Unit: 1-9

Course Code: 9308

Credit Hours: 3

MACROECONOMIC DYNAMICS

B.S. Economics (4 Years)

ALLAMA IQBAL OPEN UNIVERSITY

www.aiou.edu.pk

STUDY GUIDE

BS Economics (4-Year)

Macroeconomic Dynamics

Course Code: 9308 **Units: 1–9**

Credit Hours: 03

Department of Economics
Faculty of Social Sciences & Humanities
Allama Iqbal Open University, Islamabad

Year of Publication 2023

Quantity 1000

Layout Setting ..... Muhammad Zia Ullah

Incharge Printing ..... Dr. Sarmad Iqbal

Printer..... Allama Iqbal Open University

Publisher ..... Allama Iqbal Open University, Islamabad

COURSE TEAM

Chairperson:	**Dr. Fouzia Jamshaid**
Course Team:	**Dr. Fouzia Jamshaid** **Dr. Muhammad Ilyas** **Mr. Rizwan Ahmed Satti**
Course Coordinator:	**Dr. Fouzia Jamshaid**
Writers:	**Dr. Fouzia Jamshaid** **Ms. Saima Ashraf**
Reviewers:	**Dr. Fouzia Jamshaid** **Ms. Rabia Batool**
Editor:	**Fazal Karim**
Composing & Layout:	

CONTENTS

PREFACE

The curriculum at AIOU is designed on modern parameters using the latest information, trends, theories and techniques. An extensive consultative process is also a basic component of the activity. Development of the study material to help is the students located throughout the country is taken as a challenge. AIOU takes pride in undertaking this major task for an effective learning of the students.

The BS Economics (4 Yeas) is being offered by the Department of Economics of Allama Iqbal University for the students who are interested in the fields of economics. The scheme of study for BS Economics (4 Yeas) has been designed and the courses are developed to make these relevant to the emerging national and global trends and to meet needs of the society in this domain. The study material provides a comprehensive coverage of the core contents for BS Economics (4 Year) Program. The selection of, and the treatment of, study materials have been designed to meet both the general and specific aims set out by the Higher Education Commission (HEC) through the National Curriculum Revision Committee (NCRC).

In the end, I am happy to extend my gratitude to the course team chairman, course development coordinator, unit-writers, reviewers, and editor for the development of the course. Any suggestions for the improvement in the course will be warmly welcomed by the Department of Economics.

Prof. Dr. Zia Ul-Qayyaum
Vice Chancellor

INTRODUCTION TO THE COURSE

This course "Macroeconomic Dynamics" is an advanced level course. Slight background in macroeconomics is itself absolutely needed for understanding this course. Students with no prior knowledge to macroeconomics, however, are likely to find some of the concepts and terminology problematic. These students may wish to review the previous three courses of macroeconomics which you have already studied and were designed to clarify, and elaborate the fundamental concepts employed by various macroeconomists in the past. This advance course discusses the various theories presenting the main issues of macroeconomics. This course also provides to the students more advanced concepts in research in macroeconomics and monetary economics.

This course presents a broad view of the subject matter of macroeconomics. A major part of the course is dedicated to macroeconomic dynamics and separate units are dedicated Solow growth model, technological progress in Solow model, endogenous growth theory, non-economic factors and their role in growth, concept of dynamics of the economy welfare, distinction between static and dynamic models, dynamic economics, develop of dynamic monetary and fiscal policy, apply general equilibrium models in a dynamic environment and introduction of several open economy models that exhibit dynamic behavior.

As macroeconomics is a subject which relates both the theoretical and an empirical matter. Therefore, the presentation of the theories is complemented with examples of empirical work. Moreover, in a way that macroeconomic theories can be applied and tested. Each unit concludes with a self-assessment question for students/learners to support their understanding of study materials There are two main consequences of this advanced macroeconomic course. The one is that course applies a series of conventional models to describe and analyze the theories. The other one consequence of the course's advanced level is that assumes some background in mathematics and economics.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, learner will be able to:

- learn what causes the differences in income over time and across countries.
- develop a theory of economic growth called the Solow growth model.
- familiarize with the concept of technological progress in the Solow model and highlights the Endogenous Growth Theory
- introduce the study of non-economic factors and their influence on economic growth and development
- familiar with Ramsey growth model and the concept of dynamics of the economy welfare
- distinction between static and dynamic models which underlies modern dynamic economics.
- familiarize the reader with recent applied work on consumption and saving, and investment.
- examine the dynamic economics in greater detail and develop a more thorough explanation of dynamic monetary and fiscal policy
- apply general equilibrium economic model, structure of general equilibrium economic model and general equilibrium in a dynamic environment.
- introduce several open economy models that exhibit dynamic behavior.

Throughout this course, you'll also see the related learning outcomes identified in each unit. You can use the learning outcomes to help organize your learning and gauge your progress.

STRUCTURE OF THE STUDY GUIDE

The course "Macroeconomic Dynamics" a three credit hours course consists of nine units. A unit is a study of 12–16 hours of course work for two weeks. The course work of one unit will include study of compulsory reading materials and suggested books. You should make a timetable for studies to complete the work within the allocated time.

This study guide/course has been organized to enable you to acquire the skill of self-learning. For each unit an introduction is given, to help you to develop an objective analysis of the major and sub-themes, discussed in the prescribed reading materials. Besides this, learning outcomes of each unit are very specifically laid down to facilitate in developing logical analytical approach. Summary of main topics has also been included in the contents to understand the topics. We have given you a few self-assessments questions and activities which are not only meant to facilitate you in understanding the required reading materials, but also to provide you an opportunity to assess yourself. Recommended books and important links have been given to understand the main topics. Key terms have also been included in the study guide.

Every course has a study package including study guides, assignments and tutorial schedule uploaded by the University. For the books suggested at the end of each unit you can visit online resources, a nearby library/study center or the Central Library at main campus in AIOU.

Course Materials

The primary learning materials for this course are:

- Readings (e.g., study guides, recommended books, online links and scholarly articles)
- Lectures, (tutorial and workshops)
- Other resources.

All course materials are free to access and can be found through the links provided in each unit and sub-unit of the course. Pay close attention to the notes that accompany these course materials, as they will instruct you as to what specifically to read or watch at a given point in the course and help you to understand how these individual materials fit into the course. You can also access a list all the materials used in this course by clicking on resources mentioned in each unit.

Technical Requirements

This course is delivered online through Learning Management System (LMS). You will be required to have access to a computer or web-capable mobile device and have consistent access to the internet either to view or download the necessary course resources and to attempt any auto-graded course assessments and the final exam.

Methods of Instruction

Following are the methods for directing this guide and course also and then you will be able to understand the macroeconomics course through.

- Lecture online
- Mandatory workshops
- Workshop Quizzes
- Class discussion during workshops
- Individual, paired and small-group exercises
- Use of library for research projects
- Use of videos lectures
- Use of the internet

Types of Assignments

- Students must complete assignments from the recommended books and other sources also.
- Students must be able to research and complete the assignments, which will include library, Internet and another media research.

Activities

In of the most unit, different types of activates are mentioned for better understanding the course. If you will thoroughly study the materials and follow the links and videos, then you will be able to understand the course in easiest way.

HOW TO USE THE STUDY GUIDE

Before attending a tutorial meeting, it is imperative to prepare yourself in the following manner to get a maximum benefit of it.
You are required to follow the following steps:

Step 1
Go through the.
1. Course Outlines
2. Course Introduction
3. Course Learning Outcomes
4. Structure of the Course
5. Assessment Methods
6. Recommended Books
7. Suggested Readings

Step 2
Read the whole unit and make notes of those points which you could not fully understand or wish to discuss with your course tutor.

Step 3
Go through the self-assessment questions at the end of each unit. If you find any difficulty in comprehension or locating relevant material, discuss it with your tutor.

Step 4
Study the compulsory recommended books at least for three hours in a week recommended in your study guide. AIOU Tries to read it with the help of specific study guide for the course. You can raise questions on both during your tutorial meetings and workshops.

Step 5
First go through assignments, which are mandatory to solve/complete for this course. Highlight all the points you consider it difficult to tackle, and then discuss in detail with your tutor. This exercise will keep you regular and ensure good results in the form of higher grades.

Assessment
For each three credit hours course, a student will be assessed as follow:
- Two Assignments (continuous assessment during semester).
- Final Examination (three-hours written examination will take place at the end of each semester)
- Mandatory participation in the workshop (as per AIOU policy)
- Workshop Quizzes
- Group discussion

- Presentation

Assignments

- Assignments are written exercises that are required to complete at home or place of work after having studied 9 units/study guides with the help of compulsory and suggested reading material within the scheduled study period. (See the assignments scheduled).
- For this course 02 assignments are uploaded on the AIOU portal along with allied material. You are advised to complete your assignments within the required time and upload it to your assigned tutor.
- This is a compulsory course work, and its successful completion will make you eligible to take final examination at the end of the semester.
- You will upload your assignments to your appointed tutor, whose name is notified to you for assessment and necessary guidance through concerned Regional Office of AIOU. You can also locate your tutor through AIOU website. Your tutor will return your online assignments after marking and providing necessary academic guidance and supervision.

Workshops

- The online mandatory workshops through (LMS) of Bachelor Studies BS Economics (4, Year) courses will be arranged during each semester or as-per AIOU policy. Attendance and course quizzes are compulsory in workshops. A student will not be declared pass until he/she attends the workshop satisfactorily and actively.
- The duration of a workshop for each 03-credit course will be as per AIOU policy.

Revision before the Final Examination

It is very important that you revise the course as systematically as you have been studying.

You may find the following suggestions helpful.

- Go through the course unit one by one, using your notes during tutorial meetings to remind you of the key concepts or theories. If you have not already made notes, do so now.
- Prepare a chronology with short notes on the topics/events/personalities included in all units.
- Go through your assignments and check your weak areas in each case.
- Test yourself on each of the main topics, write down the main points or go through all the notes.
- Make sure to attend the workshops and revise all the points that you find difficult to comprehend.
- Try to prepare various questions with your fellow-students during last few tutorial meetings. A group activity in this regard is helpful. Each student should be given a

topic and revise his topics intensively, summarize it and revise in group, then all members raise queries and questions. This approach will make your studies interesting and provide you an opportunity to revise thoroughly.

- For the final exam paper, go through last semesters' papers. This can clarify questions and deciding how to frame an answer.
- Before your final exams, make sure that,
  - you get your roll-number slip
  - you know the exact location of the examination center
  - you know the date and time of the examination.

Note:

This study guide has been developed to guide the students about the course "Macroeconomic Dynamics". In this context we want to make it clear that you are not bound to depend entirely upon the recommended books in the study guide. In case you are unable to find any recommended book, please free to consult any other book which covers the main contents of the course.

Moreover, you can get information regarding your Assignments, Workshop Schedule, Assignment Results, Tutors, and Final Examination from the AIOU website: www.aiou.edu.pk and through your LMS account. You are advised to regularly visit the university website to update yourself about the activities.

COURSE OUTLINE

This course is comprised of the following units.

UNIT 01: Capital Accumulation and Population Growth

- The Accumulation of Capital
- The Golden Rule Level of Capital
- Population Growth
- Conclusion

UNIT 02: Technology, Empirics and Policy

- Technology Progress in The Solow Model
- From Growth Theory to Growth Empire
- Policies to Promote Growth
- Beyond the Solow Model: Endogenous Growth Theory
- Conclusion

UNIT 03: Beyond the Correlates of Economic Growth

- The Effects of Culture on Economic Growth
- What Determines Culture?
- Cultural Change
- Geography
- Climate
- Natural Resources

UNIT 04: Ramsey-Phelps-Koop man Model of Economic Growth

- Assumptions
- The Dynamics of the Economy Welfare
- The Balanced Growth Path
- The Effects of Government Purchases

UNIT 05: Samualson–Diamond-Gale Overlapping Generations Model

- Assumptions
- The Dynamics of the Economy
- The possibility of Dynamic Inefficiency
- Government in the Diamond Model

UNIT 06: Consumption and Investment in the Framework of Dynamic Macroeconomics

- Dynamic Consumption Theory
- Dynamic Model of Investment

UNIT 07: Monetary and Fiscal Policies in the Framework of Dynamic Macroeconomics

- Monetary Policy in the Framework of Dynamic Macroeconomics
- Monetary Policy in the Framework of Dynamic Macroeconomics

UNIT 08: Dynamic Stochastic General Equilibrium Models

- General Equilibrium Economic Model
- Structure of General Equilibrium Economic Model
- Growth in Dynamic General Equilibrium Model

UNIT 09: Dynamic Macroeconomics in Open Economy

- The Dynamic of Simple Expenditure Model
- The BOP and Money Supply
- Fiscal and Monetary Expansion under Fixed Exchange Rate
- Fiscal and Monetary Expansion under Flexible Exchange Rate
- Open Economy Dynamics under fixed and Flexible Price

Reading Material:
Recommended Textbooks

1. Abel, A. B., Blanchard, O. J., Bernanke, B., & Croushore, D. (2017). Macroeconomics. Pearson UK. 7th edition
2. Bagliano,B. (2007) Models for Dynamic Macroeconomics,
3. Mankive, N. Gregory (2022), Macroeconomics, Harvard University, USA. 11th edition
4. Romer, D. (2012). Advanced Macroeconomics, 4e. New York: McGraw-Hill. Latest edition
5. Romer, D. (2018). Macroeconomic theory. University of California, Berkeley.
6. Shone, R. (2002). Economic Dynamics: Phase diagrams and their Economic application. Cambridge University Press.
7. Stachurski, J. (2009). Economic dynamics: theory and computation. MIT Press. Latest Edition.
8. Sargent, T. J. (2009). Dynamic Macroeconomic theory. Harvard University Press. Latest Edition.

Unit No: 1

CAPITAL ACCUMULATION AND POPULATION GROWTH

Written by: Ms. Saima Ashraf

Reviewed by: Dr. Fouzia Jamshaid

CONTENTS

Page

1.1 INTRODUCTION

To measure economic growth, economists use data on gross domestic product, which measures the total income of everyone in the economy. The real GDP of the mostly countries today is more than five times its 1950 level, and real GDP per person is more than three times its 1950 level. In any given year, we also observe large differences in the standard of living among countries. The main objective of this unit is to understand what causes these differences in income over time and across countries. Our primary task in this unit and the next unit is to develop a theory of economic growth called the Solow growth model. To explain why our national income grows, and why some economies grow faster than others, we must broaden our analysis so that it describes changes in the economy over time. The Solow growth model shows how saving, population growth, and technological progress affect the level of an economy's output and its growth over time. In this unit, we analyze the roles of saving and population growth.

For the better understanding read Mankive, N. Gregory. Principles of Macroeconomics (CH #8) and Romer, D. (2012). Advanced Macroeconomics. McGraw Hill. (CH # 1)

1.2 LEARNING OUTCOMES

1. At the end of this unit, and having completed the Essential readings and activities, you should be able to:
2 understand the concept of accumulation of capital
3 define the golden rule of capital
4 understand the concept of population growth

1.3 Main Topics to Discuss

1.3.1 The Accumulation of Capital

According to Solow growth model, nation's total output of goods and services influences by three factors which are as follows:

- Growth in the capital stock
- Growth in the labor force
- Advances in technology

Our first step is to examine how the supply and demand for goods determine the accumulation of capital and we assume that the labor force and technology are fixed. We then relax these assumptions by introducing changes in the labor force and technology.

