealistic.
11. The input / output model thrives on equations that cannot be easily arrived at therefore making it difficult and abstract.
12. Large reliable data are not always available in many less developed countries to construct input - output table.

13. In smaller countries, only few industries or sectors exist and the input / output table is of little use.
14. In case of a subsistence agricultural sector, labour is the only input, and output sold in the market sectors is insignificant while commercial crops are sold to the consumption sector which does not need the input / output table.
15. It is only useful in a large economy where the number of industries or sectors is large for inter industry transactions to take place and for reliable statistical information to be available.

SELF ASSESSMENT EXERCISE:

Enumerate the problems or limitations of input -output analysis known to you.

3.3 SIGNIFICANCE OF INPUT - OUTPUT MODELS IN DEVELOPMENT. PLANNING AS LISTED BY UNITED NATION'S STUDIES.

The united nations identified and listed some significance of input - output models in development planning. These are highlighted below.

1. The U.N. posits that the analysis of import requirements and substitution possibilities is facilitated by the knowledge of the use of domestic and imported material in different branches of the economy.
2. The U.N stated that, In addition to direct requirements of capital, labour, and imports, the indirects requirements in other sectors of the economy can also be estimated.
3. Another major significance of input / output models in development planning as posited by the United Nations study was that they provide for individual branches of the economys estimates of production and import levels that are consistent with each other and with the estimates of final demand.
4. The U.N also highlighted that the solution to the model aids in the allocation of the investment required to achieve the production levels in the programme and provides a more accurate test of the adequacy of available investment resources.
5. The requirements for skilled labour can be evaluated for planning purposes to explore the implications of development programmes for the particular region concerned as well as for the economy as a whole.
6. They are primarily applicable in economics that have achieved a certain degree of industrial development and thus have a substantial volume of inter industry transactions.
7. They are significant and useful for national economic planning.

4.0 CONCLUSION

From our discussion so far on the Uses, limitations and importance of input-output analysis to planning. We can conclude that:

The uses of input-output model were that they provide for individual branches of the economy's estimates of production and import levels, that are consistent with each other and with the estimates of final demand. Since inputs are considered proportional to outputs, this technique helps in determining the amount of inter- industry flows of goods and services in less developed countries.

5.0 SUMMARY

In this unit, we have examined the uses of input- output analysis technique in planning, limitations or problems of the input- output technique to planning and the importance of input-output technique to the planning of less developed countries as listed by the United Nation. It can therefore be concluded that input-output analysis are significant and useful for national economic planning . I strongly believe that your understanding of this unit and module will usher us into the next module which discusses the Social Accounting Matrix. I expect you to read ahead as you prepare for the next module.

6.0 TUTOR-MARKED ASSIGNMENT

Enumerate and discuss the problems or limitations of input -output analysis known to you .

7.0 REFERENCES/FURTHER READING

Akosile, I. O., Adesanya, A. S. & Ajani, A. O. (2012). Management of development (A Nigeria perspective),1st edition Olas Ventures, Mushin, Lagos. Nigeria

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MODULE 3

SOCIAL ACCOUNTING MATRIX , GENERAL EQUILIBRIUM AND COMPUTABLE GENERAL EQUILIBRIUM MODELS OF ECONOMIC PLANNING

Unit 1 Social accounting matrix technique of economic planning
Unit II General equilibrium model of economic planning
Unit III Computable General equilibrium model of economic planning

UNIT 1 SOCIAL ACCOUNTING MATRIX TECHNIQUE OF ECONOMIC PLANNING

CONTENTS

1.0 Introduction:

Our discussions from preceding modules had introduced to us what we need to know about models used in proper economic planning of nations. There is no country, whether developed or Less developed that has not in one way or the other made use of models that is useful for their economic plan. Another model or models that we will be concerned with in this module is the Social Accounting Matrix, Computable general equilibrium and the general equilibrium models. Therefore,our discussion in this module will describe the basic structure of social accounting matrix, Computable general equilibrium and the general equilibrium and investigates how they are used in macroeconomic planning of Less Developed Countries of which Nigeria is one. In this unit, we shall be looking at the Social Accounting Matrix, its structure and its usefulness to effective economic planning of nations.

2.0 OBJECTIVES

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

- Define what Social Accounting Matrix (SAM) is as scholarly established in your own words.
- Know the origin and structure of Social accounting matrix .
- Identify the uses of Social accounting matrix for macroeconomic planning of developing nations.

3.0 MAIN CONTENTS

3.1 What is Social Accounting Matrix (SAM)?

"A social accounting matrix is simply defined as a single entry accounting system whereby each macroeconomic account is represented by a column for outgoings and a row for incomings"

Round (1981), Social Accounting Matrix (SAM) is a technique related to national income accounting, providing a conceptual basis for examining both growth and distributional issues within a single analytical framework in an economy. It can be seen as a means of presenting in a single matrix the interaction between production, income, consumption and capital accumulation. Although a number of SAM's were developed for a number of developing countries in the 1970s, since the 1980 and 1990s, there has been an increasingly growing interest in the designing, constructing and use of SAM in these countries especially in the 20^{th} century. It is represented in the form of a square matrix with rows and columns, which brings together data on production and income generation as generated by different institutional groups and classes, on the one hand, and data about expenditure of these incomes, by them on the other.

In a SAM, incomings are indicated as receipts for the row accounts in which they are located and outgoings are indicated as expenditure for their column accounts. Since all incomings must be, in a SAM, accounted for by total outgoings, the total of rows and columns must be equal for a given account.

Taylor (1983) sees the SAM as a tabular presentation of the mask in Macroeconomic Policy and Planning in Developing Countries accounting identities, stating that incomings must be equal to outgoings for all sectors of the economy.

Let it be known to you that SAM is a data system, including both social and economic data for an economy. The data sources for a SAM, comes from input-output tables, national income statistics, and household income and expenditure statistics. Therefore, a SAM is broader than an input-output table and typical national account, showing more detail about all kinds of transactions within an economy. However, an input-output table records economic transactions alone irrespective of the social background of the transactors.

A SAM, on the contrary in the national accounts, "... attempts to classify various institutions to their socio-economic backgrounds instead of their economic or functional activities" Chowdhury & Kirkpatrick (1994).

A SAM is a way of logical arrangement of statistical information, concerning income flows in a country's economy within a particular time period (usually a year). It can

provide a conceptual basis to analyse both distributional and growth issues within a single framework. For instance, a SAM shows the distribution of factor incomes of both domestic and foreign origin, over institutional classes and re-distribution of income over these classes. In addition, it shows the expenditure of these classes on consumption, investment and savings made by them.

According to King (1988) he points out that a SAM has two main objectives. Firstly, organising information about the economic and social structure of a country over a period of time and secondly, providing statistical basis for the creation of a plausible model capable of presenting a static image of the economy along with simulating the effects of policy interventions in the economy.

In the same vein, a Social Accounting Matrix (SAM) is a summary table, which refers to a given period, representing the production process, income distribution and redistribution which occurs between sectors, factors of production, actors in an economic system and the "Rest of the World" (ROW), meaning, all actors outside the economic system were being studied.

SAM represents the whole economic system, it highlights the inter-linkages and the circular flow of payments and receipts among the different components of the system such as goods, activities, factors, and institutions. SAM has three main aims;

1) organise the information on the social and economic structure of a country for a given period;
2) provide a synoptic view of the flows of receipts and payments in an economic system; and
3) form a statistical basis for building models of the economic system, with a view to use this to simulate the socio-economic impact of policies.

SELF ASSESSMENT EXERCISE:

What do you understand by Social Accounting Matrix?

3.2 Origin and Structure of Social Accounting Matrix

As you know that there is no invention without an inventor that is the originator of the said invention, the same is applicable to Social Accounting Matrix. Social Accounting Matrices were originally developed at the “Cambridge Growth Project” in Cambridge, UK, which developed the first SAM in 1962, Stone and Brown (1962). They were built as a matrix representation of the national account, and came to the World Bank with Graham Pyatt in the 1960s. Pyatt left Cambridge and developed SAMs, mainly at the World Bank together with the leading proponents and developers of SAMs named Erik Thorbecke.

By the early 1980s, Computable General Equilibrium (CGE) models were heavily used as the approach of the World Bank for development analysis. Social Accounting Matrices (SAMs) were similarly a mainstay of Bank analysis, which had been adopted as a presentational device by the CGE modelers" Mitra-Kahn, (2008). It is therefore important for us to look at its structure and how it is arranged.

Let us look at it from an accounting perspective, the SAM is a two-entry square table which presents a series of double-entry accounts whose receipts and outlays are recorded

in rows and columns respectively. According to Lorenzo(2012), accounts usually refer to the following:

a) **Goods and services:** these accounts depict the origin of final goods available in the economic system (production activities and imports) and their destination (activities as intermediate inputs and institutions.
b) **Production activities:** these are basically the production activities of the economy being analysed and generally refer to the defined sectors.
c) **Factors of production:** these accounts depict receipts from productive activities, which pay for factor services, and payments to institutions, which provide those services. They are usually distinguished in labour and capital, but may refer also to natural resources, such as land and water.
d) **Institutions i.e. (economic agents):** , normally comprising households, companies(corporations) and the government. These accounts record incomes of institutions along the rows and expenditure on the columns.
e) The capital account or saving-investment or accumulation account, which records allocation of resources for capital formation and use of these resources for the purchase of investment products and building up stocks of goods.
f) **The rest of the world account or external account**, in which the row records payments received by the rest of the world from the economic system and the column records the outlays of the rest of the world towards the economic system.

Each category is then normally split into several more detailed accounts which will be shown in specific rows and columns.

Here, it must be stressed that the sequence of accounts in rows and columns are identical. Regarding recording different flows in one SAM, all receipts from an account are recorded in one row (i) and expenditure in one column (j). In this way, all monetary flows (sij) in a cell

SAM's are square in nature that is (columns equal rows) in the sense that all institutional agents (Firms, Households, Government and 'Rest of Economy' sector) are both buyers and sellers. Columns represent buyers (expenditures) and rows represent sellers (receipts). SAM's were created to identify all monetary flows from sources to recipients, within a disaggregated national account. The SAM is read from column to row, so each entry in the matrix comes from its column heading, going to the row heading. Finally columns and rows are added up, to ensure accounting consistency, and each column is added up to equal each corresponding row. In the illustration below for a basic open economy, the item C (consumption) comes from Households and is paid to Firms.

Figure 3.1

Illustrative Open Economy SAM:

	Goods & Services (1)		Production activities (2)	Factors (3)		Resident Information (4)			Savings Investments (5)	(Row) Rest of the world (6)	TOTAL
				Labour	Capital Services	Household	Firms	Public Sector			
Goods and Services (1)	Trade/Transport Margin		Intermediate Consumption			Final cons. Hous.		Final cons. of P.S	Investment & various stocks	Export	Demand of goods
Productions Services (2)	Domestic Production										Inflows of activities
Factors (3)	Labour		Wages & Salaries							Labour income from ROW	Labour incomes
	Capital		Earn b. Taxes (EBT)								Capital incomes
Residents Institutions (4)	Household			Wages & Salaries		Intra house transfers	Distributed profits	Transfer to households		Transfer from ROW	Household incoming
	Firms				Earn b. Taxes (EBT)					Transfer from ROW	Firm incomes
	Public Sector	Taxes on goods & services	Taxes on activities			Taxes on social securities	Taxes	Transfer within P.S	Budget deficit	Transfer from ROW	PS Incomes
Saviings Investment (5)	Decreases of stocks		Depreciation of capital			Savings of household	Savings of firms	Budget surplus		Deficit balance of payments	Financial Resources
(Row) Rest of the World (6)	Imports			Remuneration of extra labour		Transfer to ROW	Transfer to ROW	Transfer to ROW	Surplus balance of payments		Outlays to ROW
TOTAL	Supply of goods & services		Domestic production	Payment for labour	Payment for capital services	Household expenditures	Use of EBT	Public Expenditures	Total Investments	Payments of ROW	

Source: Food and Agriculture Organisation of the United Nations 2012

For the purpose of understanding the interpretation of the SAM in the above figure, we will analyse the flows of receipts (reading per account row) and payments (reading per account column) of each account compared to the next. Only the first two rows and columns will be explained because the same applies to the remaining rows and columns.

3.2.1 READING THE ROWS

Goods and services accounts (row 1)
The rows for goods and services accounts, record payments made at market prices, which include indirect taxes (VAT etc.) due to intermediate consumption of production activities, end consumption by households, the government and investment, represented by changes in stock, and gross fixed capital formation and exports.

Activity accounts (row 2)
If we read production activity accounts, by row, we can see that activities receive payments for: goods and services produced (output from domestic production activities), net of tax and product subsidies; export subsidies and exported goods and services. These elements make up the total production value. You can carefully analyse the rest using the information we have in the figure .

3.2.2 READING THE COLUMNS
By reading the matrix column by column, the payments made by each account to other accounts can be identified. Only the first two columns are analysed because the same applies to the remaining columns

Goods and services accounts payments (column 1)
Goods and services pay the value of goods and services produced by activities (domestic production) into the activities accounts and pay the value of imported products to the rest of the world account. This account also records payments due to net stock reductions of goods held in stock (negative changes in stock over the period being analysed). The prices used for evaluating goods and services are market prices, which include indirect taxes but exclude consumption subsidies.

Activities accounts payments (column 2)
This column represents the account for domestic production activities. Activities pay: intermediate consumption to the goods and services accounts, labour and capital services to the factors accounts, indirect taxes (VAT) to public administration and physical capital consumption (depreciation) to the capital account. You can carefully analyse the rest using the information we have in the figure above .

3.2.3 THE DIFFERENT BLOCKS IN SAM
According to Lorenzo(2012), the different blocks of the SAM are made up of intermediate consumption, added value, production, end consumption, salaries and profits paid out to institutions, imports and exports, transfers, gross fixed capital formation and taxes.

a) The intermediate consumption block

All purchases made by the activities of intermediate consumption goods and services for use in their production process. In the SAM, they are translated into monetary flows of the production activities accounts to the various goods and services accounts.

b) Value Added

The value added block refers to payment of factors of production. This payment comprises salaries and capital payment (machines, buildings and other equipment). In general, the value added for each production activity is calculated by taking the difference between the value of total production shown in the total row and the value of intermediate consumption used. The value added is shown in the SAM by monetary flows from production activity accounts in columns to the labour and capital accounts in rows.

c) Domestic sales

This block deals with payments made from the goods and services accounts to production activities accounts. These domestic sales refer to the share of goods and services intended for the domestic market; exports of goods and services are therefore not included.

d) End consumption

This block covers household and State expenditure on food, non-food products and services for end consumption. In the SAM, end consumption is shown by monetary flows from household and State accounts to accounts of consumed goods and services.

e) Imports and exports

This refers to all agricultural and non-agricultural products traded abroad. In the SAM, imports are represented by payments made by imported goods and services accounts to the rest of the world account. Exports are represented by monetary flows from the rest of the world account to the exported goods and services accounts.

f) Salaries and profits

This refers to all monetary flows from factors of production accounts to household accounts. They are made up salaries received in exchange for work and as revenue from capital.

g) Transfers

They represent monetary flows which exist between the various institution accounts. These are payments between household accounts, payments from corporate accounts to household accounts, payments from the State account to household accounts and corporate accounts, payments from the Rest of the World account (emigrates) to household account and payments from household accounts to the rest of the world account.

h) Gross capital formation

This refers to all payments made by the savings and investments account to the goods and services account. It is made up of changes in stock and of GFCF.

i) Taxes

These are payments without anything in form of exchange which household, corporate and goods and services accounts make to the State account. They are made up of general income tax, of production taxes (VAT), income and earnings taxes (corporate tax and

income tax), local taxes (patents, urban taxes and council tax), registration fees and stamp duty and other payments without anything directly being exchanged.

Let us look at Table 3.1 below which shows a SAM of a simple 2-sector economy (agriculture and industry) and two institutions (households and government).
The values are expressed in **Monetary Units (MU)**.

Table 3.1

A simple SAM (matrix S)					
	Agriculture	**Industry**	**Household**	**Government**	**Total**
Agriculture	50	20	25	15	110
Industry	30	30	15	5	80
Households	20	10	0	15	45
Government	10	20	5	2	37
Total	110	80	45	37	272

Source: Food and Agriculture Organisation of the United Nations (2012)

If we look at matrix S, column by column, it can be seen that to produce 110 mu of output, the agricultural sector must pay 50 mu to the agricultural sector and 30 mu to the industrial sector for intermediate consumption. It must also pay 20 mu in salaries to households and 10 mu in taxes to the government (see "Agriculture" column).
Similarly, the industrial sector, in order to produce 80 mu of output, must pay 20 mu to the agricultural sector and 30 mu to the industrial sector for intermediate consumption. Furthermore, it must pay 10 mu in salaries to households and 20 mu in taxes to the government. (see "Industry" column).
The third column shows household expenditure. Households spend 25 mu in final consumption of agricultural products, 15 mu of industrial products and pay 5 mu in taxes.
The fourth column shows government expenditure: 15 mu are allocated to the agricultural sector and 5 mu to the industrial sector through subsidies for production. Additionally, 15 mu are transferred to households (for example, in the form of transfers as income support for poor households). Finally,2mu are made as an internal transfer to the public administration.
In mathematical terms, this is defined as follows:
a) SAM elements. Each element in matrix S is indicated S ij , where i = 1,2,.....n ; is the
row index, j = 1,2,.....n is the column index. For example, for SAM in figure 2, where i = 1,2,3,4 and j = 1,2,3,4 , s_{22}= 30 , s_{13}= 25.

Table 3.2

	Agriculture	Industry	Household	Government	Total
Agriculture	S_{11} 50	S_{12} 20	S_{13} 25	S_{14} 15	110
Industry	S_{21} 30	S_{22} 30	S_{23} 15	S_{24} 5	80
Households	S_{31} 20	S_{32} 10	S_{33} 0	S_{34} 15	45
Government	S_{41} 10	S_{42} 20	S_{43} 5	S_{44} 2	37
Total	110	80	45	37	272

Source: Food and Agriculture Organisation of the United Nations (2012)

b) Column sums $S_{.j} = \sum$ sij are the column totals. In our example, $S_{.1} = 110$, $S_{.2} = 80$, $S_{.3} = 45$, S.37

(c) Row sums $S_{i.} = \sum$ sij are the row totals,
In our example, $S_{1.}=110$, $S_{2.} = 80$, $S_{3.} = 45$, $S_{4.} =37$
As already mentioned, for a given K account, expenditure is equal to receipts and is shown by the fact that the sum of row is equal to sum of column as shown in the formula below.

$$\sum S_{ih} = \sum S_{hj}$$

i.e $S_{.h} = S_{h.}$

If you divide each element in matrix S, Sij by the total of the corresponding column S.j, you will get the column ratios or coefficients $C_{ij} = \frac{S_{ij}}{S_{.j}}$

Figure 3.2

Therefore, you will have the following matrix C:

$$\begin{vmatrix} C_{11} = \frac{S_{11}}{S_{.1}} = \frac{50}{110} & C_{12} = \frac{S_{12}}{S_{.2}} = \frac{20}{80} & C_{13} = \frac{S_{13}}{S_{.3}} = \frac{15}{45} & C_{14} = \frac{S_{14}}{S_{.4}} = \frac{15}{37} \\ C_{21} = \frac{S_{21}}{S_{.1}} = \frac{30}{110} & C_{22} = \frac{S_{22}}{S_{.2}} = \frac{30}{80} & C_{23} = \frac{S_{23}}{S_{.3}} = \frac{15}{45} & C_{14} = \frac{S_{24}}{S_{.4}} = \frac{5}{37} \\ C_{31} = \frac{S_{31}}{S_{.1}} = \frac{20}{110} & C_{32} = \frac{S_{32}}{S_{.2}} = \frac{10}{80} & C_{13} = \frac{S_{33}}{S_{.3}} = \frac{0}{45} & C_{14} = \frac{S_{34}}{S_{.4}} = \frac{15}{37} \\ C_{41} = \frac{S_{341}}{S_{.1}} = \frac{10}{110} & C_{42} = \frac{S_{42}}{S_{.2}} = \frac{20}{80} & C_{43} = \frac{S_{43}}{S_{.3}} = \frac{5}{45} & C_{44} = \frac{S_{44}}{S_{.4}} = \frac{2}{37} \end{vmatrix}$$

The result of the above is presented in the table below which shows the coefficients of one sector to the other sector. From the coefficients, economic planners can now forecast their plans for effective planning.
Therefore, the column coefficients matrix (matrix c) will be:

Table 3.3

	Agriculture	**Industry**	**Household**	**Government**
Agriculture	0.455	0.250	0.556	0.405
Industry	0.273	0.375	0.333	0.135
Household	0.182	0.125	0.000	0.4**05**
Government	0.091	0.250	0.111	0.054
Total	1.000	1.000	1.000	1.000

Source: Food and Agriculture Organisation of the United Nations 2012

SELF ASSESSMENT EXERCISE:
Elucidate more on the history and origin ofsocial accounting matrix.

3.3 USES OF SOCIAL ACCOUNTING MATRIX FOR MACROECONOMIC PLANNING:

The SAM is an approach for data organisation, reconciliation, and descriptive analysis of the structure of the economy. "The most important feature of a social accounting matrix is that it provides a consistent and convenient approach to organising economic data for a country and it can provide a basis for descriptive analysis and economic modelling in order to answer various economic policy questions" Pleskovic & Trevino (1985). A SAM can be used for Macroeconomic planning in two ways: firstly, a SAM can provide a framework for the organisation of information related to economic and social structures of a country's economy. Secondly, a SAM can serve as a database for a model of the economy under consideration. Other importance of SAM are discussed below.

1. A SAM provides comprehensive one-period information on variables, such as the structure, composition and the level of production, the distribution of income among households, and the factorial value-added.

2. It can provide statistical information on consumption and production pattern of the economy, imports, exports, investment and so on. Moreover, it may have more detailed information, depending on the data availability and particular interest, on income distribution, tax structure and monetary variables.

3 SAM can be used to improve the capabilities of countries to obtain descriptive analysis of the economy, indicating its income distribution picture, institutional and industrial structure. In a SAM, the information which takes place in public sector statistics is represented as a component of the whole economy.

4. SAM can thus provide a comparison opportunity the public sector with either the private sector or the economy as a whole.