1.3.1.1 The Supply of Goods and the Production Function

The supply of goods in the Solow model is depends on the capital stock and the labor force:

$$Y = F(K, L). \quad (1)$$

The Solow growth model assumes that the production function has constant returns to scale. It means that when an increase in inputs (capital and labor) cause the same proportional increase in output. To see that this is true, divide equation # 1 by Labor (L)

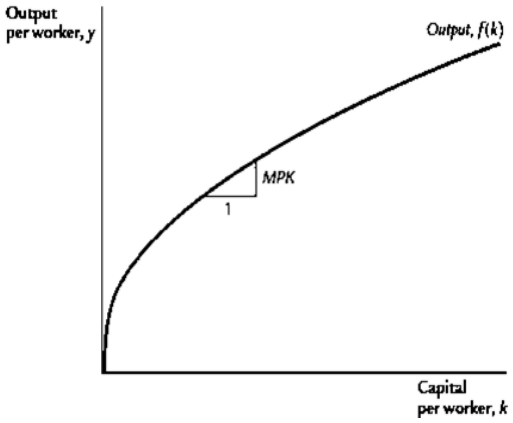
$$Y/L = F(K/L, L/L).$$

$$Y/L = F(K/L, 1). \quad (2)$$

This equation shows that the amount of output per worker Y/L is a function of the amount of capital per worker K/L. (The number 1 is constant and thus can be ignored. We designate quantities per worker with lowercase letters, so $\gamma = Y/L$ is output per worker, and $k = K/L$ is capital per worker. We can then write the production function as:

$$\gamma = f(k), \quad (3)$$

Figure # 1.1



The Production Function The production function shows how the amount of capital per worker k determines the amount of output per worker y = f(k). The slope of the production function is the marginal product of capital: if k increases by 1 unit, y increases by MPK units. The production function becomes flatter ask increases, indicating diminishing marginal product of capital.

The slope of this production function shows how much extra output a worker produces when given an extra unit of capital. This amount is the marginal product of capital MPK. Mathematically, we write.

$$MPK = f(k + 1) - f(k).$$

The Demand for Goods and the Consumption Function

The demand for goods in the Solow model comes from consumption and investment. In other words, output per worker γ is divided between consumption per worker c and investment per worker i:

$$\gamma = c + i.$$

The Solow model assumes that each year people save a fraction s (s, the saving rate, is a number between zero and one) of their income and consume a fraction (1 – s). We can express this idea with the following consumption function.

$$c = (1 - s)\,\gamma,$$

To see what this consumption function implies for investment, substitute (1 – s) γ for c in the national income accounts identity:

$$\gamma = (1 - s)\,\gamma + i.$$

Rearrange the terms to obtain.

$$i = s\gamma.$$

This equation shows that investment equals saving. Thus, the rate of saving s is also the fraction of output devoted to investment. For any given capital stock k, the production function y = f(k) determines how much output the economy produces, and the saving rate s determines the allocation of that output between consumption and investment.

1.3.1.2 Growth in the Capital Stock and the Steady State

At any moment, the capital stock is a key determinant of the economy's output, but the capital stock can change over time, and those changes can lead to economic growth. Two forces influence the capital stock:

- Investment
- Depreciation.

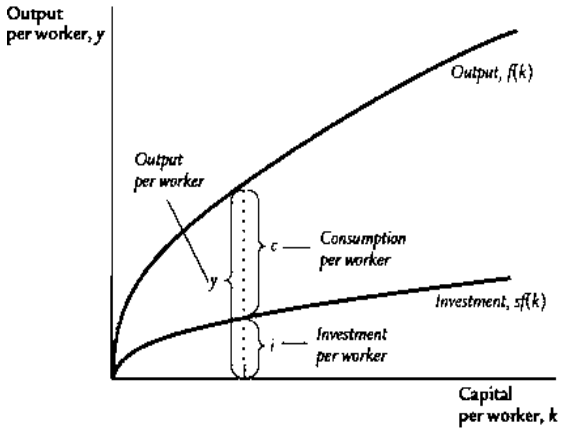
Investment is expenditure on new plant and equipment, and it causes the capital stock to rise. Depreciation is the wearing out of old capital, and it causes the capital stock to fall. As investment per worker i equals sγ. By substituting the production function for γ, we can express investment per worker as a function of the capital stock per worker:

$$i = sf(k).$$

This equation relates the existing stock of capital k to the accumulation of new capital i. Figure 1.2 shows how, for any value of k, the amount of output is determined by the production function f(k), and the allocation of that output between consumption and saving is determined by the saving rate s.

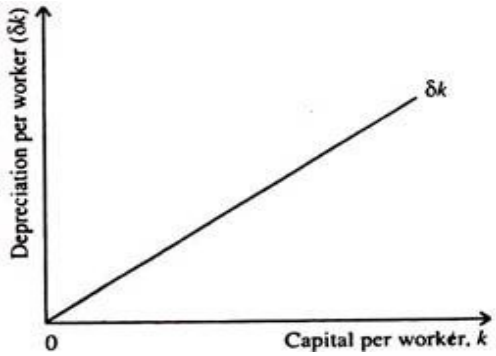
To incorporate depreciation into the model, we assume that a certain fraction **δ** of the capital stock wears out each year. Here **δ** (the lowercase Greek letter delta) is called the depreciation rate. Figure 1.3 shows how the amount of depreciation depends on the capital stock.

Figure # 1.2



Output, Consumption, and Investment The saving rate s determines the allocation of output between consumption and investment. For any level of capital k, output is f(k), investment is sf(k), and consumption is f(k) − sf(k).

Figure # 1.3



Depreciation: A constant fraction δ of the capital stock wears out every year. Depreciation is therefore proportional to the capital stock.

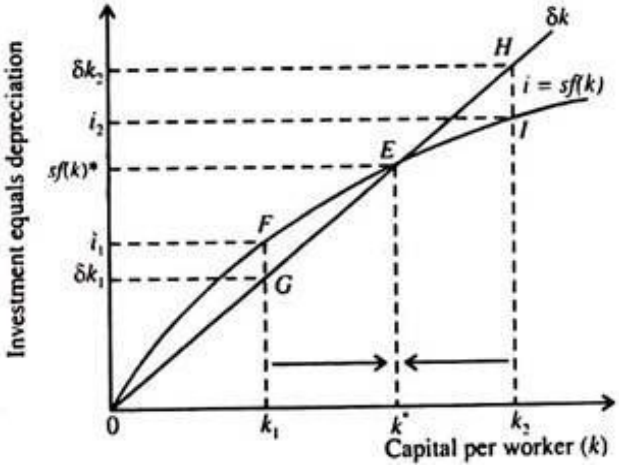
We can express the impact of investment and depreciation on the capital stock with this equation:

$$\text{Change in Capital Stock} = \text{Investment} - \text{Depreciation}$$

$$\Delta k = i - \delta k = sf(k) - \delta k = sy - \delta k$$

The change in capital stock between one year and the next is the difference between investment and depreciation. Figure 1.4 shows the higher the capital stock, the greater the amounts of output and investment. Yet the higher the capital stock, the greater also the amount of depreciation. Fig. 1.4 shows that there is only one capital stock k* at which the amount of investment equals the amount of depre-ciation, so that there is no addition to the capital stock (i.e., $\Delta k = 0$, because $i = sf(k) = \delta k$ at k*). This means that the capital stock (k) and output f(k) remain steady over time. Neither is growing nor falling. Therefore k* is called by Solow the steady-state level of capital.

Figure # 1.4



Investment, Depreciation, and the Steady State The steady-state level of capital k* is the level at which investment equals depreciation, indicating that the amount of capital will not change over time. Below k* investment exceeds depreciation, so the capital stock grows. Above k* investment is less than depreciation, so the capital stock shrinks.

1.3.2 The Golden Rule Level of Capital

The Solow model shows how an economy's rate of saving and the level of investment conjointly determine its steady-state levels of capital and income. According to policy makers, higher saving rate is not always a good thing. Their aim is more consumption and improved living standards of the people. So, every society must take decision regarding optimal consumption and saving (capital formation). The steady-state, value of k which maximizes consumption per worker is called the **Golden Rule Level of Capital**, a term first coined by Edmund Phelps and is denoted by k*g.

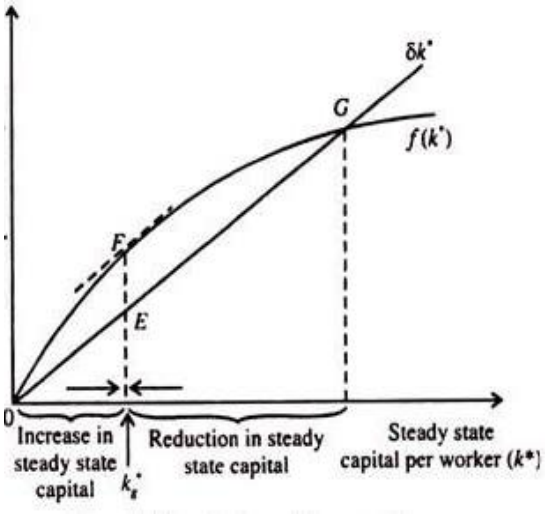
1.3.2.1 Determining the Golden Rule Level of Capital:

In order to ascertain whether the economy is at the Golden Rule level, we must determine first the steady-state consumption per worker. Then we can find out which steady state provides the maximum consumption per worker. Since consumption (c) is the difference between output (y) and investment (i), for finding steady-state consumption, we must substitute steady-state values for output and investment. Steady-state output per worker is f(k*), where k* is the steady-state capital stock per worker. Moreover, in a steady state since capital stock is not changing, investment is equal to depreciation. If we substitute f(k*) for y and δk* for i, we can express steady-state consumption per worker as;

$$c^* = f(k^*) - \delta k^*$$

According to this equation, an increase in steady-state capital has two opposite effects on steady-state consumption. One is favorable, the other is not. On the positive side, more capital means more output. On the negative side, more capital also means that more output must be used to replace worn- out capital.

Figure # 1.5



Steady-State Consumption The economy's output is used for consumption or investment. In the steady state, investment equals depreciation. Therefore, steady-state consumption is the difference between output f(k*) and depreciation δk*. Steady-state consumption is maximized at the Golden Rule steady state. The Golden Rule capital stock is denoted k*gold, and the Golden Rule level of consumption is denoted c*gold.

Fig. 1.5 shows steady-state output and steady-state depreciation as a function of the steady-state capital stock. Steady-state consumption is the difference between output and depreciation. From this figure there is only one level of capital stock — the Golden Rule level of k* — that maximizes consumption. Higher levels of capital affect both output and depreciation. If actual capital stock is less than the Golden Rule level, an increase in capital stock raises output faster than depreciation. As a result, consumption rises.

1.3.2.2 Condition for the Golden Rule of Accumulation:

The Golden Rule level of capital is characterized by a simple condition. Since at the Golden Rule level of capital (k*) the slope of both the production function (i.e., the MPK) and the depreciation line (i.e., δ) are equal;

$$MPK = \delta$$

This equation simply implies that at k*, the MPK is equal to the rate of depreciation.

1.3.3 Population Growth

It is important to understand that how the Solow model incorporate another two sources of economic growth like

- Population growth
- Technological progress.

we suppose that the population and the labor force grow at a constant rate n. For example, the U.S. population grows about 1 percent per year, so n = 0.01. This means that if 150 million people are working one year, then 151.5 million (1.01 × 150) are working the next year, and 153.015 million (1.01 × 151.5) the year after that, and so on.

1.3.3.1 The Steady State with Population Growth

As investment raises the capital stock, and depreciation reduces it. But now there is a third force acting to change the amount of capital per worker: the growth in the number of workers causes capital per worker to fall.

As k = K/L is capital per worker, and γ = Y/L is output per worker. Keep in mind, however, that the number of workers is growing over time.

The change in the capital stock per worker is;

$$\Delta k = i - (\delta + n)\, k.$$

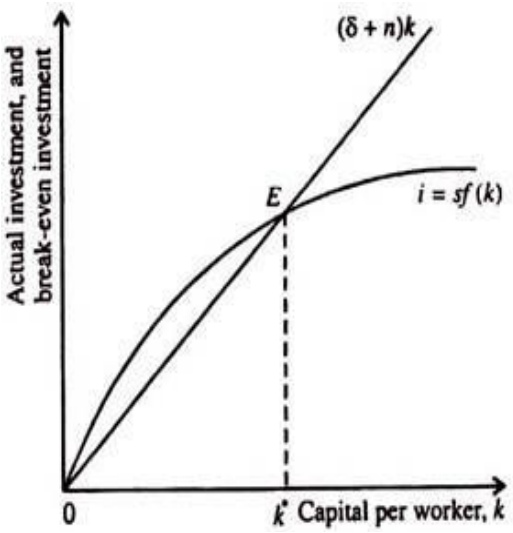
This equation shows that Investment increases k, whereas depreciation and population growth decrease k. The term (δ + n) k as defining break-even investment. Break-even investment includes the depreciation of existing capital (δk) and the amount of investment necessary to provide new workers with capital (nk). The equation shows that population growth reduces the accumulation of capital per worker much the way depreciation does. Depreciation reduces k by wearing out the capital stock, whereas population growth reduces k by spreading the capital stock more thinly among a larger population of workers.

First, we substitute sf(k) for i. The equation can then be written as;

$$\Delta k = sf(k) - (\delta + n)\, k.$$

An economy is in a steady state if capital per worker k is unchanging. As before, we designate the steady-state value of k as k*. If k is less than k*, investment is greater than break-even investment, so k rises. If k is greater than k*, investment is less than break-even investment, so k falls. In the steady state, the positive effect of investment on the capital stock per worker exactly balances the negative effects of depreciation and population growth. That is, at k*, $\Delta k=0$ and $i^*=\delta k^*+nk^*$. Once the economy is in the steady state, investment has two purposes. Some of it (δk^*) replaces the depreciated capital, and the rest (nk^*) provides the new workers with the steady-state amount of capital.

Figure # 1.6



Population Growth in the Solow Model Depreciation and population growth are two reasons the capital stock per worker shrinks. If n is the rate of population growth and dis the rate of depreciation, then (δ+ n) k is break-even investment—the amount of investment necessary to keep constant the capital stock per worker k. For the economy to be in a steady state, investment sf(k) must offset the effects of depreciation and population growth (δ+ n) k. This is represented by the crossing of the two curves.

1.3.3.2 The Effects of Population Growth

Population growth alters the basic Solow model in three ways.

- First, In the steady state with population growth, capital per worker and output per worker are constant. Because the number of workers is growing at rate n, however, total capital and total output must also be growing at rate n. Hence, although population growth cannot explain sustained growth in the standard of living (because output per worker is constant in the steady state), it can help explain sustained growth in total output.
- Second, why some countries are rich, and others are poor. Figure 1.7 shows that an increase in the rate of population growth from n1 to n2 reduces the steady-state level of capital per worker from k* 1 to k* 2. Because k* is lower and because y* = f(k*), the level of output per worker y* is also lower. Thus, the Solow model predicts that countries with higher population growth will have lower levels of GDP per person. Notice that a change in the population growth

rate, like a change in the saving rate, has a level effect on income per person but does not affect the steady-state growth rate of income per person

- Finally, population growth affects our criterion for determining the Golden Rule (consumption-maximizing) level of capital. To see how this criterion changes, note that consumption per worker is.

$$c = \gamma - i.$$

Because steady-state output is f(k*) and steady-state investment is $(\delta + n)\, k^*$, we can express steady-state consumption as;

$$c^* = f(k^*) - (\delta + n)\, k^*.$$

Using an argument largely the same as before, we conclude that the level of k* that maximizes consumption is the one at which.

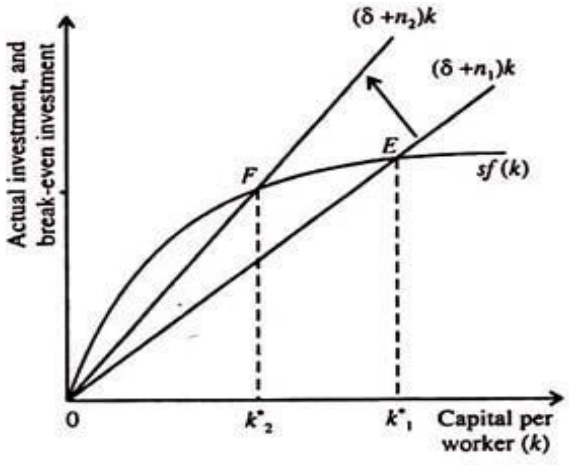
$$MPK = \delta + n,$$

or equivalently,

$$MPK - \delta = n.$$

In the Golden Rule steady state, the marginal product of capital net of depreciation equals the rate of population growth.

Figure # 1.7



The Impact of Population Growth An increase in the rate of population growth from n1 to n2 shifts the line representing population growth and depreciation upward. The new steady state k2 * has a lower level of capital per worker than the initial steady state k1 *. Thus, the Solow model predicts that economies with higher rates of population growth will have lower levels of capital per worker and therefore lower incomes.