5. A SAM can also be used as a database for macroeconomic policy modelling in developing countries. Its framework may contribute to arrangement of different sources of data in a consistent manner. Different sources of data, such as national accounts,

taxation data, household surveys, input-output tables, can be arranged into an economy-wide data framework. In most LDCs economic planning suffers from a number of problems such as insufficient, unreliable and poor quality of data.

SELF ASSESSMENT EXERCISE:

Discuss at least six uses of Social accounting matrix to a nation's economic planning.

4.0 CONCLUSION

From our discussion so far on Social accounting matrix technique of Economic Planning, we can deduce the following facts:

That SAM can be seen as a means of presenting in a single matrix the interaction between production, income, consumption and capital accumulation and that SAM can provide a framework for the organisation of information related to economic and social structures of a country's economy and can as well serve as a database for a model of the economy under consideration.

5.0 SUMMARY

In this unit, we have attempted to show what Social accounting matrix , its origin and structures, as well as the uses of the technique for economic planning is all about from various scholars of repute. Also, from the point of view of harmonization, you have learnt that SAM can provide a framework for the organisation of information related to economic and social structures of a country's economy and can as well serve as a database for a model of the economy under consideration. I belief your understanding of this unit has given you a basis to understand the next unit. I expect you by now to be anxious of reading more about computable general equilibrium model which will be duly served in the next unit.

6.0 TUTOR-MARKED ASSIGNMENT

Discuss the meaning and uses of Social accounting matrix technique in economic development planning.

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UNIT II GENERAL EQUILIBRIUM MODEL OF ECONOMIC PLANNING

CONTENTS

I.0 INTRODUCTION

Having studied critically the concept of social accounting matrix and its usefulness in the economic planning of developing nations, it is imperative to familiarise you with the topic to be discussed in this unit. There is no country, whether developed or Less developed that has not in one way or the other made use of models that is useful for their economic plan. Another model that we will be concerned with in this unit is the general equilibrium models. Therefore, our discussion in this unit will describe the overview and modern concept of General equilibrium theory in economics, ascertain the Properties and characterization of general equilibrium analysis and discuss the unresolved problems in general equilibrium analysis to check how they are used in macroeconomic analysis of Less Developed Countries of which Nigeria is one.

2.0 OBJECTIVES

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

- Understand the overview and modern concept of General equilibrium theory in economics
- Ascertain the Properties and characterization of general equilibrium analysis
- Discuss the unresolved problems in general equilibrium analysis

3.0 MAIN CONTENTS

3.1 Overview and modern concept of General equilibrium theory in economic problem

According to Scarf (2008), in economics, general equilibrium theory attempts to explain the behavior of supply, demand, and prices in a whole economy with several or many interacting markets, by seeking to prove that a set of prices exists that will result in an overall (or "general") equilibrium. General equilibrium theory contrasts to partial equilibrium, which only analyzes single markets. As with all models, this is an abstraction from a real economy; it is proposed as being a useful model, both by

considering equilibrium prices as long-term prices and by considering actual prices as deviations from equilibrium.

General equilibrium theory both studies economies using the model of equilibrium pricing and seeks to determine in which circumstances the assumptions of general equilibrium will hold. The theory dates to the 1870s, particularly the work of French economist Léon Walras in his pioneering 1874 work Elements of Pure Economics.

It is often assumed that agents are price takers, and under that assumption two common notions of equilibrium exist: Walrasian (or competitive) equilibrium, and its generalization; a price equilibrium with transfers.

Broadly speaking, general equilibrium tries to give an understanding of the whole economy using a "bottom-up" approach, starting with individual markets and agents. Macroeconomics, as developed by the Keynesian economists, focused on a "top-down" approach, where the analysis starts with larger aggregates, the "big picture". Therefore, general equilibrium theory has traditionally been classified as part of microeconomics.

The difference is not as clear as it used to be, since much of modern macroeconomics has emphasized microeconomic foundations, and has constructed general equilibrium models of macroeconomic fluctuations. General equilibrium macroeconomic models usually have a simplified structure that only incorporates a few markets, like a "goods market" and a "financial market". In contrast, general equilibrium models in the microeconomic tradition typically involve a multitude of different goods markets. They are usually complex and require computers to help with numerical solutions. Jean-Pascal (1990)

In a market system the prices and production of all goods, including the price of money and interest, are interrelated. For example, a change in the price of one good, say bread, may affect another price, such as bakers' wages. If bakers differ in tastes from others, the demand for bread might be affected by a change in bakers' wages, with a consequent effect on the price of bread e.g sweet sensation bread and mr biggs bread. Calculating the equilibrium price of just one good, in theory, requires an analysis that accounts for all of the millions of different goods that are available.

The first attempt in neoclassical economics to model prices for a whole economy was made by Léon Walras. Walras' *Elements of Pure Economics* provides a succession of models, each taking into account more aspects of a real economy (two commodities, many commodities, production, growth, money).

In particular, Walras's model was a long-run model in which prices of capital goods are the same whether they appear as inputs or outputs and in which the same rate of profits is earned in all lines of industry. This is inconsistent with the quantities of capital goods being taken as data. But when Walras introduced capital goods in his later models, he took their quantities as given, in arbitrary ratios. (In contrast, Kenneth Arrow and Gérard Debreu continued to take the initial quantities of capital goods as given, but adopted a short run model in which the prices of capital goods vary with time and the own rate of interest varies across capital goods.)

Walras was the first to lay down a research program much followed by 20th-century economists. In particular, the Walrasian agenda included the investigation of when equilibria are unique and stable. Walras' shows neither uniqueness, nor stability, nor even existence of an equilibrium is guaranteed and also proposed a dynamic process by which general equilibrium might be reached, like that of the tâtonnement or groping process.

The tatonnement process is a model for investigating stability of equilibria. Prices are announced (perhaps by an "auctioneer"), and agents state how much of each good they would like to offer (supply) or purchase (demand). No transactions and no production take place at disequilibrium prices. Instead, prices are lowered for goods with positive prices and excess supply. Prices are raised for goods with excess demand. The question for the mathematician is under what conditions such a process will terminate in equilibrium where demand equates to supply for goods with positive prices and demand does not exceed supply for goods with a price of zero. Walras was not able to provide a definitive answer to this question.

3.1.1 Current concept of general equilibrium theory in economics

The modern conception of general equilibrium is provided by a model developed jointly by Kenneth Arrow, Gerard Debreu, and Lionel W. McKenzie in the 1950s. Debreu presents this model in *Theory of Value* (1959) as an axiomatic model, following the style of mathematics promoted by Nicolas Bourbaki. In such an approach, the interpretation of the terms in the theory (e.g., goods, prices) is not fixed by the axioms. Geanakoplos(1987)

Three important interpretations of the terms of the theory have been often cited. Firslyt, suppose commodities are distinguished by the location where they are delivered. Then the Arrow-Debreu model is a spatial model of, for example, international trade.

Secondly, suppose commodities are distinguished by when they are delivered. That is, suppose all markets equilibrate at some initial instant of time. Agents in the model purchase and sell contracts, where a contract specifies, for example, a good to be delivered and the date at which it is to be delivered. The Arrow–Debreu model of inter temporal equilibrium contains forward markets for all goods at all dates. No markets exist at any future dates.

Thirdly, suppose contracts specify states of nature which affect whether a commodity is to be delivered: "A contract for the transfer of a commodity now specifies, in addition to its physical properties, its location and its date, an event on the occurrence of which the transfer is conditional. This new definition of a commodity allows one to obtain a theory of risk free from any probability concept.

Some of the recent work in general equilibrium has in fact explored the implications of incomplete markets, which is to say an inter-temporal economy with uncertainty, where there do not exist sufficiently detailed contracts that would allow agents to fully allocate their consumption and resources through time. While it has been shown that such economies will generally still have an equilibrium, the outcome may no longer be Pareto optimal. The basic intuition for this result is that if consumers lack adequate means to transfer their wealth from one time period to another and the future is risky, there is nothing to necessarily tie any price ratio down to the relevant marginal rate of substitution, which is the standard requirement for Pareto optimality. Under some conditions the economy may still be constrained Pareto optimal, meaning that a central authority limited to the same type and number of contracts as the individual agents may not be able to improve upon the outcome, what is needed is the introduction of a full set of possible contracts. Hence, one implication of the theory of incomplete markets is that inefficiency may be a result of underdeveloped financial institutions or credit constraints faced by some members of the public. Research still continues in this area.

SELF ASSESSMENT EXERCISE

Briefly discuss the contributions of any economic scholar you know to the application of General equilibrium model to economic planning problems.

3.2 Properties and characterization of general equilibrium model

Basic questions in general equilibrium analysis are concerned with the conditions under which equilibrium will be efficient, which efficient equilibria can be achieved, when equilibrium is guaranteed to exist and when the equilibrium will be unique and stable. For us to know this, we shall look at the following

a) First Fundamental Theorem of Welfare Economics

The First Fundamental Welfare Theorem asserts that market equilibria are Pareto efficient. In a pure exchange economy, a sufficient condition for the first welfare theorem to hold is that preferences be locally non satiated. The first welfare theorem also holds for economies with production regardless of the properties of the production function. Implicitly, the theorem assumes complete markets and perfect information. In an economy with externalities, like Nigeria for example, it is possible for equilibria to arise that are not efficient.

This theorem is informative in the sense that it points to the sources of inefficiency in markets. Under the assumptions above, any market equilibrium is tautologically efficient. Therefore, when equilibria arise that are not efficient, the market system itself is not to blame, but rather some sort of market failure.

b) Second Fundamental Theorem of Welfare Economics

While every equilibrium is efficient, it is clearly not true that every efficient allocation of resources will be an equilibrium. However, the second theorem states that every efficient allocation can be supported by some set of prices. In other words, all that is required to reach a particular outcome is a redistribution of initial endowments of the agents after which the market can be left alone to do its work. This suggests that the issues of efficiency and equity can be separated and need not involve a trade-off. The conditions for the second theorem are stronger than those for the first, as consumers' preferences now need to be convex (convexity roughly corresponds to the idea of diminishing rates of marginal substitution, or to preferences where "averages are better than extrema"). Further up, the Second Fundamental Theorem of Equilibrium Analysis leads to Perfect Equilibrium Analysis where market forces join together planned economies in a perfect bound.

c) Existence

Even though every equilibrium is efficient, neither of the above two theorems say anything about the equilibrium existing in the first place. To guarantee that an equilibrium exists, it suffices that consumer preferences be convex (although with enough consumers this assumption can be relaxed both for existence and the second welfare theorem). Similarly, but less plausibly, convex feasible production sets suffice for existence; convexity excludes economies of scale.

Proofs of the existence of equilibrium traditionally rely on fixed-point theorems such as Brouwer fixed-point theorem for functions (or, more generally, the Kakutani fixed-point theorem for set-valued functions). Another method of proof of existence, global

analysis, uses Sard's lemma and the Baire category theorem; this method was pioneered by Gérard Debreu and Stephen Smale.

d) Uniqueness

Although generally (assuming convexity) an equilibrium will exist and will be efficient, the conditions under which it will be unique are much stronger. While the issues are fairly technical the basic intuition is that the presence of wealth effects (which is the feature that most clearly delineates general equilibrium analysis from partial equilibrium) generates the possibility of multiple equilibria. When a price of a particular good changes there are two effects. First, the relative attractiveness of various commodities changes; and second, the wealth distribution of individual agents is altered. These two effects can offset or reinforce each other in ways that make it possible for more than one set of prices to constitute an equilibrium.

There has been much research on conditions when the equilibrium will be unique, or which at least will limit the number of equilibria. One result states that under mild assumptions the number of equilibria will be finite and odd . Furthermore if an economy as a whole, as characterized by an aggregate excess demand function, has the revealed preference property (which is a much stronger condition than revealed preferences for a single individual) or the gross substitute property then likewise the equilibrium will be unique.

e) Determinacy

Given that equilibria may not be unique, it is of some interest to ask whether any particular equilibrium is at least locally unique. If so, then comparative statics can be applied as long as the shocks to the system are not too large. As stated above, in a regular economy equilibria will be finite, hence locally unique. One reassuring result, due to Debreu, is that "most" economies are regular.

Work by Michael Mandler (1999) has challenged this claim. The Arrow–Debreu–McKenzie model is neutral between models of production functions as continuously differentiable and as formed from (linear combinations of) fixed coefficient processes. Mandler accepts that, under either model of production, the initial endowments will not be consistent with a continuum of equilibria, except for a set of Lebesgue measure zero. However, endowments change with time in the model and this evolution of endowments is determined by the decisions of agents (e.g., firms) in the model. Agents in the model have an interest in equilibria being indeterminate:

"Indeterminacy, moreover, is not just a technical nuisance; it undermines the price-taking assumption of competitive models. Since arbitrary small manipulations of factor supplies can dramatically increase a factor's price, factor owners will not take prices to be parametric.

f) Stability

In a typical general equilibrium model the prices that prevail "when the dust settles" are simply those that coordinate the demands of various consumers for various goods. But this raises the question of how these prices and allocations have been arrived at, and whether any (temporary) shock to the economy will cause it to converge back to the same outcome that prevailed before the shock. This is the question of stability of the equilibrium, and it can be readily seen that it is related to the question of uniqueness. If

there are multiple equilibria, then some of them will be unstable. Then, if an equilibrium is unstable and there is a shock, the economy will wind up at a different set of allocations and prices once the convergence process terminates. However stability depends not only on the number of equilibria but also on the type of the process that guides price changes (for a specific type of price adjustment process see Walrasian auction). Consequently some researchers have focused on plausible adjustment processes that guarantee system stability, i.e., guarantee convergence of prices and allocations to some equilibrium. When more than one stable equilibrium exists, where one ends up will depend on where one begins.

SELF ASSESSMENT EXERCISE

Analyse the basic questions in general equilibrium theory characterization.

3.3 Unresolved problems in general equilibrium model

Research building on the Arrow–Debreu–McKenzie model has revealed some problems with the model. The Sonnenschein–Mantel–Debreu results show that, essentially, any restrictions on the shape of excess demand functions are stringent. Some think this implies that the Arrow–Debreu model lacks empirical content. At any rate, Arrow–Debreu–McKenzie equilibria cannot be expected to be unique, or stable.

A model organized around the tâtonnement process has been said to be a model of a centrally planned economy and not a decentralized market economy. Some research has tried to develop general equilibrium models with other processes. In particular, some economists have developed models in which agents can trade at out-of-equilibrium prices and such trades can affect the equilibria to which the economy tends. Particularly noteworthy are the Hahn process, the Edgeworth process and the Fisher process.

The data determining Arrow-Debreu equilibria include initial endowments of capital goods. If production and trade occur out of equilibrium, these endowments will be changed and further complicating the picture.

In a real economy, however, trading, as well as production and consumption, goes on out of equilibrium. It follows that, in the course of convergence to equilibrium (assuming that occurs), endowments change. In turn this changes the set of equilibria. Put more succinctly, the set of equilibria is path dependent... [This path dependence] makes the calculation of equilibria corresponding to the initial state of the system essentially irrelevant. What matters is the equilibrium that the economy will reach from given initial endowments, not the equilibrium that it would have been in, given initial endowments, had prices happened to be just.

The Arrow–Debreu model in which all trade occurs in futures contracts at time zero requires a very large number of markets to exist. It is equivalent under complete markets to a sequential equilibrium concept in which spot markets for goods and assets open at each date-state event (they are not equivalent under incomplete markets); market clearing then requires that the entire sequence of prices clears all markets at all times. A generalization of the sequential market arrangement is the temporary equilibrium structure, where market clearing at a point in time is conditional on expectations of future prices which need not be market clearing ones.

Although the Arrow–Debreu–McKenzie model is set out in terms of some arbitrary numerals, the model does not encompass money. Frank Hahn, for example, has

investigated whether general equilibrium models can be developed in which money enters in some essential way. One of the essential questions he introduces, often referred to as the Hahn's problem is : "Can one construct an equilibrium where money has value?" The goal is to find models in which existence of money can alter the equilibrium solutions, perhaps because the initial position of agents depends on monetary prices.

Some critics of general equilibrium modeling contend that much research in these models constitutes exercises in pure mathematics with no connection to actual economies. "There are endeavors that now pass for the most desirable kind of economic contributions although they are just plain mathematical exercises, not only without any economic substance but also without any mathematical value as put by Georgescu-Roegen in one of his paper that assumes more traders in existence than there are points in the set of real numbers.

Although modern models in general equilibrium theory demonstrates that under certain circumstances prices will indeed converge to equilibria, critics hold that the assumptions necessary for these results are extremely strong. As well as stringent restrictions on excess demand functions, the necessary assumptions include perfect rationality of individuals; complete information about all prices both now and in the future; and the conditions necessary for perfect competition. However some results from experimental economics suggest that even in circumstances where there are few, imperfectly informed agents, the resulting prices and allocations may wind up resembling those of a perfectly competitive market (although certainly not a stable general equilibrium in all markets).

Frank Hahn defends general equilibrium modeling on the grounds that it provides a negative function. General equilibrium models show what the economy would have to be like for an unregulated economy to be **Pareto efficient.**

3.3.1 CRITICS OF GENERAL EQUILIBRIUM THEORY

General equilibrium theory is a central point of contention and influence between the neoclassical school and other schools of economic thought, and different schools have varied views on general equilibrium theory. Some, such as the Keynesian and Post-Keynesian schools, strongly reject general equilibrium theory as "misleading" and "useless"; others, such as the Austrian school, show more influence and acceptance of general equilibrium thinking, though the extent is debated. Other schools, such as new classical macroeconomics, developed from general equilibrium theory.In this context, while some criticize positively, some do not.

a) Keynesian and Post-Keynesian

Keynesian and Post-Keynesian economists, and their underconsumptionist predecessors criticize general equilibrium theory specifically, and as part of criticisms of neoclassical economics generally. Specifically, they argue that general equilibrium theory is neither accurate nor useful, that economies are not in equilibrium, that equilibrium may be slow and painful to achieve, and that modeling by equilibrium is "misleading", and that the resulting theory is not a useful guide, particularly for understanding of economic crises.

They said let us beware of this dangerous theory of equilibrium which is supposed to be automatically established. A certain kind of equilibrium, it is true, is reestablished in the long run, but it is after a frightful amount of suffering.

More methodologically, it is argued that general equilibrium is a

fundamentally *static* analysis, rather than a *dynamic* analysis, and thus is misleading and inapplicable. The theory of dynamic stochastic general equilibrium seeks to address this criticism.

b) Austrian economists

Whether Austrian economists supports or rejects general equilibrium theory and the precise relationship is unclear. Different Austrian economists have advocated differing positions, which have changed as Austrian economics developed over time. Some new classical economists argue that the work of Friedrich Hayek in the 1920s and 1930s was in the general equilibrium tradition and was a precursor to business cycle equilibrium theory. Others argue that while there are clear influences of general equilibrium on Hayek's thought, and that he used it in his early work, he came to substantially reject it in his later work, post 1937. It is also argued by some that Friedrich von Wieser, along with Hayek, worked in the general equilibrium tradition, while others reject this, finding influences of general equilibrium on the Austrian economists superficial.

C) New classical macroeconomics

While general equilibrium theory and neoclassical economics generally were originally microeconomic theories, New classical macroeconomics builds a macroeconomic theory on these bases. In new classical models, the macroeconomy is assumed to be at its unique equilibrium, with full employment and potential output, and that this equilibrium is assumed to always have been achieved via price and wage adjustment (market clearing). The best-known of such model is Real Business Cycle Theory, in which business cycles are considered to be largely due to changes in the real economy, unemployment is not due to the failure of the market to achieve potential output, but due to equilibrium potential output having fallen and equilibrium unemployment having risen.

d) Socialist economics

Within socialist economics, a sustained critique of general equilibrium theory and neoclassical economics generally is given in *Anti-Equilibrium*, based on the experiences of Janos Kornai with the failures of Communist central planning.

SELF ASSESSMENT EXERCISE

In your own words summarise the criticism of modern economist to the theory of general equilibrium applications

4.0 CONCLUSION

From our discussion so far on General equilibrium model,we can deduce the following facts:

General equilibrium theory attempts to explain the behavior of supply, demand, and prices in a whole economy with several or many interacting markets, by seeking to prove that a set of prices exists that will result in an overall (or "general") equilibrium.

General equilibrium theory both studies economies using the model of equilibrium pricing and seeks to determine in which circumstances the assumptions of general equilibrium will hold.

5.0 SUMMARY

In this unit, we have attempted to show what general equilibrium models are all about its properties, features and critics from various scholars of repute. Also, from the point of view of our discussion, you have learnt that General equilibrium theory both studies economies using the model of equilibrium pricing and seeks to determine in which circumstances the assumptions of general equilibrium will hold. I believe your understanding of this unit has given you a basis to understand the next unit. I expect you by now to be anxious of reading more about computable general equilibrium model which will be duly served in the next unit.

6.0 TUTOR-MARKED ASSIGNMENT

Discuss what general equilibrium analysis is and can be used for in modern economic problem solving. .

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UNIT III Computable General Equilibrium Model of economic planning

CONTENTS

1.0 INTRODUCTION

It is good that we have familiarized ourselves with what General equilibrium theory is all about in the preceding unit which provides a basic foundational platform that we shall be looking at in this unit. In this unit, we shall be looking at Computable General Equilibrium Model of economic planning. An in-depth explanation of the above topics shall be provided. It is advisable that you critically concentrate as we move along with explanations that will be given.

2.0 OBJECTIVES

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

- Show the Overview, structure and developments in CGE modelling.
- Understand CGE models as multisectoral model and its main features
- Identify the Advantages and limitations of GCE
- Identify the Uses , Types and Solutions of CGE

3.0 MAIN CONTENTS

3.1 OVERVIEW, STRUCTURE AND DEVELOPMENTS IN CGE MODELLING.

Computable general equilibrium (**CGE**) models are a class of economic models that use actual economic data to estimate how an economy might react to changes in policy, technology or other external factors. CGE models are also referred to as AGE which is applied general equilibrium models.

Computable general equilibrium (CGE) models also known as applied general equilibrium (AGE) models are built on the timeless economics foundations of Adam Smith's invisible hand, Walras law, Edgeworth's contract curve, Arrow- Debreu proof of existence and Leontief's input-output analysis . Manne (1985).

A CGE model consists of (a) equations describing model variables and (b) a database (usually very detailed) consistent with the model equations. The equations tend to be neo-classical in spirit, often assuming cost-minimizing behaviour by producers, average-cost

pricing, and household demands based on optimizing behaviour. However, most CGE models conform only loosely to the theoretical general equilibrium paradigm. For example, they may allow for:

1. non-market clearing, especially for labour (unemployment) or for commodities (inventories)
2. imperfect competition (e.g., monopoly pricinxdg)
3. demands not influenced by price (e.g., government demands)
4. a range of taxes
5. externalities, such as pollution

A CGE model database consists of:0000 and the following.