1.3.4 Conclusion

This Unit has started the process of building the Solow growth model. The model as developed shows how saving and population growth determine the economy's steady-state capital stock and its steady-state level of income per person. As we have seen, it sheds light on many features of actual growth experiences—why Germany and Japan grew so rapidly after being devastated by World War II, why countries that save and invest a high fraction of their output are richer than countries that save and invest a smaller fraction, and why countries with high rates of population growth are poorer than countries with low rates of population growth. What the model cannot do, however, is explain the persistent growth in

living standards we observe in most countries. In the model we have developed so far, output per worker stops growing when the economy reaches its steady state. To explain persistent growth, we need to introduce technological progress into the model.

1.4 SELF-ASSESSMENT QUESTIONS

1.4.1 Essay Question

1. Explain Solow growth model
2. Why might an economic policymaker choose the Golden Rule level of capital?
3. In the Solow model, how does the rate of population growth affect the steady-state level of income? How does it affect the steady-state rate of growth?
4. How does an increase in the population growth rate affect economic growth?

1.4.2 Multiple Choice Questions

1. When capital increases by ΔK units, output increases by:
2. The Solow growth model describes:

A) how output is determined at a point in time.
B) how output is determined with fixed amounts of capital and labor.
C) how saving, population growth, and technological change affect output over time.
D) the static allocation, production, and distribution of the economy's output

3) In the Solow growth model, the demand for goods equals investment:

A) minus depreciation.
B) plus, saving.
C) plus, consumption.
D) Plus, depreciation

4. In a steady state with population growth and technological progress:

A) the capital share of income increases.
B) the labor share of income increases.
C) in some cases, the capital share of income increases and sometimes the labor share increases.
D) the capital and labor shares of income are constant.

5. In the Solow growth model, the assumption of constant returns to scale means

A) all economies have the same amount of capital per worker.
B) the steady-state level of output is constant regardless of the number of workers.
C) the saving rate equals the constant rate of depreciation.
D) the number of workers in an economy does not affect the relationship between output per worker and capital per worker.

Answer Key (MCQs)

1) MPK * ΔK units
2) C
3) C
4) D
5) D

1.4.1 Key Terms

Solow growth model: It shows that in the long run, an economy's rate of saving determines the size of its capital stock and thus its level of production.

Golden Rule Level of Capital: The steady-state, value of k which maximizes consumption per worker.

Steady state: A situation where an investment is equal to depreciation. That means that investment is being used just to repair and replace the existing capital stock.

Break-even investment: This amount of investment is needed to keep the capital per effective worker constant.

RECOMMENDED BOOKS

1. Abel, A. B., Blanchard, O. J., Bernanke, B., & Croushore, D. (2017). Macroeconomics. Pearson UK. 7th edition (CH # 6)
2. Mankive, N. Gregory (2022), Macroeconomics, Harvard University, USA. 11th edition (CH # 8)
3. Romer, D. (2012). Advanced Macroeconomics, 4e. New York: McGraw-Hill. Latest edition (CH # 1)
4. Romer, D. (2018). Macroeconomic theory. University of California, Berkeley.
5. Todaro, M. P., & Smith, S. C. (2015). Economic Development. Pearson Education,
   (Vol. 1). Bukupedia. (CH # 3)

Links/Bibliography

- http://business.baylor.edu/Tom_Kelly/MANKIW4-5.htm
  (31/3/2020)
- http://www.economicsdiscussion.net/solows-model/solows-analysis-of-growth-economic-growth/15430
  (2/4/2020)
- http://www.economicsdiscussion.net/economic-growth/golden-rule-of-capital-accumulation-economic-growth/15442
  (3/4/2020)
- https://www.economicsdiscussion.net/solows-model/extension-of-the-solow-model-with-diagram/15452
  (28/5/2020)

Unit No: 2

TECHNOLOGY, EMPIRICS AND POLICY

Written by: Ms. Saima Ashraf

Reviewed by:Dr. Fouzia Jamshaid

CONTENTS

Page

2.1 INTRODUCTION

Our first task in this unit is to make the Solow model more general and realistic. Solow model shows how changes in capital (through saving and investment) and changes in the labor force (through population growth) affect the economy's output. Now we add the third source of growth changes in technology. The Solow model does not explain technological progress but, takes it as exogenously.

Our second task is to move from theory to empirics. Over the past two decades, a large literature has examined that the Solow model can shed much light on international growth experiences, but it is far from the last word on the subject.

Our third task is to examine how a nation's public policies can influence the level and growth of its citizens' standard of living. We address five questions: Should our society save more or less? How can policy influence the rate of saving? Are there some types of investment that policy should especially encourage? What institutions ensure that the economy's resources are put to their best use? How can policy increase the rate of technological progress? The Solow growth model provides the theoretical framework within which we consider these policy issues. Our fourth and final task is to consider what the Solow model leaves out. It is important to consider whether we have oversimplified matters. In the last section, we examine a new set of theories, called endogenous growth theories, which help to explain the technological progress that the Solow model takes as exogenous.

For better understanding read Mankive, N. Gregory. Principles of Macroeconomics (CH #08) and Romer, D. (2012). Advanced Macroeconomics. McGraw Hill. (CH # 1)

2.2 LEARNING OUTCOMES

At the end of this unit, and having completed the Essential readings and activities, you should be able to:

- familiarize with the concept of technological progress in the Solow Model
- move from theory to empirics
- understand the fact that how policies to promote growth
- consider what the Solow model leaves out.
- highlights the endogenous growth theory

2.3 MAIN TOPICS TO DISCUSS

2.3.1 Technological Progress in the Solow Model

Solow model assumed an unchanging relationship between the inputs of capital and labor and the output of goods and services. The model can be modified to include exogenous technological progress, which over time expands society's production capabilities.

2.3.1.1 The Efficiency of Labor

The production function is.

$$Y = F(K, L).$$

We now write the production function as;

$$Y = F(K, L \times E),$$

where E is a new (and somewhat abstract) variable called the efficiency of labor. It means the productive capacity of a worker. It indicates the ability of the worker to do more work or better work during a given period. The efficiency of labor rises when there are improvements in the health, education, or skills of the labor force. The term $L \times E$ can be interpreted as measuring the effective number of workers. In other words, L measures the number of workers in the labor force, whereas $L \times E$ measures both the workers and the technology with which the typical worker comes equipped. This new production function states that total output Y depends on the inputs of capital K and effective workers $L \times E$. The essence of this approach to modeling technological progress is that increases in the efficiency of labor E are analogous to increases in the labor force L. The simplest assumption about technological progress is that it causes the efficiency of labor E to grow at some constant rate g. For example, if $g = 0.02$, then each unit of labor becomes 2 percent more efficient each year: output increases as if the labor force had increased by 2 percent more than it really did. This form of technological progress is called labor augmenting, and g is called the rate of labor-augmenting technological progress. Because the labor force L is growing at rate n, and the efficiency of each unit of labor E is growing at rate g, the effective number of workers $L \times E$ is growing at rate $n + g$.

2.3.1.2 The Steady State with Technological Progress

Technological progress does not cause the actual number of workers to increase, technological progress causes the effective number of workers to increase. Previously, when there was no technological progress, we analyzed the economy in terms of quantities per worker; now we can generalize that approach by analyzing the economy in terms of quantities per effective worker. We now let $k = K/(L \times E)$ stand for capital per effective worker and $\gamma = Y/(L \times E)$ stand for output per effective worker. With these definitions, we can again write $\gamma = f(k)$. The equation showing the evolution of k over time becomes.

$$\Delta k = sf(k) - (\delta + n + g)\, k.$$

The change in the capital stock Δk equals investment sf(k) minus breakeven investment $(\delta + n + g)$ k. Break-even investment includes three terms: to keep k constant, δk is needed to replace depreciating capital, nk is needed to provide capital for new workers, and gk is needed to provide capital for the new "effective workers" created by technological progress

Figure: 2.1

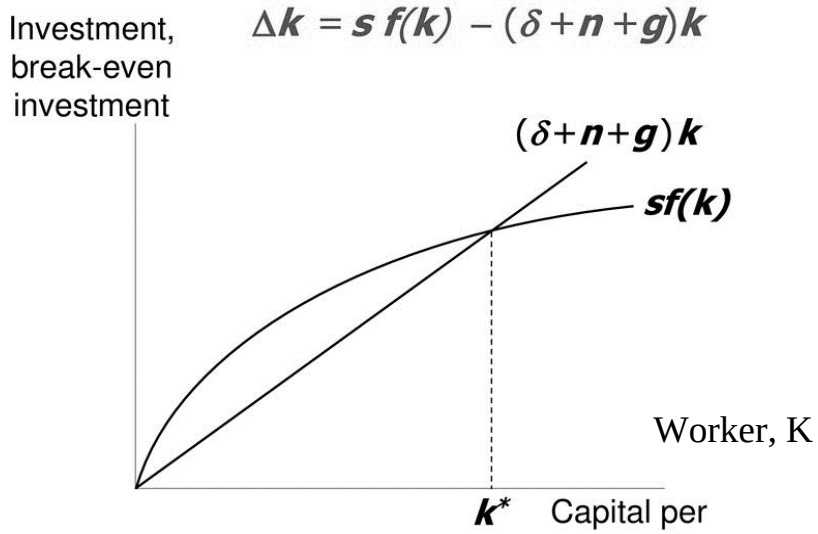


Figure 2.1 shows the inclusion of technological progress does not substantially alter the analysis of the steady state. There is one level of k, denoted k*, at which capital per effective worker and output per effective worker are constant. As before, this steady state represents the long-run equilibrium of the economy.

2.3.1.3 The Effect of Technological Progress

With the addition of technological progress, our model can finally explain the sustained increases in standards of living that we observe. That is, we have shown that technological progress can lead to sustained growth in output per worker. By contrast, a high rate of saving leads to a high rate of growth only until the steady state is reached. Once the economy is in steady state, the rate of growth of output per worker depends only on the rate of technological progress. According to the Solow model, only technological progress can explain sustained growth and persistently rising living standards.

2.3.2 From Growth Theory to Growth Empirics

Solow model introduced exogenous technological progress to explain sustained growth. Let's now discuss what happens when this theory is forced to confront the facts.

2.3.2.1 Balanced Growth

According to the Solow model, technological progress causes the values of many variables to rise together in the steady state. This property, called balanced growth, does a good job of describing the long-run data for the U.S. economy.

Consider first output per worker Y/L and the capital stock per worker K/L. According to the Solow model, in the steady state, both variables grow at g, the rate of technological progress. U.S. data for the past half century show that output per worker and the capital stock per worker have in fact grown at approximately the same rate—about 2 percent per year. Technological progress also affects factor prices. The real rental price of capital is constant over time. These predictions hold true for the United States. Over the past 50 years, the real wage has increased about 2 percent per year; it has increased at about the same rate as real GDP per worker. The real rental price of capital (measured as real capital income divided by the capital stock) has remained about the same. The Solow model's prediction about factor prices is noteworthy when contrasted with Karl Marx's theory of the development of capitalist economies. Marx predicted that the return to capital would decline over time and that this would lead to economic and political crisis. Economic history has not supported Marx's prediction, which partly explains why we now study Solow's theory of growth rather than Marx's.

2.3.2.2 Convergence

There is tremendous variation in living standards around the World. The world's poor countries have average levels of income per person that are less than one-tenth the average levels in the world's rich countries. These differences in income are reflected in almost every measure of the quality of life. Much research has been devoted to the question of whether economies converge over time to one another. Do economies that start off poor subsequently grow faster than economies that start off rich? If they do, then the world's poor economies will tend to catch up with the world's rich economies. This property of catch-up is called convergence. If convergence does not occur, then countries that start off behind are likely to remain poor. The Solow model makes clear predictions about when convergence should occur. According to the model, whether two economies will converge depends on why they differ in the first place. On the one hand, suppose two economies happen by historical accident to start off with different capital stocks, but they have the same steady state, as determined by their saving rates, population growth rates, and efficiency of labor. In this case, we should expect the two economies to converge; the poorer economy with the smaller capital stock will naturally grow more quickly to reach the steady state. On the other hand, if two economies have different steady states, perhaps because the economies have different rates of saving, then we should not expect convergence. Instead, each economy will approach its own steady state.

Experience is consistent with this analysis. In samples of economies with similar cultures and policies, studies find that economies converge to one another at a rate of about 2 percent per year. That is, the gap between rich and poor economies closes by about 2 percent each year. An example is the economies of individual American states. For historical reasons, such as the Civil War of the 1860s, income levels varied greatly

among states at the end of the nineteenth century. Yet these differences have slowly disappeared over time. In international data, a more complex picture emerges. When researchers examine only data on income per person, they find little evidence of convergence: countries that start off poor do not grow faster on average than countries that start off rich. This finding suggests that different countries have different steady states. If statistical techniques are used to control for some of the determinants of the steady state, such as saving rates, population growth rates, and accumulation of human capital (education), then once again the data show convergence at a rate of about 2 percent per year. In other words, the economies of the world exhibit conditional convergence: they appear to be converging to their own steady states, which in turn are determined by such variables as saving, population growth, and human capital.

2.3.2.3 Factor Accumulation Versus Production Efficiency

An international difference in income per person can be attributed to either (1) differences in the factors of production, such as the quantities of physical and human capital, or (2) differences in the efficiency with which economies use their factors of production. That is, a worker in a poor country may be poor because he lacks tools and skills or because the tools and skills he has are not being put to their best use. To describe this issue in terms of the Solow model, the question is whether the large gap between rich and poor is explained by differences in capital accumulation (including human capital) or differences in the production function. Much research has attempted to estimate the relative importance of these two sources of income disparities. The exact answer varies from study to study, but both factor accumulation and production efficiency appear important. Moreover, a common finding is that they are positively correlated: nations with high levels of physical and human capital also tend to use those factors efficiently. There are several ways to interpret this positive correlation. One hypothesis is that an efficient economy may encourage capital accumulation. Another hypothesis is that capital accumulation may induce greater efficiency. A final hypothesis is that both factor accumulation and production efficiency are driven by a common third variable. Perhaps the common third variable is the quality of the nation's institutions, including the government's policymaking process.

2.3.3 Policies to Promote Growth

According to the Solow growth model, how much a nation saves and invests is a key determinant of its citizens' standard of living. So, policy discussion starts with a natural question: is the rate of saving in the economy too low, too high, or about, right? Saving, investment allocation and institutions play an important role to promote growth.

2.3.3.1 Changing the Rate of Saving

To move the economy toward the Golden Rule steady state, policymakers should increase national saving. But how can they do that? Higher national saving means higher public saving, higher private saving, or some combination of the two. Much of the debate on which of these options is likely to be most effective. The government affects national saving through

public saving. When its spending exceeds its revenue, the government runs a budget deficit, which represents negative public saving. The government also affects national saving by influencing private savings. How much people decide to save depends on the incentives they face, and these incentives are altered by a variety of public policies.

Many economists argue that high tax rates on capital discourage private saving. Some economists have proposed increasing the incentive to save by replacing the current system of income taxation with a system of consumption taxation. Many disagreements over public policy are rooted in different views about how much private saving responds to incentives.

2.3.3.2 Allocating the Economy's Investment

Policymakers trying to stimulate economic growth must confront the issue of what kinds of capital the economy needs most. policymakers can rely on the marketplace to allocate the pool of saving to alternative types of investment. Those industries with the highest marginal products of capital will naturally be most willing to borrow at market interest rates to finance new investment. Many economists advocate that the government should merely create a "level playing field" for different types of capital. Most economists are skeptical about industrial policies. Once the government gets into the business of rewarding specific industries with subsidies and tax breaks, the rewards are as likely to be based on political clout as on the magnitude of externalities.

One type of capital that necessarily involves the government is public capital. This policy was motivated by a desire partly to increase short-run aggregate demand and partly to provide public capital and enhance long-run economic growth.

2.3.3.3 Establishing the Right Institutions

One reason of nations may have different levels of production efficiency is that they have different institutions guiding the allocation of scarce resources. Creating the right institutions is important for ensuring that resources are allocated to their best use.