1. tables of transaction values, showing, for example, the value of coal used by the iron industry. Usually the database is presented as an input-output table or as a social accounting matrix. In either case, it covers the whole economy of a country (or even the whole world), and distinguishes a number of sectors, commodities, primary factors and perhaps types of household.
2. elasticities: dimensionless parameters that capture behavioural response. For example, export demand elasticities specify by how much export volumes might fall if export prices went up. Other elasticities may belong to the Constant Elasticity of Substitution class. Amongst these are Armington elasticities, which show whether products of different countries are close substitutes, and elasticities measuring how easily inputs to production may be substituted for one another. Expenditure elasticities show how household demands respond to income changes.

CGE models are descended from the input-output models pioneered by Wassily Leontief, but assign a more important role to prices. Thus, where Leontief assumed that, say, a fixed amount of labour was required to produce a ton of iron, a CGE model would normally allow wage levels to (negatively) affect labour demands.

CGE models derive too from the models for planning the economies of poorer countries constructed (usually by a foreign expert) from 1960 onwards. Compared to the Leontief model, development planning models focused more on constraints or shortages—of skilled labour, capital, or foreign exchange.

CGE modelling of richer economies descends from Leif Johansen's 1960 MSG model of Norway, and the static model developed by the Cambridge Growth Project in the UK. Both models were pragmatic in flavour, and traced variables through time. The Australian MONASH model is a modern representative of this class. Perhaps the first CGE model similar to those of today was that of Taylor and Black (1974).These models are as well applicable to economic planning of developing nations.

Let it be known to you that CGE modeling reproduces in the most possible realistic manner the structure of the whole economy and therefore the nature of all existing economic transactions among diverse economic agents like productive sectors, households, and the government, among others. Moreover, CGE analysis, in comparison to other available techniques, captures a wider set of economic impacts derived from a shock or the implementation of a specific policy reform, see (Figure 3.3). In that sense, the CGE approach is especially useful when the expected effects of policy implementation are complex and materialize through different transmission channels.

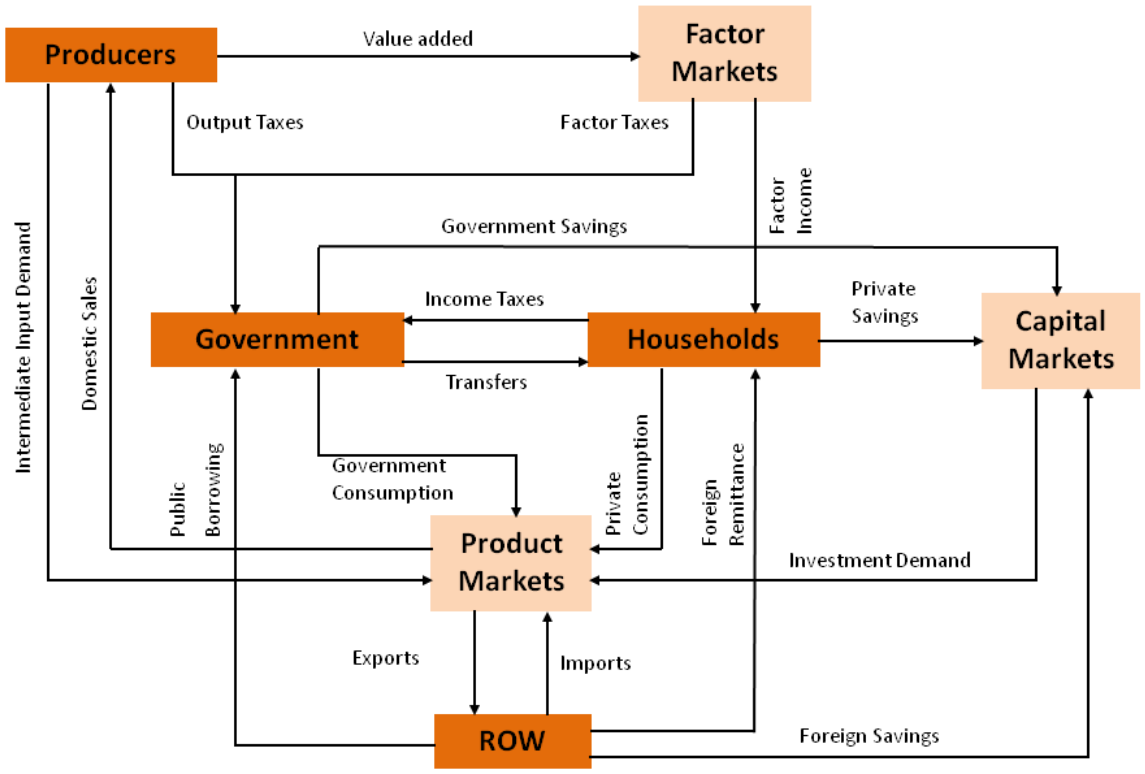

Figure 3.3 A SIMPLIFIED STRUCTURE OF CGE MODEL

Let us briefly consider the diagram above which shows the interaction of all economic agents in the economy. The individual household, producers or business firm, government, the markets and the rest of the world where import and export is made possible. The arrow shows the inter-relationship among these economic agents.For example, look at Government and household, the households paid income taxes to government while in return government engage in transfer payment to the household in form of bursary and scholarship. Therefore, for easy assimilation, follow the arrow concurrently.

SELF ASSESSMENT EXERCISE

Discuss briefly the structure of CGE modeling in economic analysis.

3.2 CGE MODELS AS MULTISECTORAL MODEL AND ITS MAIN FEATURES

This section provides a review of different types of multisectoral models and then focuses in particular on CGE models. CGE model belong to a class of models generally referred to as multisectoral macro models. As we have earlier discussed in previous modules, Models that fall into category include the following:

(a). Input-Output Models
(b). Linear Programming Models.
(c). Macroeconometric Models.

(d). Computable (or applied) General Equilibrium Models.

The essential features of the different types of models, are presented below. It should be mentioned however that these are broad generalizations for the purpose of identifying the dominant characteristic of each type of model. For instance, CGE

Model have both static and dynamic components. However, in most cases we have static CGE models because the dynamic components are not as well developed as what we may find with macroeconometric models.

TYPOLOGY OF MACRO MODELS

Look at the following models specified; LP IO MM CGE

Where:

LP - Linear programming Models

IO - Input Output Models

MM - Macroeconometric Models

CGE - Computable General Equilibruim Models

The focus of this section is however on CGE models. CGE represents one of the most prominent types of models used for policy analysis.

Unlike macroeconometric models that emphasize time series data analysis, CGE model focus on interindustry analysis thereby permitting the analysis of the impacts of policy on resource allocation. Another feature is that CGE models in general can be numerically solved for market clearing prices on all product and factor markets, Moreover, CGE models are generally focused on the real side of the economy, although financial instruments and financial markets are gaining increasing attention.

CGE models are highly non-linear and allow for feedback relations from production levels and prices to final demand. They have neo-classical production and expenditure functions and incorporate a variety of substitution possibilities in production, demand and trade. Formalized analyses of general equilibrium systems have provided insights into the factors determining the allocation of resources and the distribution of incomes in market economies. With the development of CGE models, the general equilibrium theory has become an operational tool in empirically oriented economic analysis.

The basic structure of a CGE model can be generalized as follows: It starts with the specifications of the agents in the economy and their behavior; the rules that bring different markets to equilibrium and macroeconomic conditions. Most CGE models identify four categories of agents: households, producers, government and the rest of the world. Usually, behavioural rules are specified for these actors that reflect their assumed motivations. For example, producers maximize profits subject to technological constraints and households maximize utility subject to budget constraints. Third, agents make their decisions based on signals they observe. In the neoclassical models, these signals are the prices. Next, a set of market equilibrium conditions and macro constraints are imposed on the system: the balance of payments, savings-investment balance, the government budget and factor market equilibrium.

A CGE model is one of the most rigorous, cutting-edge quantitative methods to evaluate the impact of economic and policy shocks -particularly policy reforms- in the economy as a whole. Because of its nature, this tool is significantly useful for policy design.

SELF ASSESSMENT EXERCISE
What are the features of CGE models as a multi-sector model in economic analysis.

3.3 ADVANTAGES AND LIMITATIONS OF CGE

a) ADVANTAGES OR STRENGHT OF CGE

CGE models have a number of strong advantages and expectedly, some drawbacks. Among the several benefits of the CGE models are the following. They provide conceptual consistency for model analysis. CGE models are based on established axioms and principles of microeconomics such as profit and utility maximization, and rational behaviour of economics agents. For instance, under the Walras law, households are presumed to be on their budget constraint, there are zero profit conditions for firms; and demand and supply are equal for all commodities and factors of production. In addition to conceptual consistency, the social accounting matrix, which provides the data base for CGE models, ensures accounting consistency: expenditures cannot exceed incomes and there is also consistent factor allocation making sure that factor markets are cleared.

Another advantages of CGE models is that analysis is based on inter-industry or multi-sector backward and forward linkages. Hence, they permit analyses of resource allocation and how policies impact or permeate through the various sectors of the economy. A major strength of CGE is that it allows for welfare analysis. It provides a laboratory for evaluating winners and losers from policy changes which may provide an avenue to apply compensatory schemes for losers from economic reforms, especially if they belong to the vulnerable groups. In other words, it allows for the analysis of equity implications of policy measures and changes in real income resulting from changes in prices.

a) LIMITATIONS OR PROBLEMS OF CGE

CGE models also have some important limitations. Firstly, like other types of models, CGE models are abstractions from reality, Hence. Their structures are influenced significantly by the judgements and predispositions of the modeller. Modellers have significant flexibility in the choice of model set up, especially, functional forms, disaggregation, closure rules,etc. Secondly, CGE models are still relatively aggregated given their focus on macroeconomic, sectoral and social effects. Thirdly, they require large numbers of parameters and elasticities, which often have to be 'borrowed' or 'guesstimated. 'Additionally, there are no common statistical tests for the model specifications. Hence, unlike macro econometric models, it is difficult to assess the validity and reliability of the particular specification forms chosen by the modeler. Fourthly, CGE models are not appropriate for forecasting. Fifth, issues of uncertainty, financial sector, and true dynamics are sill rudimentary in CGE models. Finally, it requires considerable technical skill to formulate, solve and interpret the results of a CGE model.

SELF ASSESSMENT EXERCISE
Highlight the advantages and problems of CGE modeling

3.4 USES, TYPES AND SOLUTIONS OF CGE MODELS

a) USES OF CGE MODELS

CGE models are useful whenever we wish to estimate the effect of changes in one part of the economy upon the rest. For example, a tax on flour might affect bread prices, the CPI which is the consumer price index, and hence perhaps wages and employment. They have been used widely to analyse trade policy. More recently, CGE has been a popular way to estimate the economic effects of measures to reduce greenhouse gas emissions.

CGE models always contain more variables than equations—so some variables must be set outside the model. These variables are termed exogenous; the remainder, determined by the model, is called endogenous. The choice of which variables are to be exogenous is called the model closure, and may give rise to controversy. For example, some modellers hold employment and the trade balance fixed; others allow these to vary. Variables defining technology, consumer tastes, and government instruments (such as tax rates) are usually exogenous.

Today there are many CGE models of different countries. One of the most well-known CGE models is global GTAP model of world trade.

CGE models are useful to model the economies of countries for which time series data are scarce or not relevant (perhaps because of disturbances such as regime changes). Here, strong, reasonable, assumptions embedded in the model must replace historical evidence. Thus developing economies are often analysed using CGE models, such as those based on the IFPRI template model.

CGE models are the best choice if the economic or policy shock to be evaluated is expected to have significant impacts throughout the economy. Moreover, CGE models are the best option if the research question involves analyzing the static/dynamic, direct/ indirect and short/long term effects caused by a shock. Thus, because of its nature, CGE analysis performs well when evaluating, among others:

- Fiscal policy
- Trade policy
- Climate Change shocks
- Shocks in international prices etc.

b) Comparative-static and dynamic type of CGE model

Many CGE models are comparative-static: they model the reactions of the economy at only one point in time. For policy analysis, results from such a model are often interpreted as showing the reaction of the economy in some future period to one or a few external shocks or policy changes. That is, the results show the difference (usually reported in percent change form) between two alternative future states (with and without the policy shock). The process of adjustment to the new equilibrium is not explicitly represented in such a model, although details of the closure (for example, whether capital stocks are allowed to adjust) lead modellers to distinguish between short-run and long-run equilibria.

By contrast, dynamic CGE models explicitly trace each variable through time—often at annual intervals. These models are more realistic, but more challenging to construct and solve—they require for instance that future changes are predicted for all exogenous variables, not just those affected by a possible policy change. The dynamic elements may arise from partial adjustment processes or from stock/flow accumulation relations:

between capital stocks and investment, and between foreign debt and trade deficits. However there is a potential consistency problem because the variables that change from one equilibrium solution to the next are not necessarily consistent with each other during the period of change.

Recursive-dynamic CGE models are those that can be solved sequentially (one period at a time). They assume that behaviour depends only on current and past states of the economy. Alternatively, if agents' expectations depend on the future state of the economy, it becomes necessary to solve for all periods simultaneously, leading to full multi-period dynamic CGE models. Within the latter group dynamic stochastic general equilibrium models explicitly incorporate uncertainty about the future.

b) Solution Techniques

Early CGE models were often solved by a program custom-written for that particular model. Thus, models were expensive to construct, and sometimes appeared as a 'black box' to outsiders. Today most CGE models are formulated and solved using one of the GAMS or GEMPACK software systems. AMPL, Excel and MATLAB are also used. The use of such systems has lowered the cost of entry to CGE modeling, allowed model simulations to be independently replicated, and increased the transparency of the models.

SELF ASSESSMENT EXERCISE

Elucidate on the uses of CGE modeling in economic analysis.

4.0 CONCLUSION

From our discussion so far on Computable general equilibrium models of Economic Planning , we can deduce the following facts:

That Computable general equilibrium (CGE) models are a class of economic models that use actual economic data to estimate how an economy might react to changes in policy, technology or other external factors. CGE models are also referred to as AGE which is applied general equilibrium models.

5.0 SUMMARY

In this unit, we have attempted to show what Computable general equilibrium models is all about, its structures , advantages, limitations as well as its uses, types and critics from various schools of thought. Also, from the point of view of our discussion, you have learnt that a CGE model consists of the equations describing model variables and a database that is consistent with the model equations. The equations tend to be neo-classical in spirit, often assuming cost-minimizing behaviour by producers, average-cost pricing, and household demands based on optimizing behaviour. However, most CGE models conform only loosely to the theoretical general equilibrium paradigm. I believe your understanding of this unit has given you a basis to prepare for the next unit. I expect you by now to be anxious of reading more about linear programming techniques which will be duly served in the next unit.

6.0 TUTOR-MARKED ASSIGNMENT

List and explain the various limitations and weaknesses of Computable general equilibrium models.

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MODULE 4

LINEAR PROGRAMMING TECHNIQUE AND COST-BENEFIT ANALYSIS OF ECONOMIC PLANNING

Unit 1: Introduction to the concept of Linear Programming technique
Unit 2: Linear Programming technique and its application in Planning
Unit 3: Project selection technique of cost-benefit analysis

UNIT I INTRODUCTION TO THE CONCEPT OF LINEAR PROGRAMMING TECHNIQUE

CONTENTS

1.0 INTRODUTION

Our discussion in the last module of this course was based on a multisector economic model known as SAM, GE, and CGE. Similarly, we referred to the necessity of a plan being consistent and constructive based on the economic nature that is prevalent in such economy. Therefore our task in this last module would be to look at the process of plan formulation using other multi sector model or technique. It is therefore intended to introduce you to the concept of Linear programming technique and benefit-cost analysis and their relevance in economic planning of nations.

2.0 OBJECTIVES

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

- Identify the Origin and meaning of linear programming technique
- Show the Conditions and generalisations of linear programming
- Highlight the assumptions of linear programming technique.

3.0 MAIN CONTENTS

3.1 ORIGIN AND MEANING OF LINEAR PROGRAMMING TECHNIQUE

As we have been discussing from the earlier modules and unit, another multi-sector model is what we shall be looking at which is Linear Programming.

Linear Programming is a mathematical device developed by the mathematician George Dantzig in 1947 for planning the diversified activities of the United States of America Air Force connected with the problem of supplies to the forces. Linear or mathematical

programming, also known as activity analysis, has been further developed in its application to the firm, managerial economics and finally to development planning.
It is a mathematical technique for the analysis of optimum decisions, subject to certain constraints in the form of linear inequalities. Mathematically speaking, it applies to those problems which require the solution of maximization or minimization problems subject to a system of linear inequalities stated in terms of certain variables. The problems of maximization and minimization are also called optimization problems. When cost and price per unit change with the size of output, the problem is non – linear and if they do not change with output, the problem is linear. Linear programming may thus be defined as a method to decide the optimum combination of factors to produce a given output or the optimum combination of products to be produced by given plan and equipment. It is also used to decide between a variety of techniques to produce a commodity. The technique involved in linear programming is similar to the one adopted in input – output analysis for the industry.

SELF ASSESSMENT EXERCISE
Discuss the meaning and origin of linear programming technique.

3.2 CONDITIONS AND GENERALISATIONS OF LINEAR PROGRAMMING

You should know that for any principle to hold in any situation, certain conditions and generalizations has to be satisfied. The application of linear programming (LP) technique to any problem rests on certain conditions and generalizations. First, there is a definite objective. It may be the maximization of profits or national income or employment of the minimization of costs. It is known as the objective function or the criterion function. If a quantity is maximized, its negative quantity is minimized. Every maximization problem has its dual problem, that of minimization. The original problem is the primal problem which always has its dual. If the primal problem pertains to maximization, the dual involves minimization and vice versa.
Secondly there should be alternative production processes for achieving the objective. The concept of process or activity is the most important in linear programming. A process is a 'specific' method of performing an economic task.' It is 'some physical operation, e.g consuming something, storing something, selling something, throwing something away, as well as manufacturing something in a particular manner. The LP technique enables the planning authority to choose the most efficient and economical process in attaining the objectives.
Thirdly, there must be certain constraints or restraints of the problem. They are the limitations or restrictions pertaining to certain conditions of the problems, as to what cannot be done and what has to be done. They are also known as inequalities. They may be limitations of resources such as land, labour or capital.
Fourthly, there are the choice variables, the various production processes or activities so as to maximize or minimize the objective function and to satify all the restraints.
Lastly, there are the feasible and optimal solutions. Given the income of the consumer and the prices of goods, feasible solutions are all possible combinations of the goods he can feasibly buy. Feasible solutions of two goods for the consumer are all combinations that lie on and to the left of the budget line. Whereas, on an isocost line, they are the combinations that lie on and to right of it. We may put it differently that a feasible

solution is one which satisfies all the restraints. The optimal solution is the best of the feasible solutions. If a feasible solution maximizes or minimizes the objective function, it is an optimal solution. The best available procedure for finding out the optimal solution out of the possible feasible solutions is the simplex method. It is a highly mathematical and technical method involved in linear programming. However, the main aim of linear programming is to find out optimal solutions and study their characteristics.

SELF ASSESSMENT EXERCISE

Briefly Show the conditions and generalizations involves in Linear Programming technique.

3.3 ASSUMPTIONS OF LINEAR PROGRAMMING TECHNIQUE

The linear programming analysis is based upon the following assumptions.

i. The decision-making body is faced with certain constraints or resource restrictions. They may be credit, raw material and space constraints on its activities. The type of constraints in fact depend upon the nature of problem. Mostly, they are fixed factors in they production process.
ii. It assumes a limited number of alternative production processes.
iii. It assumes linear relations among the different variables which implies constant proportionality between inputs and outputs within a process.
iv. Input – output prices and coefficients are given and constant. They are known with certainty.
v. The assumption of additivity also underlies linear programming techniques which means that the total resources used by all firms must equal the sum of resources used by each individual firm.
vi. The LP technique assumes continuity and divisibility in produces and factors.
vii. Institutional factors are also assumed to be constant.

Lastly, for programming a certain period is assumed. For conveniences and more accurate results, the period is generally short, though longer periods are not ruled out.

SELF ASSESSMENT EXERCISE

Highlight the assumptions underlying linear programming technique.

4.0 CONCLUSION

From our discussion so far on the introduction to linear programming as a concept , we can deduce the following facts:

That Linear or mathematical programming, also known as activity analysis, has been further developed in its application to the firm, managerial economics and finally to development planning for the analysis of optimum decisions, subject to certain constraints in the form of linear inequalities. It also applies to those problems which require the solution of maximization or minimization problems subject to a system of linear inequalities stated in terms of certain variables which is also regarded as optimisation problems.

5.0 SUMMARY

In this unit, we have attempted to discuss the introductory concept of linear programming, its origin and meaning, conditions and generalization, and assumptions underlying the concept. Also, from the point of view of our discussion, you have learnt that the main aim of linear programming is to find out optimal solutions and study their characteristics. I believe your understanding of this unit has given you a basis to understand the next unit. I expect you by now to be anxious of reading more about what will be duly served in the next unit.

6.0 TUTOR-MARKED ASSIGNMENT

The concept of linear programming as a model of economic planning of nations cannot be overemphasized; Discuss

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UNIT II LINEAR PROGRAMMING TECHNIQUE AND ITS APPLICATION IN PLANNING

CONTENTS

1.0 INTRODUCTION

Our discussion in the last unit has introduced to us the linear programming technique and its properties as it can be used in formulating economic plan. Therefore , our discussion in this unit will describe the Production capacity technique of Linear Programming, Show the various limitations of linear programming and the Uses of linear programming model in planning of Less Developed Countries of which Nigeria is one. It is important to take closer attention to the explanations given in this unit for easy assimilation.