A nation's legal tradition is an example of such an institution. Some countries, such as the United States, Australia, and Singapore have English-style common-law systems. Other nations, such as Italy and Spain have legal traditions that evolved from the French Napoleonic Code. Studies have found that legal protections for shareholders and creditors are stronger in English-style than French-style legal systems. As a result, the English-style countries have better-developed capital markets. Nations with better-developed capital markets, in turn, experience more rapid growth because it is easier for small and start-up companies to finance investment projects, leading to a more efficient allocation of the nation's capital. Another important institutional difference across countries is the quality of government itself. Ideally, governments should provide a "helping hand" to the market system by protecting property rights, enforcing contracts, promoting competition, prosecuting fraud, and so on.

2.3.4 Beyond the Solow Model: Endogenous Growth Theory

To understand fully the process of economic growth, we need to go beyond the Solow model and develop models that explain technological advance. Models that do this often go by the label endogenous growth theory because they reject the Solow model's assumption of exogenous technological change.

According to Endogenous theory, the long-run rate of growth is primarily determined by endogenous variables that are internal to the system, such as human capital, innovation and investment capital.

2.3.4.1 Understanding Endogenous Growth

Endogenous growth theory popularized in the 1980. The endogenous growth theory was developed as a reaction to omissions and deficiencies in the Solow- Swan neoclassical growth model. This theory explains the long-run growth rate of an economy based on endogenous factors as against exogenous factors of the neoclassical growth theory. Endogenous growth theory holds that **investment in human capital, innovation, and knowledge** are significant contributors to economic growth.

Assumption of the theory

- There are many firms in a market. Knowledge or technological advance is a non-rival good.
- There are increasing returns to scale to all factors taken together and constant returns to a single factor, at least for one.
- Technological advance comes from things people do. This means that technological advance is based on the creation of new ideas.
- Many individuals and firms have market power and earn profits from their discoveries. This assumption arises from increasing returns to scale in production that leads to imperfect competition.

Key factors of this theory

- The long run growth rate of an economy depends on government policy measures. For example, subsidies for research and development or education increase the growth rate
- This theory is also needed to elaborate the economic advantages of the industrialized or developed countries versus developing or non-industrialized countries.
- Technological advancements are considering as an essential factor when explaining economic growth
- Government policy should encourage entrepreneurship as a means of creating new businesses and ultimately as an important source of new jobs, investment and innovation
- To specify capital accumulation, human capital is added in the model to represent time, energy and money devoted to acquiring knowledge by individuals.

- Investment in human capital leads to leads to more productive labor, which generates higher wages. Furthermore, skilled laborers may also generate other positive external effects.
- There are increasing returns to scale from capital investment especially in infrastructure and investment in education and health and telecommunications.
- Private sector investment in **research & development** is a key source of technical progress. The protection of property rights and patents is essential in providing incentives for businesses and entrepreneurs to engage in research and development.
- Therefore, an extra independent variable (H: human capital) is taken in the economy's production function:

$$Y = AF(K, L, H)$$

- Furthermore, public infrastructure is a factor directly contributing to economic productivity. Therefore, the economic production function is extended by including this factor KG:

$$Y = AF(K, L, H, KG)$$

2.3.5 Conclusion

Long-run economic growth helps to lift people out of extreme poverty. Sustained growth stimulates jobs and contributes to lower unemployment rates which is turn helps to reduce income inequality. Higher economic growth will raise tax revenues and reduce government spending on unemployment & poverty related welfare benefits. In this context, the Solow growth model and the endogenous growth models show how saving, population growth, and technological progress interact in determining the level and growth of a nation's standard of living. These theories give much insight, and they provide the intellectual framework for much of the debate over public policy aimed at promoting long-run economic growth.

2.4 SELF-ASSESSMENT QUESTIONS

2.4.1 Essay Questions

1. In the Solow model, what determines the steady-state rate of growth of income per worker?
2. How can policymakers influence a nation's saving rate?
3. How does endogenous growth theory explain persistent growth without the assumption of exogenous technological progress? How does this differ from the Solow model?
4. In the steady state of the Solow model, at what rate does output per person grow? At what rate does capital per person grow?

2.4.2 Multiple Choice Questions

1. The production function Y = F (K, L *E) where E stands for
    a. Efficiency of Labor
    b. External Labor
    c. Extraordinary Labor
2. Technological progress causes the values of many variables to rise together in the steady state. This property called.
    a. Balanced growth
    b. Un balanced growth

If endogenous growth models are correct, a lower rate of growth in the long run could occur as a result of which of the following?

A) a lower rate of saving
B) a lower rate of depreciation
C) a redefinition of depreciation
D) a redefinition of the steady state
E) none of the above

3. If endogenous growth models are correct, a lower rate of growth in the long run could occur as a result of which of the following?
    a. A lower rate of saving
    b. A lower rate of depreciation
    c. A redefinition of depreciation
4. Which theory is based on the concept of Technological progress?
    a. Endogenous growth theory
    b. Solow Growth

Answer Key

1) a
2) a
3) a
4) b

2.5 KEY TERMS

Labor: The term "labor" encompasses all people who work for pay
Efficiency of labor: It means the productive capacity of a worker.
The endogenous growth models: It emphasize technical progress resulting from the rate of investment, the size of the capital stock, and the stock of human capital.

RECOMMENDED BOOKS

1 Abel, A. B., Blanchard, O. J., Bernanke, B., & Croushore, D. (2017). Macroeconomics. Pearson, UK. 7th edition (CH # 6)

2 Mankiw, N. G. (2020). Principles of macroeconomics. Cengage Learning. Harvard University, USA. 9th edition (CH #08)

3 Mankive, N. Gregory (2022), Macroeconomics, Harvard University, USA. 11th edition (CH # 8)

4 Romer, D. (2012). Advanced Macroeconomics, 4e. New York: McGraw-Hill. Latest edition (CH # 1)

5. Romer, D. (2018). Macroeconomic theory. University of California, Berkeley.

6. Todaro, M. P., & Smith, S. C. (2015). Economic Developments' Pearson Education, (Vol. 1). Bukupedia. (CH # 3).

Links/Bibliography

- https://www.topperlearning.com/answer/define-efficiency-of-labour-/3e5n1kdll (31/5/2020)
- https://www.investopedia.com/terms/e/endogenous-growth.asp (4/6/2020)
- https://www.pitt.edu/~mgahagan/Solow.htm (4/6/2020)
- https://www.tutor2u.net/economics/reference/economic-growth-neo-classical-growth-the-solow-model (4/6/2020)

Unit No: 3

BEYOND THE CORRELATED OF ECONOMIC GROWTH

Written by: Ms. Saima Ashraf

Reviewed by: Dr. Fouzia Jamshaid

CONTENTS

Pages

3.1 INTRODUCTION

Economics and economic systems, especially in the developing world, must be viewed in a broader perspective than that postulated by traditional economics. They must be analyzed within the context of the overall social system of a country and, indeed, within an international, global context as well. By "social system," we mean the interdependent relationships between economic and noneconomic factors. In this unit, we introduce the study of non-economic factors and their influence on economic growth and development. The developing world has made substantial economic development progress in recent years. But the most striking feature of the global economy remains its extreme contrasts. Output per worker in the United States is about 10 times higher than that of in India and more than 50 times higher than in the Democratic Republic of Congo (DRC). How did such wide disparities come about? Why have some developing countries made so much progress in closing these gaps, while others have made so little? The developing nations must face a lot of challenges and noneconomic factors which hinder them to get progress. These challenges encompass culture, customs, habits, religion, climate, adverse geography, limited natural resources and social system. In this unit, we discuss all these factors and their consequences on the economy.

For better understanding read Todaro, M. P., & Smith, S. C. (2015). Economic Development, Pearson Education, 2015: Economic Development (Vol. 1). Bukupedia. (CH # 2)

3.2 LEARNING OUTCOMES

At the end of this unit, and having completed the Essential readings and activities, you should be able to:

- explain the effect of culture on economic growth
- familiarize with the concept of what determine culture?
- understand the impact of change in culture on economy
- familiarize the concept of geography and its consequences
- highlights the topic of climate
- identify the impact of natural resources

3.3 MAIN TOPICS TO DISCUSS

3.3.1 The Effect of Culture on Economic Growth

Culture refers to the cumulative deposit of knowledge, experience, beliefs, values, attitudes, meanings, hierarchies, religion, notions of time, roles, spatial relations, concepts of the universe, and material objects and possessions acquired by a group of people in the course of generations through individual and group striving. It is the systems of knowledge shared by a relatively large group of people. Culture is communication, communication is culture. Culture varies widely from one region of the world to another and from one social setting to another. Culture and economy are intricately related. A culture consists of the "objects" of a society,

3.3.1.1 Culture and Economic Growth

Experience is showing how the cultural resources of a community can be converted into economic wealth by promoting the unique identity, traditions, and cultural products and services of a region, towards generating jobs and revenue. Investing in the conservation of cultural assets, promoting cultural activities and traditional knowledge and skills developed by humans over very long periods of adaptation to the environment, moreover, are also very effective means to strengthen environmental sustainability and the social capital of communities.

3.3.1.2 Culture and Politics

Politically, culture plays a natural part in a development policy that is serious about human rights. A free and strong cultural sector will promote other rights and values such as freedom of expression, diversity and debate about needs in society. Culture ensures unity during crisis, influences identity, debate and dialogue. It is important for nation building and for peace and reconciliation.

3.3.1.3 Culture and Development

Culture is one of the main pillars of development and sustenance of communities and no society can progress in its absence. It is the identity where common values, attitudes, preferences, knowledge are attributed to the behavior in a particular social group and has a positive influence on social development in any given country.

Women Contribution

In many cultures, it is considered socially unacceptable for women to contribute significantly to household income, and hence women's work may remain concealed or unrecognized. These combined factors perpetuate the low economic status of women and can lead to strict limitations on their control over household resources.

Development policies that increase the productivity differentials between men and women are likely to worsen earnings disparities as well as further erode women's economic status within the household. Studies have shown that development efforts can increase women's workload while at the same time reduce the share of household resources over which they exercise control. Consequently, women and their dependents remain the most economically vulnerable group in developing countries.

Role of Culture

The role of culture in creating green jobs, reducing poverty, making cities more sustainable, providing safe access to water and food, preserving the natural resources and strengthening the resilience of communities in the face of disasters, is truly major and irreplaceable.

Impact on Society

Traditional celebrations are some of the core aspects of any culture. Whether it is a wedding, a harvest festival, a religious holiday, or a national observance, our celebrations are woven tightly into our overall cultural identity. Celebrating our traditions offers an excellent opportunity for intercultural exchange and understanding. The undertakings contribute to an increase in the intellectual potential and build conscious, open and tolerant society. Cultural events are fun, entertaining and educative. They allow individuals to integrate physically and mentally. Identity expressed through culture is a necessity for all human development.

3.3.2 What Determine Culture?

The values and norms of a culture do not emerge fully formed. There are six determinant of culture including prevailing political and economic philosophies, the social structure of a society, and the dominant religion, language, and education.

1. Education

Education plays a key role in a society. It is a medium through which individual learn many of the language, conceptual, and mathematical skills that are indispensable in a modern society.

2. Religious and Ethical Systems

It includes Christianity, Islam, Hinduism, Buddhism, and Confucianism etc. It is a system of shared beliefs and rituals that concerned with the realm of the sacred and refer to a set of moral principles, or values, that are used to guide and shape behavior. Most of the world's ethical systems are the product of religious.

3. Political Philosophy

It is the fundamental questions about the state, government, politics, liberty, justice and the enforcement of a legal code by authority.

4. Language

Language is one the defining characteristics of a culture and it includes spoken and unspoken. With spoken language, people can communicate with each other and it is the nature of a language structures the way we perceive the world. Unspoken language is used in nonverbal communication by a host of nonverbal cues.

5. Economic Philosophy

It concerns itself with conceptual, methodological, and ethical issues that arise within the scientific discipline of economics.

6. Social Structure

It refers the basic social organization. The first is the degree to which the basic unit of social organization is the individual. The second is the degree to which a society is stratified into classes or castes.

3.3.3 Culture Change

Any process of growth and culture that fails to improve the welfare of the people experiencing the greatest hardship, broadly recognized to be women and children, has failed to accomplish one of the principal goals of development. This is part of an exploration into why some countries are poorer than others. These societies should change their culture in order to get progress.

3.3.3.1 Discrimination

Sometimes there are social or cultural factors that hold back poor countries. Discrimination is one of these. If there are certain people groups that are discriminated against, the country's overall productivity can suffer. This may be a tribe, a caste, a racial category, or minority language group.

3.3.3.2 Women Culture Change

The fact that the welfare of women and children is strongly influenced by the design of development policy underscores the importance of integrating women into development programs. To improve living conditions for the poorest individuals, women must be drawn into the economic mainstream. This would entail increasing female participation rates in educational and training programs, formal-sector employment, and agricultural extension programs. It is also of primary importance that precautions be taken to ensure that women have equal access to government resources provided through schooling, services, employment, and social security programs. Legalizing informal-sector employment where most of the female labor force is employed would also improve the economic status of women.

3.3.3.3 Population

Closely linked to this is the population issue. If women see staying at home and bringing up children as their chief role, they will have more children than those who work. There is nothing wrong with having lots of children, if you can provide for them. With fewer children, a poor household can invest more in the health and education of each child, thereby equipping the next generation with the health, nutrition, and education that can lift living standards in future years.

The limits of cultural interpretations

At the same time, cultural influences on development are notoriously hard to call from the outside. Hinduism was often cited as one of the reasons why India would never develop. Because everyone accepts their place in the world, it was assumed that Hindus would lack the ambition required to innovate and do business on an international stage.

3.3.4 Geography

Location and climate have large effects on income levels and income growth through their effects on transport costs, disease burdens, and agricultural productivity, among other channels.

Geography also seems to affect economic policy choices. Geography such as tropical pests, mountains, and other physical barriers, distance to world markets, and landlocked status (which may render port access politically dubious or economically costly) may limit the ability of a low-income country to initiate and sustain economic development, especially when other compounding factors are present. When these constraints are most binding, development policy must initially focus on strategies for overcoming them.

The assumption in much of the press is that there must be something fundamentally different and special about the geography and climate of this region and the culture of its peoples to explain its recurrent plight. But, in fact, similar root problems are found in this area as in other regions that have failed to develop poor institutions, ethnolinguistic fractionalization, and "fault lines" of regional inequality corresponding with ethnic or religious areas. Undoubtedly the area has some quite unfavorable geography; but other regions with unfavorable endowments have substantially overcome their disadvantages over time.

3.3.4.1 Adverse Geography

Many analysts argue that geography must play some role in problems of agriculture, public health, and comparative development more generally. Landlocked economies, common in Africa, often have lower incomes than coastal economies. Developing countries are primarily tropical or subtropical, and this has meant that they suffer more from tropical pests and parasites, endemic diseases such as malaria, water resource constraints, and extremes of heat. A great concern going forward is that global warming is projected to have its greatest negative impact on Africa and South Asia. The extreme case of favorable physical resource endowment is the oil rich Persian Gulf states. At the other extreme are countries like Chad, Yemen, Haiti, and Bangladesh, where endowments of raw materials and minerals and even fertile land are relatively minimal. However, as the case of the DRC shows vividly, high mineral wealth is no guarantee of development success. Conflict over the profits from these industries has often led to a focus on the distribution of wealth rather than its creation and to social strife, undemocratic governance, high inequality, and even armed conflict, in what is called the "curse of natural resources." Clearly, geography is not destiny; high-income Singapore lies almost directly on the equator, and parts of southern India have exhibited enormous

economic dynamism in recent years. Prior to colonization, some tropical and subtropical regions had higher incomes per capita than Europe. However, the presence of common and often adverse geographic features in comparison to temperate zone countries means it is beneficial to study tropical and subtropical developing countries together for some purposes. Redoubled efforts are now under way to extend the benefits of the green revolution and tropical disease control to sub-Saharan Africa.

3.3.5 Climate

Almost all developing countries are situated in tropical or subtropical climatic zones. It has been observed that the economically most successful countries are in the temperate zone. Although social inequality and institutional factors are widely believed to be of greater importance, the dichotomy is more than coincidence. Colonialists apparently created unhelpful "extractive" institutions where they found it uncomfortable to settle. But also, the extremes of heat and humidity in most poor countries contribute to deteriorating soil quality and the rapid depreciation of many natural goods. They also contribute to the low productivity of certain crops, the weakened regenerative growth of forests, and the poor health of animals. Extremes of heat and humidity not only cause discomfort to workers but can also weaken their health, reduce their desire to engage in strenuous physical work, and generally lower their levels of productivity and efficiency. As malaria and other serious parasitic diseases are often concentrated in tropical areas. There is evidence that tropical geography does pose significant problems for economic development and that special attention in development assistance must be given to these problems, such as a concerted international effort to develop a malaria vaccine.

3.3.6 Natural Resources

No simple generalization is possible as to the role of natural resources in the economic development of the country because the distribution of natural resources among them is so uneven. Some Developing countries have valuable deposits of bauxite, tin, copper, tungsten, nitrates, and petroleum and have been able to use their natural resource endowments to achieve rapid growth. This is true, for instance, of Kuwait and several other members of the Organization of Petroleum Exporting Countries (OPEC). In other

instances, natural resources are owned or controlled by the multinational corporations of industrially advanced countries, with the economic benefits from these resources largely diverted abroad. Furthermore, world markets for many of the farm products and raw materials that the Developing countries export are subject to large price fluctuations that contribute to instability in their economies.

Other Developing countries lack mineral deposits, have little arable land, and have few sources of power. Moreover, most of the poor countries are situated in Central and South America, Africa, the Indian subcontinent, and southeast Asia, where tropical climates prevail. The heat and humidity hinder productive labor; human, crop, and livestock diseases are widespread; and weed and insect infestations plague agriculture. A weak resource base can be a serious obstacle to growth. Real capital can be accumulated, and the quality of the labor force improved through education and training. But it is not as easy to augment the natural resource base. It may be unrealistic for many of the Developing countries to envision an economic destiny comparable with that of, say, the United States or Canada. But we must be careful in generalizing: Japan, for example, has achieved a high level of living despite a limited natural resource base. It simply imports the large quantities of natural resources that it needs to produce goods for consumption at home and export abroad.

3.4 SELF-ASSESSMENT QUESTIONS

3.4.1 Essay Questions

1) What is the impact of economic and noneconomic factors on the economic growth?
2) How change in culture is important to get prosperity?
3) Explain the determinant of culture and how culture can be changed?
4) Highlight the importance of women contribution in the process of economic growth.
5) Provide examples of the importance of natural resources to economics.

3.4.2 Multiple Choice Questions

1. What is not one of the layers of cultural influence?
    a) Social
    b) Organizational
    c) Company
2. Which of the following is not normally perceived as a component of culture?

a) Values
b) Motivation
c) Religion

3. Which of the following statements about factors of production is false?
    a) The term 'factors of production' is another term for resources.
    b) The factor of production termed labor means human resources.
    c) The factor or production termed land means natural resources.
    d) The factor of production termed capital means the money which the owners of firms need in order to set their firms up.
4. Traditional environmental issues include which of the following?
    a) Natural resource conservation.
    b) Climate change.
    c) Pollution.
    d) All of them

Answer Key (MCQs)

1) c
2) b
3) d
4) d

3.5 KEY TERMS

Culture: It encompasses the social behavior and norms found in human societies, as well as the knowledge, beliefs, arts, laws, customs, capabilities, and habits of the individuals in these groups

Social system: The organizational and institutional structure of a society, including its values, attitudes, power structure, and traditions.

Climate: The weather conditions prevailing in an area in general or over a long period.

Geography: It is a field to the study of the lands, features, inhabitants, and phenomena of the Earth and planet

Resource endowment: A nation's supply of usable factors of production, including mineral deposits, raw materials, and labor.

Natural resources: The resources that exist without actions of humankind. This includes all valued characteristics like magnetic, gravitational, electrical properties and forces, etc.

OPEC: The Organization of the Petroleum Exporting Countries is an intergovernmental organization of 13 nations. Founded on 14 September 1960 in Baghdad.

RECOMMENDED BOOKS

1. Ghatak, S., & Levine, P. (2009). *Development Macroeconomics*. New York: Routledge.
2. McConnell, C. R., Brue, S. L., & Flynn, S. M. (2009*). Economics: Principles, problems, and policies.* Boston McGraw-Hill/Irwin. (CH# 39)
3. Romer, D. (2018). *Macroeconomic theory*. University of California, Berkeley.
4. Todaro, M. P., & Smith, S. C. (2015). *Economic Developments'* Pearson Education, (Vol. 1). Bukupedia. (CH #2)

LINKS/BIBLIOGRAPHY

- https://www.livescience.com/21478-what-is-culture-definition-of-culture.html 8/6/2020
- http://people.tamu.edu/~i-choudhury/culture.html 9/6/2020
- https://www.premiumtermpapers.org/what-is-culture-what-are-the-six-determinants-or-factors-that-influence-culture/ 9/6/2020
- https://earthbound.report/2007/07/01/cultural-and-social-factors-that-affect-development/ 9/6/2020
- https://en.wikipedia.org/wiki/Economic_geography 9/6/2020

Unit No: 4

RAMSEY-PHELPS-KOOP MAN MODEL OF ECONOMIC GROWTH

Written by: Dr. Fouzia Jamshaid

Reviewed by: Ms. Rabia Batool

CONTENTS

Page

4.1 INTRODUCTION

In this unit, we will discuss the Ramsey–Cass–Koopmans model, or Ramsey growth model. It is a neoclassical model of economic growth based primarily on the work of Frank P. Originally Ramsey set out the model as a social planner's problem of maximizing levels of consumption over successive generations. Originally Ramsey set out the model as a social planner's problem of maximizing levels of consumption over successive generations. The Ramsey–Cass–Koopmans model differs from the Solow–Swan model in that the choice of consumption is explicitly micro founded at a point in time and so endogenizes the savings rate. As a result, unlike in the Solow–Swan model, the saving rate may not be constant along the transition to the long run steady state.

In this unit, we will also discuss the assumption the Ramsey–Cass–Koopmans model, or Ramsey growth model. This unit will also elaborate the topics of the Dynamics of the Economy Welfare, the Balanced Growth Path and the Effects of Government Purchases
For better understanding read Romer, D. (2012). Advanced Macroeconomics. McGraw Hill.(CH # 2)

4.2 LEARNING OUTCOMES

At the end of this unit, and having completed the Essential readings and activities, you should be able to:

- familiar with the assumptions of Ramsey–Cass–Koopmans model, or Ramsey growth model.
- define the concept of dynamics of the economy welfare
- explain how balanced growth path works
- highlight the effects of government purchases

4.3 Main Topics to Discuss

4.3.1 Assumptions

The model assumes a single market economy within a continuous time, frame in which households and firms operate in closed, perfectly competitive market conditions. There exists no links between generations that live infinitely, and all households and firms are identical. Consumers have "rational expectations", meaning households have perfect knowledge of how market work to internalize their consumption behaviors.

4.3.1.1 Firms

There are many identical firms. Each has access to the production function Y = F (K, AL), which satisfies the same assumptions as in Chapter 1. The firms hire workers and rent capital in competitive factor markets and sell their output in a competitive output market. Firms take A as given; as in the Solow model, A grows exogenously at rate g. The firms maximize profits. They are owned by the households, so any profits they earn accrue to the households.

4.3.1.2 Households

There are also many identical households. The size of each household grows at rate n. Each member of the household supplies 1 unit of labor at every point in time. In addition, the household rents whatever capital it owns to firms. It has initial capital holdings of K (0)/H, where K (0) is the initial amount of capital in the economy and H is the number of households. As in the Solow model, the initial capital stock is assumed to be strictly positive. For simplicity, here we assume there is no depreciation. The household divides its income (from the labor and capital it supplies and, potentially, from the profits it receives from firms) at each point in time between consumption and saving so as to maximize its lifetime utility. The household's utility function takes the form.

4.3.1.3 Utility function

C (t) is the consumption of each member of the household at time t. u (•) is the instantaneous utility function, which gives each member's utility at a given date. L (t) is the total population of the economy; L (t)/H is therefore the number of members of the household. Thus u (C (t)) L (t)/H is the household's total instantaneous utility at t. Finally, ρ is the discount rate; the greater is ρ, the less the household values future consumption relative to current consumption.1

The instantaneous utility function takes the form

$$U(C(t)) = C(t)^{1-\theta}$$

$$1 - \theta,\ \theta > 0,\ \rho - n - (1 - \theta)g > 0. \quad (2.2)$$

This functional form is needed for the economy to converge to a balanced growth path. It is known as constant-relative-risk-aversion (or CRRA) utility. The reason for the name is that the coefficient of relative risk aversion (which is defined as $-Cu''(C)/u'(C)$) for this utility function is θ, and thus is independent of C. Since there is no uncertainty in this

model, the household's attitude toward risk is not directly relevant. But θ also determines the household's willingness to shift consumption between different periods. When θ is smaller, marginal utility falls more slowly as consumption rises, and so the household is more willing to allow its consumption to vary over time. If θ is close to zero, for example, utility is almost linear in C, and so the household is willing to accept large swings in consumption to take advantage of small differences between the discount rate and the rate of return on saving. Specifically, one can show that the elasticity of substitution between consumption at any two points in time is 1/θ.2

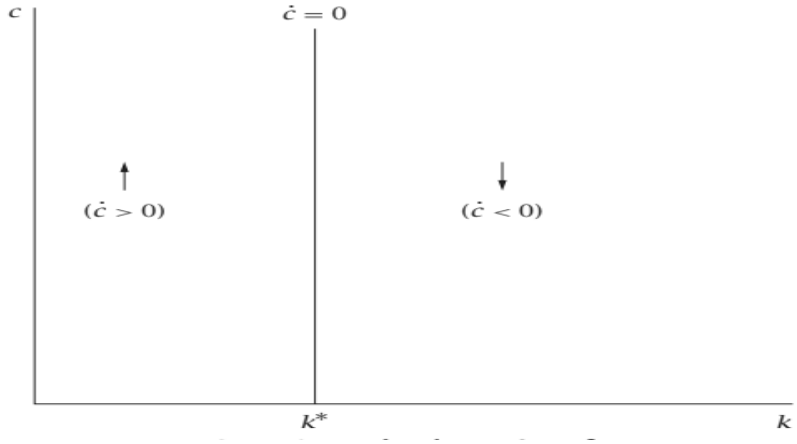
Three additional features of the instantaneous utility function are worth mentioning. First, $C^{1-\theta}$ is increasing in C if $\theta < 1$ but decreasing if $\theta > 1$;

dividing $C^{1-\theta}$ by $1 - \theta$ thus ensures that the marginal utility of consumption is positive regardless of the value of θ. Second, in the special case of $\theta \to 1$, the instantaneous utility function simplifies to ln C; this is often a useful case to consider.3 And third, the assumption that $\rho - n - (1 - \theta)\, g > 0$ ensures that lifetime utility does not diverge: if this condition does not hold, the household can attain infinite lifetime utility, and its maximization problem does not have a well-defined solution.4

4.3.2 The Dynamics of the Economy Welfare

The most convenient way to describe the behavior of the economy is in terms of the evolution of *c* and *k*.

FIGURE 4.1 The dynamics of c



4.3.2.1 The Dynamics of c

Since all households are the same, equation (2.20) describes the evolution of c not just for a single household but for the economy. Since r (t) = f (k (t)), we can rewrite (2.20) as

$$\frac{\dot{c}(t)}{c(t)} = \frac{f'(k(t)) - \rho - \theta g}{\theta}.$$

Thus ˙c is zero when f(k) equals ρ +θ g. Let k∗ denote this level of k. When k exceeds k∗, f _(k) is less than ρ + θ g, and so ˙c is negative; when k is less than k∗, ˙c is positive. This information is summarized in Figure 2.1. The arrows show the direction of motion of c. Thus, c is rising if k < k∗ and falling if k > k∗. The ˙c = 0 line at k = k∗ indicates that c is constant for this value of k.10

4.3.2.2 The Dynamics of k

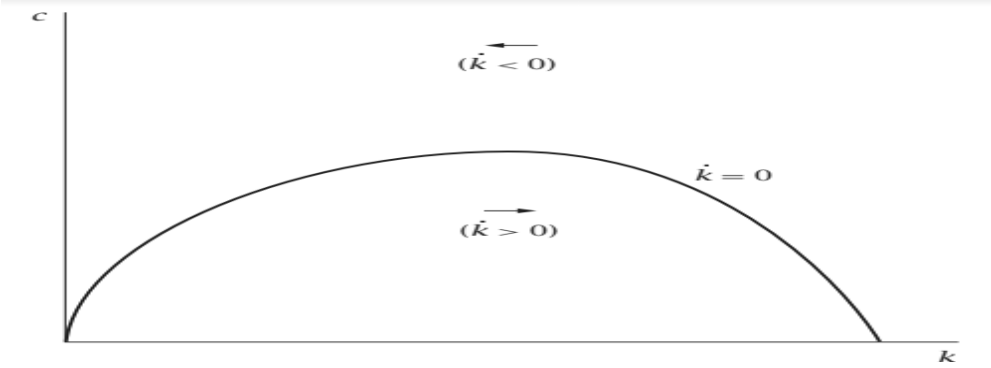
As in the Solow model, ˙k equals actual investment minus break-even investment. Since we are assuming that there is no depreciation, break-even investment is (n + g) k. Actual investment is output minus consumption,

f (k) − c. Thus,

$$\dot{k}(t) = f(k(t)) - c(t) - (n + g)k(t).$$

For a given k, the level of c that implies ˙k = 0 is given by f (k) − (n + g)k; in terms of Figure (in Chapter 1), ˙k is zero when consumption equals the difference between the actual output and break-even investment lines. This value of c is increasing in k until f _(k) = n +g (the golden-rule level of k) and is then decreasing. When c exceeds the level that yields ˙k = 0, k is falling; when c is less than this level, k is rising. For k sufficiently large, break-even investment exceeds total output, and so ˙k is negative for all positive values of c. This information is summarized in Figure 2.2; the arrows show the direction of motion of k.

FIGURE 4.2 The dynamics of k



4.3.2.3 Welfare:

A natural question is whether the equilibrium of this economy represents a desirable outcome. The answer to this question is simple. The first welfare theorem from microeconomics tells us that if markets are competitive and complete and there are no externalities (and if the number of agents is finite), then the decentralized equilibrium is Pareto-efficient—that is, it is impossible to make anyone better off without making someone else worse off. Since the conditions of the first welfare theorem hold in our model, the equilibrium must be Pareto-efficient. And since all households have the same utility, this means that the decentralized equilibrium produces the highest possible utility among allocations that treat all households in the same way. To see this more clearly,

consider the problem facing a social planner who can dictate the division of output between consumption and investment at each date and who wants to maximize the lifetime utility of a representative household. This problem is identical to that of an individual household except that, rather than taking the paths of w and r as given, the planner takes into account the fact that these are determined by the path of k, which is in turn determined by (2.25).

The intuitive argument involving consumption at consecutive moments used to derive or applies to the social planner as well: reducing c by _c, at time t and investing the proceeds allows the planner to increase c, at time t + _t by ef _(k (t))_te−(n+g)_t _c.12 Thus c (t) along the path chosen by the planner must satisfy And since equation giving the evolution of k reflects technology, not preferences, the social planner must obey it as well. Finally, as with households' optimization problem, paths that require that the capital stock becomes negative can be ruled out on the grounds that they are not feasible, and paths that cause consumption to approach zero can be ruled out on the grounds that they do not maximize households' utility.

In short, the solution to the social planner's problem is for the initial value of c to be given by the value on the saddle path, and for c and k to then move along the saddle path. That is, the competitive equilibrium maximizes the welfare of the representative household.