2.0 OBJECTIVES

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

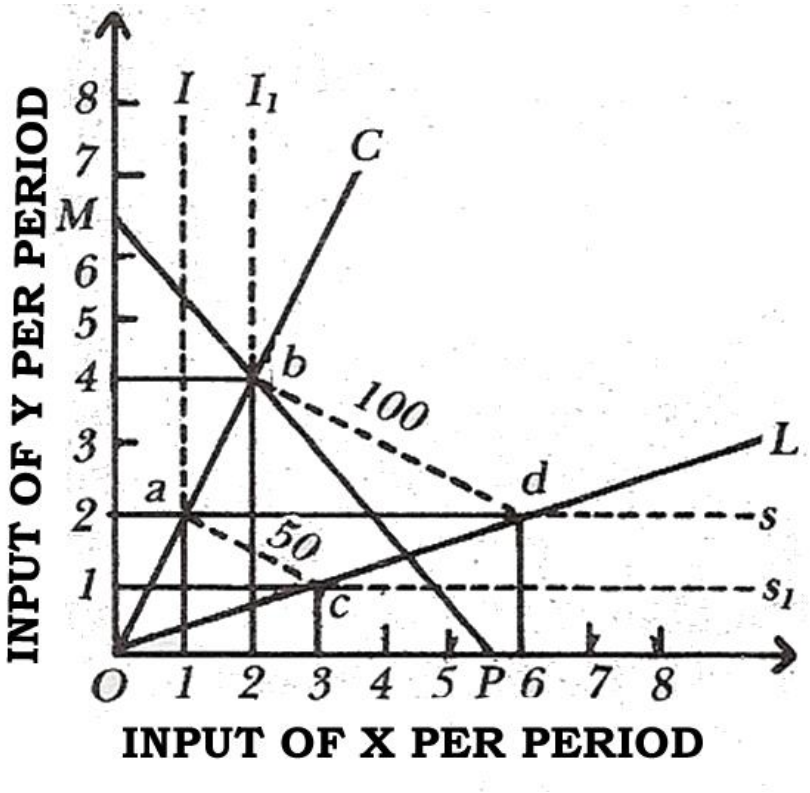
- Understand the Production capacity of LP technique.
- Highlight the Limitations of linear programming technique.
- Mention the uses of linear programming technique in planning

3.0 MAIN CONTENTS

3.1 PRODUCTION CAPACITY TECHNIQUE

In plan formulation, the planners have to decide whether to use labour – intensive or capital – intensive technique of production, depending on its outlay, They will choose that technique which maximizes output.

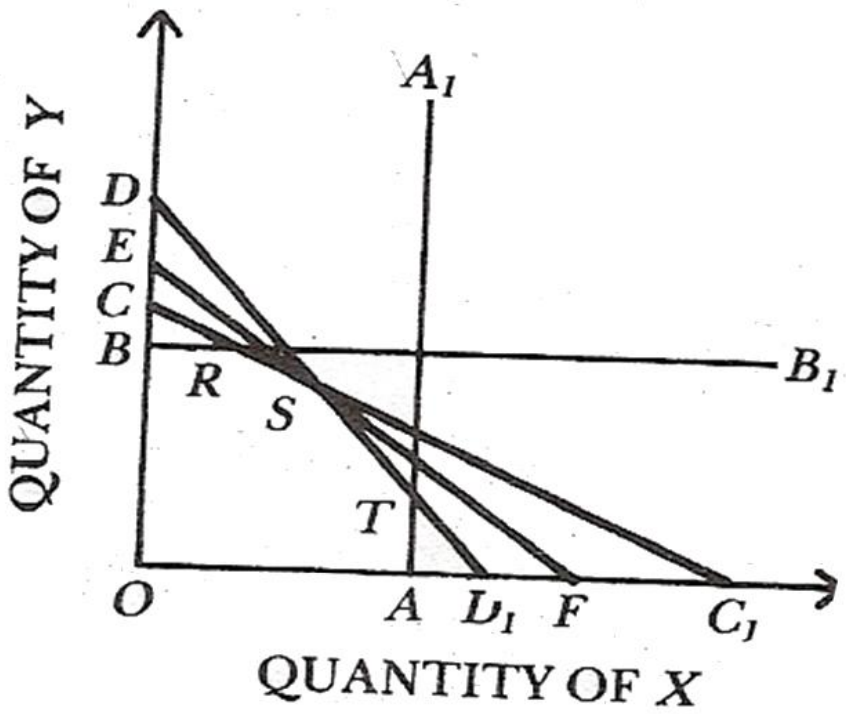
Let us suppose that it is planned to produce a commodity Z. using X and Y inputs, its objective is to maximize output. It has two alternative production processes, C (capital – intensive) and L (labour – intensive). The constraint is a given cost outlay MP as shown in the figure. All other assumptions given above are applicable. The problem is explained in terms of Fig. 4.1.



Source: The Economics of Development and Planning, Jhingan M.L (2007)

FIG 4.1

Units of input Y per period are measured along the vertical axis and units of input X per period are shown on the horizontal axis. If process C requires two units of input Y to every unit of input X, it will produce 50 units of commodity Z. If the inputs of X and Y are doubled to four units of Y and two units of X output is also doubled to 100 units of Z. These combinations of X and Y, represented by a and b, establish the output scale along the capital – intensive process ray OC. On the other hand, the same units (50) of good Z can be produced by process L by combing three units of X with one unit of Y. And 100 units of Z can be produced by doubling the inputs X and Y to six units of X and two units of Y. These output scales are established along the labour – intensive process ray Ol, as represented by input combinations c and d. If the points a and c at the 50 units level on the linear rays OC and OL are joined, they form an isoquant (shown, dotted) $lasc_1$. At the 100 units output level, the corresponding isoquant is l_1bds. The cost – outlay constraint is represented by the isocost curve MP and it places a limit on the production capacity of the project The project can produce with either of the two available techniques C and L within the area represented by the triangle Obd. It is not possible for it to produce outside this 'area of feasible solutions' the 'optimal solution' which maximizes the output will occur at the point where the isocost curve touches the isoquant with the highest output. In Fig. 4.1 the isocost curve MP touches the isoquant l_1bds at point b on the process ray OC. It shows that the project will use the capital – intensive technique C by using four units of input Y and two units of input X and produce 100 units of commodity Z.



Source: The Economics of Development and Planning, Jhingan M.L (2007)

FIG 4.2

Take another project whose objective function is to maximize its revenue subject to certain constraints of limited capacities. Suppose it produces two products, X and Y.
It has four departments each with a fixed capacity. Let these departments relate to manufacturing,

Assembling, polishing, and packing the product which be designated as A,B,C and D. The Problem is illustrated graphically in Fig. 4.2. The Production of X and Y is subject to constraints, A,B, C and D. Constraint A limits the production of X To OA. Constraints B limits the production of Y to OB. Constraint C limits the production of both X and Y to OC_1, and OC respectively, while constraints D limits their production to OD_1 and OD. The area OATSRB shows all combinations of X and Y that can be produced without violating any combination at any point outside this area.
The original solution can be found out by taking an isoprofit line within the feasibility zone. An isoprofit all combinations of X and Y which yield the same profit to the firm. The optimal solution lies on the highest isoprofit line EF in the polygon OATSRB.This is point S. Any point other than S lies outside the zone of feasible production.
Every linear programming maximization problem has its dual problem, that of minimization. The original problem is known as the primal problem, which always has its dual.If the primal problem pertains to maximization, the dual involves minimization, and vice versa.
Now we take another planning problem. Suppose the planner undertake a project which aims at minimization of costs. Two types of goods X_1 and X_2 are to be produced. Let the planners attach weights of 3 and 8 to units of these goods. Let there be 2 units of resource X_1 and 6 units of resource X_2. Let the production of 1 unit of X_1 use 1 unit of input C_1

and 2 units of input C_2. Similarly, Let the production of X_2 use 2 units of C_1 and 8 units of C_2. The problem can now be set in the linear programming form as;
Maximise $3X_1 + 8X_2$ (R, i.e. revenue)
Subject to the constraints

$$X_1+2X_2 \leq 2$$
$$2X_1+8X_2 \leq 6$$

and none of these quantities is negative. The optimal solution is $X_1=2$, $X_2= ½$ and R=7
The dual problem is ;
Let P_1 be the imputed price of X_1 and P_2 be the imputed price of X_2,
Minimize $2P_1+6P_2$ (C, i.e. cost).
Subject to the constraints

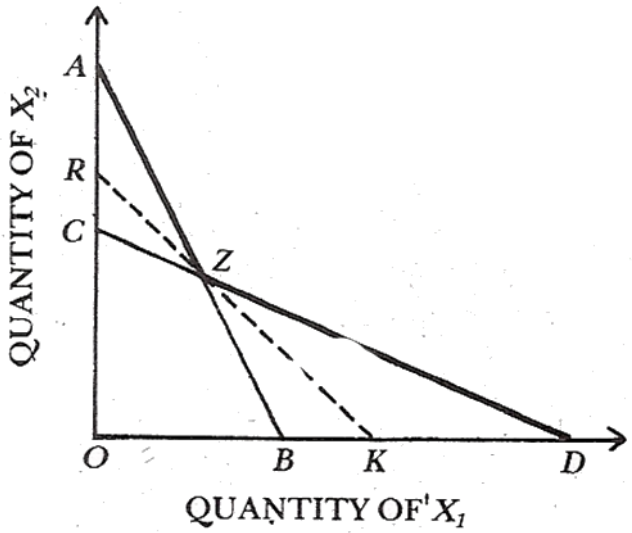
$$P_1+2P_2 \geq 3$$
$$2P_1+8P_2 \geq 8$$

and that none of these prices is negative. The optimal solution is:

$P_1=1_1=1/2$ and C=7.

These are the shadow or dual prices. But as all values have been imputed to the two resources, the maximum value of the objective function C must equal R. Hence C=R=7.

FIG 4.3



Source: The Economics of Development and Planning, Jhingan M.L (2007)

FIG 4.3
Graphically line AB represents $P_1+2P_2=3$ and line CD respresents $2P_1 + 8P_2=8$. The feasible solutions lie on or above the thick line AZD in figure 4.3. The optimal solution is at point Z where the isocost (dotted line) RK passes through the point of intersection of AB and CD.

SELF ASSESSMENT EXERCISE
Graphically illustrate the optimal solution of Linear Programming

3.2 LIMITATIONS OF LINEAR PROGRAMMING

Linear programming has turned out to be a highly useful tool of analysis in development planning. But it has its limitations. As a matter of fact, actual planning problems cannot be solved directly by the LP technique due to a number of restraints. Firstly, it is not easy to define a specific objective function. Secondly, even if a specific objective function is laid down, it may not be so easy to find out the various social institutional, financial and other constraints which may be operative in pursuing the given objective. Thirdly, given a specific objective and a set of constraints, it is possible that the constraints may not be directly expressible as linear inequalities. Fourthly, even if the above problems are surmounted, a major problem is one of estimating relevant value of the various constant co-efficients that enter into an LP problem, i.e. population, prices, etc. Fifthly, one of the defects of this technique is that it is based on the assumption of linear relations between inputs and outputs. This implies that inputs and outputs are additive, multiplicative and divisible. But the relations between inputs and outputs are not always linear. In real life, most of the relations are non-linear. Sixth, this technique assumes perfect competition in product and factor markets. But perfect competition is not a reality. Seventh, the LP technique is based on the assumption of constant returns in the economy. In reality, there are either diminishing or increasing returns.

To further buttress this point, it is a highly mathematical and complicated technique. The solution of a problem with linear programming requires the maximization or minimization of a clearly specified variable. The solution of a linear programming problem is also arrived at with the 'Simplex method' which involves a large number of mathematical calculations. It requires a special computational technique, an electric computer or desk calculator. Such computers are not only costly, but also require experts to operate them. Mostly, the LP models present trial-and-error solutions and it is difficult to find out really optimal solutions to the various economic problems.