4.3.3 The Balanced Growth Path

4.3.3.1 Properties of the Balanced Growth Path

The behavior of the economy once it has converged to Point E is identical to that of the Solow economy on the balanced growth path. Capital, output, and consumption per unit of effective labor are constant. Since y and c are constant, the saving rate, $(y - c)/y$, is also constant. The total capital stock, total output, and total consumption grow at rate $n + g$. And capital per worker, output per worker, and consumption per worker grow at rate g. Thus, the central implications of the Solow model concerning the driving forces of economic growth do not hinge on its assumption of a constant saving rate. Even when saving is endogenous, growth in the effectiveness of labor remains the only source of persistent growth in output per worker. And since the production function is the same as in the Solow model, one can repeat the calculations of Section 1.6 demonstrating that significant differences in output per worker can arise from differences in capital per worker only if the differences in capital per worker, and in rates of return to capital, are enormous.

4.3.3.2 The Social Optimum and the Golden-Rule Level of Capital

The only notable difference between the balanced growth paths of the Solow and Ramsey–Cass–Koopmans models is that a balanced growth path with a capital stock above the golden-rule level is not possible in the Ramsey–Cass– Koopmans model. In the Solow model, a sufficiently high saving rate causes the economy to reach a balanced growth path with the property that there are feasible alternatives that involve higher consumption at every moment. In the Ramsey–Cass–Koopmans model, in contrast, saving is derived from the behavior of households whose utility depends on their consumption, and there are no externalities. As a result, it cannot be an equilibrium for

the economy to follow a path where higher consumption can be attained in every period: if the economy were on such a path, households would reduce their saving and take advantage of this opportunity. This can be seen in the phase diagram. Consider again Figure 2.5. If the initial capital stock exceeds the golden-rule level (that is, if k (0) is greater than the k associated with the peak of the $\dot{k} = 0$ locus), initial consumption is above the level needed to keep k constant; thus $\dot{k}$ is negative. k gradually approaches $k*$, which is below the golden-rule level. Finally, the fact that $k*$ is less than the golden-rule capital stock implies that the economy does not converge to the balanced growth path that yields the maximum sustainable level of c. The intuition for this result is clearest in the case of g equal to zero, so that there is no long-run growth of consumption and output per worker. In this case, $k*$ is defined by $f\_(k*) = \rho$ (see [2.24]) and kGR is defined by $f\_(kGR) = n$, and our assumption that $\rho - n - (1 - \theta)\, g > 0$ simplifies to $\rho > n$. Since $k*$ is less than kGR, an increase in saving starting at $k = k*$ would cause consumption per worker to eventually rise above its previous level and remain there (see Section 1.4). But because households' value present consumption more than future consumption, the benefit of the eventual permanent increase in consumption is bounded. At some point—specifically, when k exceeds $k*$—the tradeoff between the temporary short-term sacrifice and the permanent long-term gain is sufficiently unfavorable that accepting it reduces rather than raises lifetime utility. Thus, k converges to a value below the golden-rule level. Because $k*$ is the optimal level of k for the economy to converge to, it is known as the *modified golden-rule* capital stock.

4.3.4 The Effects of Government Purchases

Thus far, we have left government out of our model. Yet modern economies devote their resources not just to investment and private consumption but also to public uses. In the United States, for example, about 20 percent of total output is purchased by the government; in many other countries the figure is considerably higher. It is thus natural to extend our model to include a government sector.

4.3.4.1 Adding Government to the Model

Assume that the government buys output at rate G (t) per unit of effective labor per unit time. Government purchases are assumed not to affect utility from private consumption; this can occur if the government devotes the goods to some activity that does not affect utility at all, or if utility equals the sum of utility from private consumption and utility from government provided goods. Similarly, the purchases are assumed not to affect future output; that is, they are devoted to public consumption rather than public investment. The purchases are financed by lump-sum taxes of amount G (t) per unit of effective labor per unit time; thus, the government always runs a balanced budget. We will see there, however, that in this model the government's choice between tax and deficit finance has no impact on any important variables. Thus, the assumption that the purchases are financed with current taxes only serves to simplify the presentation. Investment is now the difference between output and the sum of private consumption and government purchases. Thus, the equation of motion for k, (2.25), becomes.

$$\dot{k}(t) = f(k(t)) - c(t) - G(t) - (n + g)k(t).$$

A higher value of G shifts the $\dot{k} = 0$ locus down: the more goods that are purchased by the government, the fewer that can be purchased privately if k is to be held constant. By assumption, households' preferences are unchanged. Since the Euler equation is derived from households' preferences without imposing their lifetime budget constraint, this condition continues to hold as before. The taxes that finance the government's purchases affect households' budget constraint, however. Specifically, (2.14) becomes.

$$\int_{t=0}^{\infty} e^{-R(t)} c(t) e^{(n+g)t}\, dt \leq k(0) + \int_{t=0}^{\infty} e^{-R(t)} [w(t) - G(t)] e^{(n+g)t}\, dt.$$

Reasoning parallel to that used before shows that this implies the same expression as before for the limiting behavior of k

4.3.4.2 The Effects of Permanent and Temporary Changes in Government Purchases

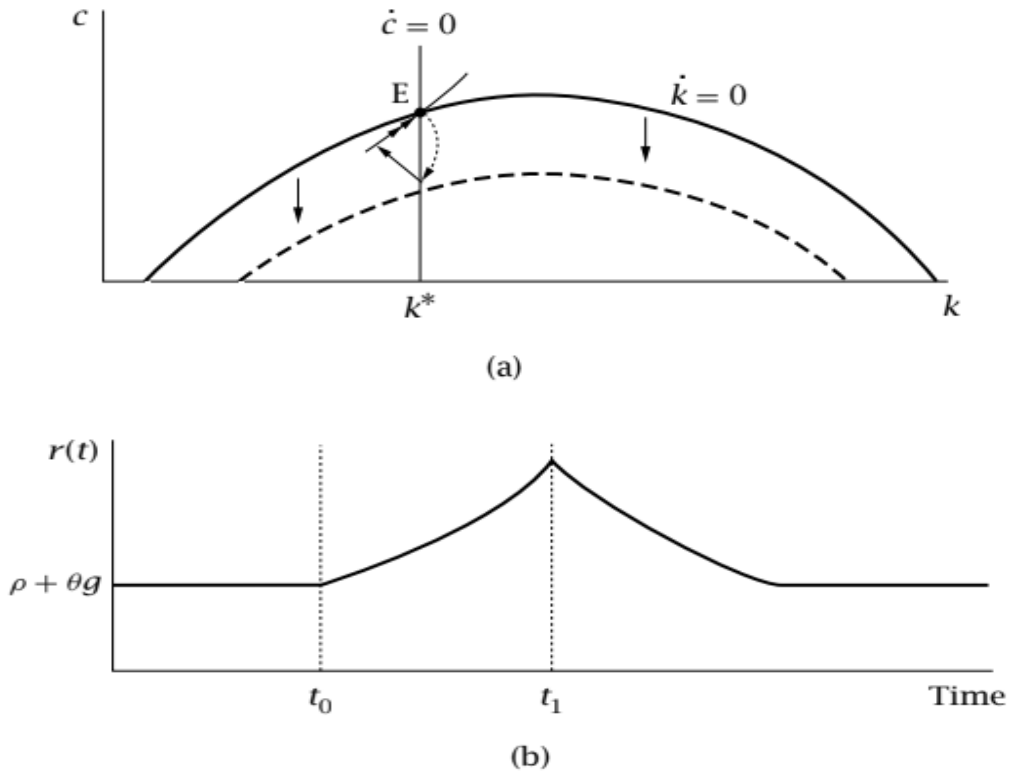
To see the implications of the model, suppose that the economy is on a balanced growth path with $G(t)$ constant at some level GL, and that there is an unexpected, permanent increase in G to GH. From (2.40), the $\dot{k} = 0$ locus shifts down by the amount of the increase in G. Since government purchases do not affect the Euler equation, the $\dot{c} = 0$ locus is unaffected.

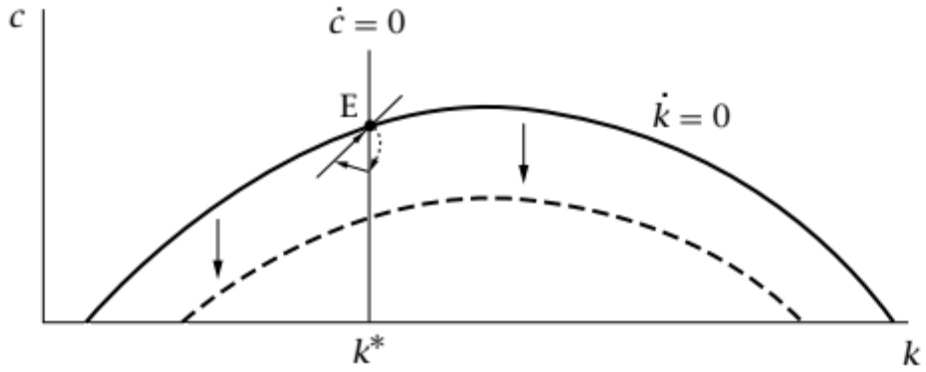
This is shown in Figure 3 We know that in response to such a change, c must jump so that the economy is on its new saddle path. If not, then as before, either capital would become negative at some point or households would accumulate infinite wealth. In this case, the adjustment takes a simple form: c falls by the amount of the increase in G, and the economy is immediately on its new balanced growth path. Intuitively, the permanent increases in government purchases and taxes reduce households' lifetime wealth. And because the increases in purchases and taxes are permanent, there is no scope for households to raise their utility by adjusting the time pattern of their consumption.

Thus, the size of the immediate fall in consumption is equal to the full amount of the increase in government purchases, and the capital stock and the real interest rate are unaffected. An older approach to modeling consumption behavior assumes that consumption depends only on current disposable income and that it moves less than one-for-one with disposable income. Recall, for example, that the Solow model assumes that consumption is simply fraction $1 - s$ of current income. With that approach, consumption falls by less than the amount of the increase in government purchases. As a result, the rise in government purchases crowds out investment, and so the capital stock starts to fall, and the real interest rate starts to rise. Our analysis shows that those results rest critically on the assumption that households follow mechanical rules: with intertemporal

optimization, a permanent increase in government purchases does not cause crowding out. A more complicated case is provided by an unanticipated increase in G that is expected to be temporary. For simplicity, assume that the terminal date is known with certainty. In this case, c does not fall by the full amount of the increase in G, $GH - GL$. To see this, note that if it did, consumption would jump up discontinuously at the time that government purchases returned to GL; thus, marginal utility would fall discontinuously. But since the return of G to GL is anticipated, the discontinuity in marginal utility would also be anticipated, which cannot be optimal for households. During the period of time that government purchases are high, $\dot{k}$ is governed by the capital-accumulation equation, (2.40), with $G = GH$; after G returns to GL, it is governed by (2.40) with $G = GL$. The Euler equation, (2.24), determines the dynamics of c throughout, and c cannot change discontinuously at the time that G returns to GL. These facts determine what happens at the time of the increase in G: c must jump to the value such that the dynamics implied by (2.40) with $G = GH$ (and by [2.24]) bring the economy to the old saddle path at the time that G returns to its initial level. Thereafter, the economy moves along that saddle path to the old balanced growth path.

Figure 4.3 effects of a temporary increase in government purchases





(c)

4.4 SELF-ASSESSMENT QUESTIONS

1. What are the assumptions of the Ramsey –Phelps-Koop man Model of Economic Growth?
2. Explain dynamics of the economy welfare.
3. Describe the balanced growth path.
4. What are the effects of government purchases?

4.4.1 KEY TERMS

Firm: is a for-profit business organization such as a corporation, limited liability company (LLC), or partnership—that provides professional services.

Household: It may consist of a single family or another group of people. ... The household is the basic unit of analysis in many social, microeconomic and government models, and is important to economics and inheritance.

Utility function is an important concept that measures preferences over a set of goods and services. Utility represents the satisfaction that consumers receive for choosing and consuming a product or service.

Economic welfare: Basically, it refers to how well people are doing. ... An increase in real output and real incomes suggests people are better off and therefore there is an increase in economic welfare.

Balanced-growth path: of a dynamic model is a trajectory such that all variables grow at a constant rate.

Government purchases: are expenditures on goods and services by federal, state, and local governments. The combined total of this spending, excluding transfer payments and interest on the debt, is a key factor in determining a nation's gross domestic product (GDP).

RECOMMENDED BOOKS

1. Bagliano, F. C., & Bertola, G. (2004). Models for Dynamic Macroeconomics. OUP Oxford.
2. Mankive, N. Gregory (2022), Macroeconomics, Harvard University, USA. 11th edition (CH # 7& CH#14)
3. Romer, D. (2012). Advanced Macroeconomics, New York: McGraw-Hill. Latest edition (CH # 2)
4. Stachurski, J. (2009). Economic Dynamics: Theory and Computation. MIT Press.

LINKS/BIBLIOGRAPHY

https://www.studocu.com/en-gb/document/university-of-aberdeen/advanced-macroeconomics/essays/ramsey-cass-koopman-model-essay/1481254/view 6/4/2020

https://en.wikipedia.org/wiki/Ramsey%E2%80%93Cass%E2%80%93Koopmans_model#:~:text=The%20Ramsey%E2%80%93Cass%E2%80%93Koopmans%20model,the%20work%20of%20Frank%20P.&text=Originally%20Ramsey%20set%20out%20the,of%20consumption%20over%20successive%20generations. 31/3/2020

Unit No: 5

SAMUELSSON-DIAMOND-GALE OVERLAPPING GENERATION

Written by: Dr. Fouzia Jamshaid

Reviewed by: Ms. Rabia Batool

CONTENTS

Page

5.1 INTRODUCTION

In this unit, we introduce the distinction between static and dynamic models which underlies modern dynamic economics. As the name suggests, this new model emphasizes the dynamic nature of economic fluctuations. The dictionary defines the word "dynamic" as "relating to energy or objects in motion, characterized by continuous change or activity." This definition applies readily to economic activity. The economy is continually bombarded by various shocks. These shocks have an immediate impact on the economy's short-run equilibrium, and they also affect the subsequent path of output, inflation, and many other variables. The dynamic AD–AS model focuses attention on how output and inflation respond over time to exogenous changes in the economic environment. Although the dynamic model is new to the reader, most of its components are not. Many of the building blocks of this model will be familiar from previous units, even though they sometimes take on slightly different forms. More important, these components are assembled in new ways. In this unit, we discussed the dynamic of the economics, it's limitation, importance and the role of the government.

For better understanding read Romer, D. (2012). Advanced Macroeconomics. McGraw Hill. (CH # 2), Mankive, N. Gregory, Macroeconomics, 9th edition (CH #14) and Nymoen, R. (2005). Introductory Dynamic Macroeconomics. Oslo: Department of Economics, University of Oslo. Paper.

5.2 LEARNING OUTCOMES

At the end of this unit, and having completed the Essential readings and activities, you should be able to:

- differentiate between static and dynamic economics
- familiar with Samuelsson approach of dynamic economics
- understanding of gale overlapping generation
- explain dynamic economics, it's limitation and scope
- familiar diamond model
- highlight the role of government in diamond model

5.3 MAIN TOPICS TO DISCUSS

5.3.1 Assumption

5.3.1.1 Economic Dynamics:

Economic dynamics is a more realistic method of analyzing the behavior of the economy or certain economic variables through time. The definition of economic dynamics has been a controversial issue and it has been interpreted in various ways. We shall try to explain the standard definitions of economic dynamics.

5.3.1.2 Samuelson's Approach of Dynamic Economics

Samuelson's definition of economic dynamics pointed the way to differential and difference equations as key tools in the study of economic stability and changes of economic variables over time, as developed in the second part of that book. The new tools were particularly useful for the investigation of business cycles, as forcefully illustrated by Samuelson's multiplier-accelerator model. That was distinct from the mathematical and economic frameworks deployed in the static microeconomic theory of constrained maximizing choices by individual agents, discussed in the first part of Foundations. Samuelson argued that meaningful operational propositions in economics were based on two different types of hypotheses. The first was that the conditions of equilibrium are equivalent to the maximization of some amount.

5.3.1.3 The Overlapping Generations (OLG)

The overlapping generations (OLG) model is one of the dominating frameworks of analysis in the study of macroeconomic dynamics and economic growth. In contrast, to the Ramsey–Cass–Koopmans neoclassical growth model in which individuals are infinitely-lived, in the OLG model individuals live a finite length of time, long enough to overlap with at least one period of another agent's life.

The OLG model is the natural framework for the study of: (a) the life-cycle behavior (investment in human capital, work and saving for retirement), (b) the implications of the allocation of resources across the generations, such as Social Security, on the income per capita in the long-run, (c) the determinates of economic growth in the course of human history, and (d) the factors that triggered the fertility transition.

5.3.1.4 Growth with Overlapping Generations(assumption)

In many situations, the assumption of a representative household is not appropriate because.

- 1 household do not have an infinite planning horizon.
- 2 new households arrive (or are born) over time.

New economic interactions: decisions made by older "generations" will affect the prices faced by younger "generations". Overlapping generations models

- Capture potential interaction of different generations of individuals.
- in the marketplace.

- Provide tractable alternative to infinite-horizon representative agent
- models.
- Some key implications different from neoclassical growth model.
- Dynamics in some special cases quite like Solow model
- rather than the neoclassical model.
- Generate new insights about the role of national debt and Social
- Security in the economy

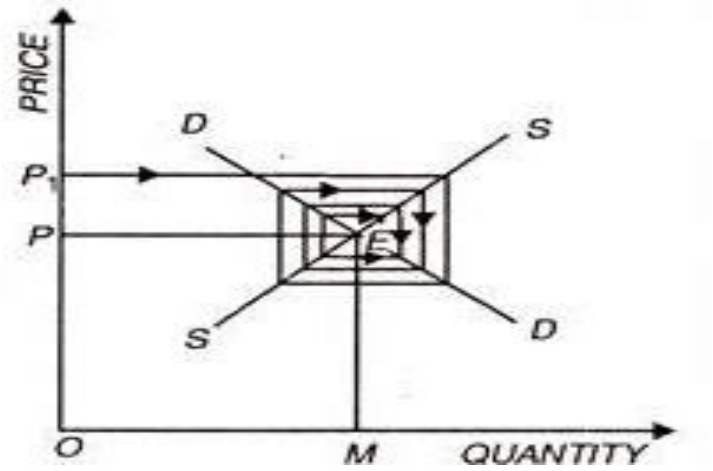
5.3.2 THE DYNAMIC OF THE ECONOMY

5.3.2.1 Concept of Dynamic Economics:

The concept of dynamics is derived from Physics. It refers to a state where there is a change such as movement. We have known that there is movement in statics also, but this movement is certain, regular and expected. While dynamics refers to that movement which is uncertain, unexpected and irregular. Therefore, an aero plane flying in the sky is in a dynamic state only if its direction, height and speed are uncertain. We know from day-to-day experience that fluctuations occur in the economy quite often. And it is not possible to make correct predictions about such fluctuations. The concept of dynamics is nearer to reality. In dynamic economics we study the economic variables like consumption function, income and investment in a dynamic state. According to Prof. Harrod, "Economic dynamics is the study of an economy in which rates of output are changing." In the real world, economic variables like population, capital, techniques of production, fashions, habits, etc. do not change at a constant rate. The rate of change is different at different times.

According to Prof. Hicks, "Economic dynamics refers to that part of economic theory in which all quantities must be dated." From Prof. Hicks's definition, we come to know that time element occupies great importance in dynamic economics. Here economic variables are related to different points of time. According to Baumol, "Economic dynamics is the study of economic phenomenon in preceding and succeeding events." Comparative economic statics does not show the path of change of the old to new equilibrium. But in dynamic economics we also study the path of change or the movement towards equilibrium. This path can be explained with the help of the diagram given below which relates to price determination in a market.

Figure # 5.1



In the diagram drawn below, DD is the demand curve and SS is the supply curve. Suppose the initial price is OP1. At OP1 price, supply of the commodity is more than its demand. As a result, price falls. This process of falling price continues till demand becomes equal to the supply of the commodity. E is the point where demand for and supply of the commodity are equal. This is a point of equilibrium. Here OP is the equilibrium price. OM is the quantity demanded and supplied. This equilibrium path of the price change is shown through the arrow lines in the figure.

- In a dynamic economy, population grows.
- Quantity of capital grows.
- Modes of production improve.
- Industrial institutions undergo changes. Inefficient organizations are replaced by efficient organizations.
- Habits of the people, fashions and customs change, as wants of the people increase.

5.3.2.2 Scope and Importance of Dynamic Economics:

Dynamic economics is becoming more and more popular since 1925. Though the principles advocated by Clark and Aftalian were dynamic in nature, yet their main purpose was to explain the business fluctuations. After 1925, dynamic economics became popular not only in business fluctuations but also in the determination of income and growth models.

1. Study of Time Element:

Time element occupies an important role in dynamic economics. Economic problems concerning continuous change of economic variables and path of change can be studied only in dynamic economics.

2. Trade Cycles:
Theories of trade cycles have been advocated only through the introduction of dynamic economics. Theories of trade cycles are based on dynamic economics as they refer to the fluctuations of the different time periods.

3. Basis of many Economic Theories:
Dynamic economics has an important place in economics because many economic theories are based on it. For example, saving and investment theory, theory of interest, effect of time element in price determination, etc. are based on dynamic economics.

4. More Flexible Approach:
Dynamic analysis is more flexible. Models regarding the possibilities of economic change can be development in dynamic analysis. That is why it has been found a useful mode of study. Dynamic economics is also useful in solving the problems of economic planning, economic growth and trade cycles.

5. Realistic Approach:
Dynamic economic analysis is nearer to the reality. In a real world, economic variables like national income, consumption, etc. change irregularly and uncertainly. Moreover, economic variables of the previous period also affect the present economy. And time clement occupies an important role in economic analysis.

5.3.3 THE POSSIBILITY OF DYNAMIC INEFFICIENCY

5.3.3.1 Limitations
Its main limitations are the following:

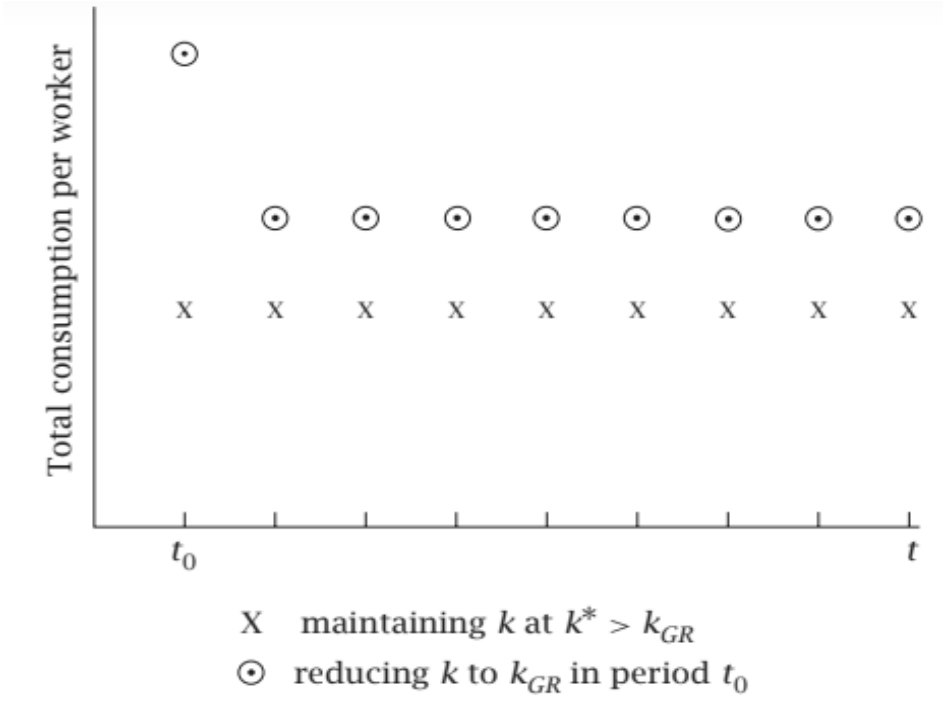
1. Complex Approach:
Dynamic economic analysis is a complex approach for the study of economic variables because it is based on time element. To find solutions of various problems, we must make use of mathematics and economics which is beyond the understanding of a common man.

2. Not Fully Developed:
Many economists like Samuelson and Harrod, have developed dynamic approach of economic analysis. They have developed their theories through dynamic analysis. But this mode of economic analysis has not been fully developed. The reason is that factors affecting economic variables change very soon. Dynamic approach is not developing at the speed at which economic factors change.

5.3.3.2 The Possibility of Dynamic Inefficiency
The one major difference between the balanced growth paths of the Diamond and Ramsey–Cass–Koopmans models involves welfare. We saw that the equilibrium of the Ramsey–Cass–Koopmans model maximizes the welfare of the representative household. In the Diamond model, individuals born at different times attain different levels of utility,

and so the appropriate way to evaluate social welfare is not clear. If we specify welfare as some weighted sum of the utilities of different generations, there is no reason to expect the decentralized equilibrium to maximize welfare, since the weights we assign to the different generations are arbitrary. A minimal criterion for efficiency, however, is that the equilibrium be Pareto-efficient. It turns out that the equilibrium of the Diamond model need not satisfy even this standard. In particular, the capital stock on the balanced growth path of the Diamond model may exceed the golden-rule level, so that a permanent increase in consumption is possible.

Figure 5.2 The Possibility of Dynamic Inefficiency



5.3.4 GOVERNMENT IN THE DIAMOND MODEL

5.3.4.1 What Is the Porter Diamond?

The Porter Diamond, properly referred to as the Porter Diamond Theory of National Advantage, is a model that is designed to help understand the competitive advantage that nations or groups possess due to certain factors available to them, and to explain how governments can act as catalysts to improve a country's position in a globally competitive economic environment. The model was created by Michael Porter, a recognized authority on corporate strategy and economic competition, and founder of the Institute for Strategy and Competitiveness at the Harvard Business School. It is a proactive economic theory, rather

than one that simply quantifies competitive advantages that a country or region may have. The Porter Diamond is also referred to as "Porter's Diamond" or the "Diamond Model."

5.3.4.2 Components

The four different components of the framework are

1. Factor Conditions (endowments)

Factor conditions include the nation's production resources, including infrastructure, labor force, land, and natural resources. According to Porter, "a nation does not inherit but instead creates the most important factors of production—such as skilled human resources or a scientific base. A lack of less important factors, such as an unskilled labor force or access to raw materials, can be mediated through technology or by implementing what Porter calls "a global strategy."

Factor endowment can be categorized into two forms:

- "Home-grown" resources/highly specialized resources
- Natural endowments

2. Related and Supporting Industries

This component refers to industries that supply, distribute, or are otherwise related to the industry being examined. For many firms, the presence of related and supporting industries is of critical importance to the growth of that particular industry. A critical concept here is that national competitive strengths tend to be associated with "clusters" of industries. For example, Silicon Valley in the US and Silicon Glen in the UK are techno clusters of high-technology industries which includes individual computer software and semi-conductor firms. In Germany, a similar cluster exists around chemicals, synthetic dyes, textiles and textile machinery.

3. Demand Conditions

Demand conditions in the domestic market provide the primary driver of growth, innovation and quality improvement. The premise is that a strong domestic market stimulates the firm from being a startup to a slightly expanded and bigger organization. As an illustration, we can take the case of Germany which has some of the world's premier automobile companies like Mercedes, BMW, Porsche. German auto companies have dominated the world when it comes to the high-performance segment of the world automobile industry. However, their position in the market of cheaper, mass-produced autos is much weaker. This can be linked to a domestic market which has traditionally demanded a high level of engineering performance. Also, the transport infrastructure of Germany, with its Autobahns does tend to favor high-performance automobiles.

4. Strategy, Structure and Rivalry

National performance sectors are inevitably related to the strategies and the structure of the firms in that sector. Competition plays a big role in driving innovation and the subsequent upgradation of competitive advantage. Since domestic competition is more direct and impacts earlier than steps taken by foreign competitors, the stimulus provided by them is higher in terms of

innovation and efficiency. As an example, the Japanese automobile industry with 8 major competitors (Honda, Toyota, Suzuki, Isuzu, Nissan, Mazda, Mitsubishi, and Subaru) provide intense competition in the domestic market, as well as the foreign markets in which they compete.

5.3.4.3 Government

The role of the government in Porter's Diamond Model is described as both 'a catalyst and challenger '. Porter doesn't believe in a free market where the government leaves everything in the economy up to 'the invisible hand'. However, Porter doesn't see the government as an essential helper and supporter of industries either. Governments cannot create competitive industries; only companies can do that. Rather, governments should encourage and push companies to raise their aspirations and move to even higher levels of competitiveness. This can be done by stimulating early demand for advanced products (demand factors); focusing on specialized factor creations such as infrastructure, the education system and the health sector (factor conditions); promoting domestic rivalry by enforcing anti-trust laws; and encouraging change. The government can thus assist the development of the four aforementioned factors in the way that should benefit the industries in a certain country.

The government plays a vital role in the success of a firm or company. It is the government that provides for technical and financial aid to companies for its growth. The government has been referred to as 'a catalyst and challenger'. Porter believes that the market is not meant to be in the 'invisible hands but the government should regulate it in order to stimulate the creation of advanced factors and therefore, leading to the development of competitive advantage. Government policies, investment in infrastructure, funding, etc. are some ways in which governments help in intensifying home demand.

5.4 SELF-ASSESSMENT QUESTIONS

1. What is Samuelson's approach of dynamic economics?
2. Explain Dynamic of Economics.
3. Define the possibility of Dynamic inefficacy.
4. Highlight The overlapping generations (OLG).
5. What are the four component of the Porter Diamond and what the role of government in diamond model?

5.5 KEY TERMS

Static economics: deals with relations and processes under the assumption of uniformity and persistence of either the absolute or relative economic quantities involved.

Dynamic economics: deals with relations and processes under the assumption of change in either the absolute or the relative economic quantities.

Economic efficiency: is when all goods and factors of production in an economy are distributed or allocated to their most valuable uses and waste is eliminated or minimized.

Porter's Diamond model: explains the factors that can drive competitive advantage for one national market or economy over another.

Multiple Choice Questions

1. DAD stands for:
   a) Diverged Aggregate Demand
   b) Dynamic aggregate Demand
   c) Draw Aggregate Demand
2. DAS stands for:
   a) Dynamic Aggregate Supply
   b) Dynamic Aggregate System
   c) Determined Aggregate Supply
3. DSGE stands for:
   a) Dynamic, Stochastic, General Equilibrium
   b) Dynamic, Supply, General Equilibrium
   c) None of these
4. A supply shock reduces output and raises
   a) inflation
   b) Employment
   c) Supply
5. The long-run equilibrium represents the:
   a) normal state
   b) Abnormal state
   c) Both a and b

Answer Key (MCQs)

1. Dynamic Aggregate Demand
2. Dynamic Aggregate Supply
3. Dynamic, Stochastic, General Equilibrium
4. Inflation
5. Normal State

RECOMMENDED BOOKS

1. Bagliano, F. C., & Bertola, G. (2004). Models for Dynamic Macroeconomics. Oxford University Press on Demand.
2. Mankive, N. Gregory (2022), Macroeconomics, Harvard University, USA. 11th edition (CH#14)
3. Nymoen, R. (2005). Introductory Dynamic Macroeconomics. Oslo: Department of Economics, University of Oslo. Paper.
4. Romer, D. (2012). Advanced Macroeconomics, 4e. New York: McGraw-Hill. Latest edition (CH # 2)
4. Stachurski, J. (2009). Economic Dynamics: Theory and Computation. MIT Press.