SELF ASSESSMENT EXERCISE

Highlight and discuss the various limitations known to you when considering Linear Programming.

3.3 USES OF LINEAR PROGRAMMING IN PLANNING

Linear programming as a tool of economic development is more realistic than the input-output approach. In input-output analysis only one method is adopted to produce a commodity. It does not take into consideration the bottlenecks (constraints) which a development project has to face in underdeveloped countries. But in linear programming a definite objective is set to maximize income or minimize costs. All possible processes or techniques are taken into account for achieving the desired objective. This necessitates even the substitution of one factor for another till the most efficient and economical process is evolved. So projects and techniques which are too uneconomical to implement are not undertaken. By assuming certain constraints, linear programming as a tool of development planning is superior to the input-output technique. In underdeveloped countries, the planning agencies are faced with such constraints as the lack of sufficient capital and machinery, growing populations, etc. Resources exist that cannot be used properly for want of the co operant factors. Linear programming takes to due note of these constraints and helps in evolving an optimum plan for attaining the objectives

within a specified period of time. Thus the LP technique has been used for constructing theoretical multi- sector planning models for countries like India. Such models extend the consistency models of the input-output type to optimization of income or employment or any other quantifiable plan objective under the constraints of limited resources and technological conditions of production.

In practice, however, the LP technique is being used in solving a limited number of economic problems in developing countries. This is due to the lack of proper personnel for working out mathematical equations and for operating highly mechanical computers. Mostly the LP technique has been found to be extremely useful for sectoral planning in developing countries, for example, in selecting optimum alternatives in respect of location and technologies in industries, transport, and power or in farm management. This technique is being used in farm management for determining the optimum combination of different crops e.g Livestock and crops. The objective function used in such studies is either the minimization of costs or the maximization of income. The constraints are set by pre-determined levels of demand or the availability of resources such as raw materials or capacity. Besides, this technique is being used for the solution of diet problem where the aim is to minimize costs, given the values of minimum nutrients of the diet and the prices of products as constraints. It is also with the LP technique that the transport problems is being solved by the railways, airways and transport companies with regard to the selection of routes, transportation of goods, allocation of the means of transport (i.e. railway, wagons, aircrafts,trucks etc.depending on the type of transport under study).Again, this technique is used to assign jobs to the work force for maximum effectiveness and optimum results subject to constraints of wages and other costs. Similarly, purchasing, assembling, production and marketing problems are being solved through the LP technique in order to minimize costs and maximize profits, given the various constraints in the case of each problem. However, for an extensive use of this technique for development planning, developing economies will have to depend upon larger resources of trained personnel, and finance.

SELF ASSESSMENT EXERCISE

Mention the uses of Linear Programming in plan programming.

4.0 CONCLUSION

From our discussion so far on the linear programming technique and its application in planning, we can deduce the following facts:

Mostly the LP technique has been found to be extremely useful for sectoral planning in developing countries, for example, in selecting optimum alternatives in respect of location and technologies in industries, transport, and power or in farm management.

5.0 SUMMARY

In this unit, we have attempted to discuss the linear programming technique and its application in planning, Production capacity technique of LP, Limitations of linear programming technique and the uses of linear programming technique in planning. Also, from the point of view of our discussion, you have learnt that the main aim of linear programming is to find out optimal solutions to available constraints posed by available

resources. I believe your understanding of this unit will prepare you for the last unit of this last module. Therefore, read ahead

6.0 TUTOR-MARKED ASSIGNMENT

Discuss briefly the methods of linear programming models used in plan formulation by planners.

7.0 REFERENCES/FURTHER READING

Akosile, I. O., Adesanya, A. S. & Ajani, A. O. (2012).Management of development (A Nigeria perspective), 1st edition Olas Ventures, Mushin, Lagos. Nigeria

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UNIT III PROJECT SELECTION TECHNIQUE OF COST-BENEFIT ANALYSIS

CONTENTS

1.0 Introduction:

This is the last unit of the last module of this course. Our discussion in the last unit has finally taught us what we need to know about linear programming technique and its usefulness in formulating economic plan. Therefore, our discussion in this unit will describe the Projects Selection technique of cost-benefit analysis, optimal investment allocation, Problems of multiple objectives in investment allocation and assumptions underlying project selection. It is important for us to take closer attention to the explanations given in this unit for easy assimilation and understanding.

2.0 OBJECTIVES

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

- Optimal investment allocation.
- Problems of multiple objectives
- Assumptions underlying project selection

3.0 MAIN CONTENTS

3.1 OPTIMAL INVESTMENT ALLOCATION

Once the planning authority has laid down the optimum investment target called the optimal investment allocation (whether derived from the availability of resource or the desired rate of growth of national output), the next important step in this macro phase of plan formulation is to determine the investment priorities. This relates to the composition of investment or the sectors and projects that should receive priority in the plan. In economics, such a decision belongs to the area of optimal investment allocation. It is therefore the responsibility of the planning authority to choose and priorties well on the best and needed projects that can fit into their plan to satisfy the condition of optimal allocations of projects. However, this is based on the economic system that is prevalent in such nation be it developed or developing.

3.1.1 Types of economic system:

In a decentralized economic system, or a free enterprise economy, investible resources would be attracted by those sectors or projects that offer the highest rates of return on capital invested. However, in a planned process of economic development, such a criterion of investment allocation may be a very faulty guide to the optimization of the objective of the plan. For one thing, in a LDC, the price mechanism may not act as perfectly as it does in developed countries. For another, there may be considerable divergence between social and private costs and benefits of investment in different sectors.

A less developed country can therefore not afford to draw up a plan in which the investment pattern happens to be inefficient or suboptimal. How do we decided whether an investment pattern is an efficient or inefficient one? The simple test would be that in which no sector or project included in the plan should yield a lower marginal discounted income per unit of the scarce resources used than any sector or project excluded from the plan, otherwise, it will be difficult to maximize the present value of (discounted) income.

SELF ASSESSMENT EXERCISE

What do you understand by optimal investment allocation?

3.2 PROBLEMS OF MULTIPLE OBJECTIVES IN INVESTMENT ALLOCATION:-

Infact, the selection of priority sectors and projects for inclusion in a plan is complicated by the existence of multiple objectives underlying a plan. These objectives may be, for instance, the maximization of the rate of growth of real national income or per capital output, creation of maximum employment opportunities, maximisation of consumption or some balance of payments objectives. There is no single technical criterion which would optimize all the objectives of a plan at the same time.

The second problem that arises is that even if we attach greater importance to a single objective, like the maximization of the rate of growth of national output, there is no unanimity about the most suitable investment criterion to be used. The planner has to choose suitable investment criteria in order to make a choice therewith of priority sectors and projects.

Even after the choice of investment criterion has been made, the selection of priority areas of development is not a straight one. A scholar argued that investment planning in the LDCs consists of ranking projects in accordance with their benefit-cost ratio in descending order and choosing projects till the investible funds available for the plan are exhausted. This gives one the impression of a plan being little more than a more collection of projects. Such a method of assigning priorities obviously goes away with all the macro-economic exercises that are necessary for investment planning. Even then, little can authority of Less Developed Countries do in this regards.

SELF ASSESSMENT EXERCISE

Discuss the problems of multiple objectives as encountered under optimal investment allocation.

3.3 ASSUMPTIONS UNDERLYING PROJECT SELECTION.

The above method of ranking projects and sectors in order of their Cost- benefit ratios for determining priorities is based on two principal assumptions, namely

(1) That each project or sector of the economy is an independent entity and

(2) That it has no indirect costs and benefits ratio. This, however would be an over-simplified way of assigning priorities and would give us a less than optimal result. This would be clear from the following example.

Suppose on the basis of Cost-benefit-ratios the following five sectors have been ranked for inclusion in an hypothetical plan.

Table 4.1

Types of Project	**Cost/Benefit Ratio**
1. An irrigation project	.91
2. An iron and steel mill;	.89
3. A coal mining project;	.88
4. A soil conservation scheme;	.71
5. A railway project	.69

Source: Issues and Strategies in Economic Planning, Otokiti S.O (1999)

Now, out of this list, if the total savings available would allow for the inclusion of only two schemes in the plan. Which ones can be selected? A superficial answer could be that since the first two projects yields a higher Cost-benefit ratio, these should receive priority. But it will be noted that projects(1) and (4) are complementary and would result in a greater increase in output, if undertaken simultaneously, than (1) and (2) or project (3) and (4). Similarly, the case of projects (2) and (5) are complementary in that iron and steel project compliment railway project and as such should be given higher priority of selection.

The reason behind it is that various projects and sectors, especially in a LDC, are characterized by complementary on external economies and diseconomies. Different sectors of an economy are interdependent because of which the nature and significance of a project changes dramatically. In order to evaluate the priority of a sector or project, These externalities must be internalized, i.e. taken note of any calculations that are made to determine the investment priorities.

TABLE 4.2

PROJECT SELECTIONS AND COST-BENEFIT RATIO STRUCTURE							
	Projects	**CBR**	**Complementary Structures**				
		-	**1**	**2**	**3**	**4**	**5**
1	An Irrigation project	**.91**	**-**	**67.5**	**39**	**99.2**	**74**
2	An Iron and Steel Mill	**.89**	**67.5**	**-**	**41**	**37.4**	**90.7**
3	Coal Mining Project	**.88**	**39.0**	**41.0**	**-**	**47.0**	**81.1**
4	Soil Conservation scheme	**.71**	**99.2**	**37.4**	**47**	**-**	**69.0**
5	A railway project	**.69**	**74.0**	**90.7**	**81**	**69**	**0**

Source: Issues and Strategies in Economic Planning, Otokiti S.O (1999)

In the above CBR (cost-benefit ratio) table, we can confidently select projects that are complementary in the structure. Project 2 and 5 that is Iron and Steel is a complement to Railway project which has a CBR of .89 and .69 and a complementary structure of 90.7. Invariably, if the planning authorities were to select projects , they will choose projects that has high CBR and are complementary to achieve optimum and efficient resources allocation.

SELF ASSESSMENT EXERCISE

Rank and discuss the projects above according to order of priorities to you and make your comments.

4.0 CONCLUSION

From our discussion so far on project selection technique of cost-benefit analysis, we can deduce the following facts:

That after the choice of investment criterion has been made, the selection of priority areas of development is not a straight one and that investment planning in the LDCs consists of ranking projects in accordance with their cost-benefit ratio in descending order and choosing projects till the investible funds available for the plan are exhausted.

5.0 SUMMARY

In this unit, we have attempted to discuss Projects Selection technique of cost-benefit analysis, optimal investment allocation, Problems of multiple objectives in investment allocation and assumptions underlying project selection. Also, from the point of view of our discussion, you have learnt that if the planning authorities were to select projects , they will choose projects that has high CBR and are complementary to achieve optimum and efficient resources allocation. I believe you have intimate yourself with your course material and have been able to acquire the needed knowledge that is expected of you. I therefore encourage you to read more for proper impartation and assimilation of this course.

6.0 TUTOR-MARKED ASSIGNMENT

Describe what project selections is all about in plan formulation using the cost-benefit analysis.

7.0 REFERENCES/FURTHER READING

Akosile, I. O., Adesanya, A. S. & Ajani, A. O. (2012).Management of development (A Nigeria perspective), 1st edition Olas Ventures, Mushin, Lagos. Nigeria

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