LINKS/BIBLIOGRAPHY

- http://www.sfu.ca/~bkrauth/econ808/808_lec4.pdf 5/5/2020
- https://www.business-to-you.com/porter-diamond-model/#:~:text=and%20stimulate%20innovation.-,Government,'a%20catalyst%20and%20challenger'.&text=Rather%2C%20governments%20should%20encourage%20and,even%20higher%20levels%20of%20competitiveness. 5/5/2020
- https://www.investopedia.com/terms/p/porter-diamond.asp 10/5/2020
- https://tradebrains.in/porters-diamond-model/ 12/5/2020
- https://www.economicsdiscussion.net/economics-2/static-economics/static-economics-scope-importance-and-limitations/14291 12/5/2020

Unit No: 6

CONSUMPTION AND INVESTMENT IN THE FRAMEWORK OF DYNAMIC MACROECONOMICS

Written by: Ms. Saima Ashraf

Reviewed by: Dr. Fouzia Jamshaid

CONTENTS

Page

6.1 INTRODUCTION

Optimizing models of intertemporal choices are widely used by theoretical and empirical studies of consumption. This unit outlines their basic analytical structure, along with some extensions. The technical tools introduced here aim at familiarizing the reader with recent applied work on consumption and saving, and investment. This unit illustrates and solves the basic version of the intertemporal consumption choice model, deriving theoretical relationships between the dynamics of permanent income, current income, consumption and saving and discusses problems raised by empirical tests of the theory, focusing on the excess sensitivity of consumption to expect income changes and on the excess smoothness of consumption, following unexpected income variations. In this unit, precautionary saving motive is also discussed.

The elementary textbooks do not explicitly study investment behavior in terms of a formal dynamic optimization problem. Rather, they offer qualitatively sensible interpretations of investment behavior at a point in time. In this unit, we analyze investment decisions from an explicitly dynamic perspective by introducing dynamic continuous-time optimization techniques. In this unit, we study the dynamic optimization problem of a firm that aims at maximizing present discounted cash flows. We focus on technical insights rather than on empirical implications, and the problem's set up may at first appear quite abstract.

For better understand read Bagliano, F. C., & Bertola, G. (2004). Models for Dynamic Macroeconomics. Oxford University Press on Demand. (CH # 1 & 2)

6.2 LEARNING OUTCOMES

At the end of this unit, and having completed the Essential readings and activities, you should be able to:

- understand the permanent income and optimal consumption.
- importance of the role of precautionary saving
- familiar with consumption and financial returns
- understand the model of investment.

6.3 MAIN TOPICS TO DISCUSS

6.3.1 Dynamic Consumption Theory

Permanent Income and Optimal Consumption
The basic model used in the modern literature on consumption and saving choices is based on two main assumptions:

1. Identical economic agents maximize an intertemporal utility function, defined on the consumption levels in each period of the optimization horizon, subject to the constraint given by overall available resources.
2. Under uncertainty, the maximization is based on expectations of future relevant variables (for example, income and the rate of interest) formed rationally by agents, who use optimally all information at their disposal.

6.3.1.1 Empirical Issues

The dynamic implications of the permanent income model of consumption illustrated above motivated many recent empirical studies on consumption. Similarly, the life-cycle theory of consumption developed mainly by F. Modigliani has been subjected to empirical scrutiny. The partial-equilibrium perspective makes it difficult to discuss the relationship between long-run saving and growth rates at the aggregate level.

The link between income growth and saving depends also on the interest rate and becomes more complicated when the assumption of an exogenously given income process is abandoned. But even empirical studies based on cross-sectional individual data show that saving, if any, occurs only in the middle and old stages of the agent's life: consumption tracks income too closely to explain wealth accumulation only based on a life-cycle motive. As regards aggregate short-run dynamics, the first empirical test of the fundamental implication of the permanent income/rational expectations model of consumption is due to R. E. Hall (1978). Since Hall's contribution, the empirical literature has further investigated the dynamic implications of the theory, focusing mainly on two empirical regularities apparently at variance with the model: the consumption's excess sensitivity to current income changes, and its excess smoothness to income innovations. The remainder of this section illustrates these problems and shows how they are related.

6.3.1.2 The Role of Precautionary Saving

Recent developments in consumption theory have been aimed mainly at solving the empirical problem. The basic model has been extended in various directions, by relaxing some of its most restrictive assumptions. On the one hand, as already mentioned, liquidity constraints can prevent the consumer from borrowing as much as required by the optimal consumption plan. On the other hand, it has been recognized that in the basic model saving is motivated only by a rate of interest higher than the rate-of-time preference

and/or by the need for redistributing income over time, when current incomes are unbalanced between periods. Additional motivations for saving may be relevant in practice, and may contribute to the explanation of, for example, the apparently insufficient decumulation of wealth by older generations, the high correlation between income and consumption of younger agents, and the excess smoothness of consumption in reaction to income innovations. This section deals with the latter strand of literature, studying the role of a precautionary saving motive in shaping consumers' behavior. First, we will spell out the microeconomic foundations of precautionary saving, pointing out which assumption of the basic model must be relaxed to allow for a precautionary saving motive. Then, under the new assumptions, we shall derive the dynamics of consumption and the consumption function and compare them with the implications of the basic version of the permanent income model previously illustrated.

Microeconomic Foundations

Thus far, with a quadratic utility function, uncertainty has played only a limited role. Indeed, only the expected value of income affects consumption choices—other characteristics of the income distribution do not play any role. With quadratic utility, marginal utility is linear and the expected value of the marginal utility of consumption coincides with the marginal utility of expected consumption. An increase in uncertainty on future consumption, with an unchanged expected value, does not cause any reaction by the consumer. If marginal utility is a convex function of consumption, then the consumer displays a prudent behavior, and reacts to an increase in uncertainty by saving more: such saving is called precautionary, since it depends on the uncertainty about future consumption.

6.3.1.3 Consumption and Financial Returns

In the model studied so far, the consumer uses a single financial asset with a certain return to implement the optimal consumption path. A precautionary saving motive has been introduced by abandoning the hypothesis of quadratic utility. However, there is still no choice on the allocation of saving. If we assume that the consumer can invest his savings in n financial assets with uncertain returns, we generate a more complicated choice of the composition of financial wealth, which interacts with the determination of the optimal consumption path. The chosen portfolio allocation will depend on the characteristics of the consumer's utility function and of the distribution of asset returns. Thereby extended, the model yields testable implications on the joint dynamics of consumption and asset returns and becomes the basic version of the consumption-based capital asset pricing model (CCAPM).

6.3.2 DYNAMIC MODEL OF INVESTMENT

6.3.2.1 Convex Adjustment Costs

In what follows, F(t) denotes the difference between a firm's cash receipts and outlays during period t. We suppose that such cash flows depend on the capital stock K(t) available at the beginning of the period, on the flow I(t) of investment during the period,

and on the amount N(t) employed during the period of another factor of production, dubbed "labor.

The investment decisions should be based not only on the contribution of capital to profits at a given moment in time, but also on their outlook. If the relevant exogenous conditions indexed by t in R (·) and the dynamics of the other, equally exogenous, variable. The firm should vary its capital stock, the adjustment should be gradual. Moreover, if large positive and negative fluctuations of exogenous variables are expected, the firm should not vary its investment rate sharply, because the cost and revenues generated by upward and downward capital stock fluctuations do not offset each other exactly. Convexity of the adjustment cost function implies that the total cost of any given capital stock variation is smaller when that variation is diluted through time, hence the firm should behave in a forward looking fashion when choosing the dynamics of its investment rate and should try to keep the latter stable by anticipating the dynamics of exogenous variables.

6.3.2.2 Continuous-Time Optimization

Neither the realism nor the implications of convex adjustment costs depend on the length time of the period over which revenue, cost, and investment flows are measured. Current investment cannot increase the capital stock available for use within each such period, implying that K(t) could be taken as given when evaluating opportunities for further investment. This accounting convention, of course, is more accurate when the length of the period is shorter.

6.3.2.3 A Dynamic IS–LM Model

The dynamic IS–LM model of Blanchard (1981), capturing the interactions between forward-looking prices of financial assets and output and highlighting the role of expectations in determining (through investment) macroeconomic outcomes and the effects of monetary and fiscal policies. As in the static version of the IS–LM model, the level of goods prices is exogenously fixed and constant over time. However, the previous sections' positive relationship between the forward-looking q variable and investment is explicitly accounted for by the aggregate demand side of the model.

6.3.2.4 Irreversible Investment Under Uncertainty

Throughout the previous sections, the firm was supposed to know with certainty the future dynamics of exogenous variables relevant to its optimization problem. This section briefly outlines formal modeling techniques allowing uncertainty to be introduced in explicit, if stylized, ways into the investment problem of a firm facing linear adjustment costs. The assumption that time is indefinitely divisible is of course far from completely realistic; also, less than fully realistic are the assumptions that the capital stock is made up of infinitesimally small particles, and that it may be an argument of a differentiable production function. As was the case under certainty, however, such assumptions make it possible to obtain precise and elegant quantitative results by means of analytical calculus techniques.

Stochastic Calculus

First, we need to introduce uncertainty into the formal continuous-time optimization framework introduced above. So far, all exogenous features of the firm's problem we redetermined by the time index t: knowing the position in time of the dynamic system was enough to know the product price, the cost of factors, and any other variable whose dynamics are taken as given by the firm. To prevent such dynamics from being perfectly foreseeable, one must let them depend not only on time, but also on something else: an index, denoted (w) of the unknown state of nature A function{z(t;w)}of a time index t and of the state of nature ˘ is a stochastic process, that is, a collection of random variables. The state of nature, by definition, is not observable. If the true w were known, in fact, the path of the process would again depend on t only, and there would be no uncertainty. But if (w) belongs to a set on which a probability distribution is defined, one may formally assign likelihood levels to different possible (w) and different possible time paths of the process. This makes it possible to formulate precise answers to questions, clearly of interest to the firm, concerning the probability that processes such as revenues or costs reach a given level within a given time interval.

Optimization under Uncertainty and Irreversibility

We are now ready to employ these formal tools in the study of a firm that, in partial equilibrium, maximizes the present discounted value at rate r of its cash flows. In the presence of uncertainty, exogenous variables relevant to profits are represented by the realization of a stochastic process, Z(t), rather than by the time index t. As seen above, the optimal profit flow may be a convex function of exogenous variables (but it may also, under different assumptions, be concave). In such cases Jensen's inequality introduces a link between the expected value and variability of capital's marginal revenue product. For simplicity, we will disregard such effects, supposing that the profit flow is linear in Z. Like in the previous section, let K(t) be the capital stock installed at time t. For simplicity, let this be the only factor of production, so that the firm's cash flow gross of investment-related expenditures is F(K)Z. We suppose further that units of capital may be purchased at a constant price Pk and have no scrap value. If capital is useful—that is, if $F'(K) > 0$—this implies that all investment is irreversible.

6.4 SELF-ASSESSMENT QUESTIONS

1. Define the assumption of Permanent Income and Optimal Consumption.
2. Elaborate the consumption and financial return.
3. Explain the role of precautionary Saving.
4. What is the Dynamic IS–LM Model?
5. How will you explain irreversible investment under uncertainty?

6.4.1 MULTIPLE CHOICE QUESTIONS

1. Precautionary saving occurs.
    a) Need to boost investment.
    b) Necessary for growth
    c) Consumer habit to save more.
    d) Precautionary motive to delay consumption and save in the current.
2. The CCAPM predicts that an asset's return premium is proportional to its.
    a) Consumption Beta.
    b) Market Beta
    c) Financial Beta
3. The dynamic IS–LM model capturing the interactions between;
    a) Forward-looking prices
    b) Market Prices
    c) Industry price
4. Who propounded the permanent income hypothesis of consumer behavior?
    a) J. M Keynes
    b) Milton Friedman
    c) Duesenberry
    d) James Tobin

Answer Key (MCQs)

1. d
2. a
3. a
4. b

6.5 KEY TERMS

Precautionary saving: It is saving that occurs in response to uncertainty regarding future income.

The permanent income hypothesis: It is an economic theory attempting to describe how agents spread consumption over their lifetimes.

The optimal consumption: when a consumer maximizes utility, the marginal utility per dollar spent must be the same for all goods and services in the consumption bundle.

The consumption capital asset pricing model (CCAPM): It is an extension of the capital asset pricing model (CAPM) that uses a consumption beta instead of a market beta to explain expected return premiums over the risk-free rate.

Financial return: is the money made or lost on an investment over some period of time.

Irreversible investment: It acknowledges that the value of capital may not be fully recoverable when resold.

RECOMMENDED BOOKS

1. Bagliano, F. C., & Bertola, G. (2004). Models for Dynamic Macroeconomics. Oxford University Press on Demand. (CH # 1 and 2)
2. Mankive, N. Gregory (2022), Macroeconomics, Harvard University, USA. 11th edition (CH#14 and CH#17)
3. Romer, D. (2012). Advanced Macroeconomics, 4e. New York: McGraw-Hill. Latest edition
4 Stachurski, J. (2009). Economic Dynamics: Theory and Computation. MIT Press.

LINKS/BIBLIOGRAPHY

- https://www.le.ac.uk/users/dsgp1/COURSES/ELOMET/SUPP1.PDF 6/6/2020
- https://www.investopedia.com/terms/c/ccapm.asp#:~:text=The%20consumption%20capital%20asset%20pricing%20model%20(CCAPM)%20is%20an%20extension,over%20the%20risk%2Dfree%20rate. 12/6/2020

Unit No: 7

MONETARY AND FISCAL POLICY IN THE FRAMEWORK OF THE DYNAMIC MACROECONOMICS

Written by: Ms. Saima Ashraf

Reviewed by: Dr. Fouzia Jamshaid

CONTENTS

Page

7.1 INTRODUCTION

In this unit, we examine the dynamic economics in greater detail and develop a more thorough explanation of dynamic monetary and fiscal policy. Dynamic economics refers to a state where there is a change such as movement. The concept of dynamics is nearer to reality. In dynamic economics we study the economic variables like consumption function, income and investment in a dynamic state. Monetary policy, the demand side of economic policy, refers to the actions undertaken by a nation's central bank to control money supply to achieve macroeconomic goals that promote sustainable economic growth. In this unit, we identify monetary policy shocks with innovations in some measure of reserves or in the federal funds rate. These assumptions about the interest elasticity of the supply of or demand for reserves imply monetary policy shocks that produce dynamic responses of macroeconomic variables that are anomalous relative to traditional monetary analyses.

Fiscal policy is the means by which a government adjusts its spending levels and tax rates to monitor and influence a nation's economy. It is the sister strategy to monetary policy through which a central bank influences a nation's money supply. The fiscal policy in dynamic economic models shows that households are rational, forward looking decision units. The government (that is, the federal, state and local governments) affect private decisions of individual households in several different ways. The unit examines many types of fiscal policies, including deficit finance, changes in the level and timing of government spending, choice of the tax base, tax progressivity, investment incentives and social security. In addition, the unit considers the interaction of demographic change and fiscal choices, the effect of fiscal policies on the stock market, particularly investment incentives, and the question of whether conventional measures of government debt are intrinsically well defined.

For better understanding read Mankive, N. Gregory. Principles of Macroeconomics (CH #14) and Auerbach, A. J., & Kotlikoff, L. J. (1987). Dynamic Fiscal Policy. Cambridge University Press. (CH # 1)

7.2 LEARNING OUTCOMES

By the end of this unit, and having completed the Essential readings and activities, you should be able to understand the:

- dynamic economics
- highlight monetary policy in the framework of dynamic macroeconomics
- understanding of the tradeoff between output variability and inflation variability
- explain the fiscal policy
- understanding of the different tools of fiscal policy
- impact of fiscal policy under dynamic macroeconomics

7.3 Main Topics to Discussion

7.3.1 Monetary Policy in the Framework of the Dynamic Macroeconomics

Dynamic model of inflation and output used to show how various shocks affect the time paths of output, inflation, and interest rates. We now use the model to shed light on the design of monetary policy. It is worth pausing at this point to consider what we mean by the phrase "the design of monetary policy." So far in this analysis, the central bank has had a simple role: it merely had to adjust the money supply to ensure that the nominal interest rate hit the target level prescribed by the monetary-policy rule. The two key parameters of that policy rule are θ_π (the responsiveness of the target interest rate to inflation) and θ_y (the responsiveness of the target interest rate to output). We have taken these parameters as given without discussing how they are chosen. Now that we know how the model works, we can consider a deeper question: what should the parameters of the monetary policy rule be?

7.3.1.1 The Tradeoff between Output Variability and Inflation Variability

Consider the impact of a supply shock on output and inflation. According to the dynamic AD–AS model, the impact of this shock depends crucially on the slope of the dynamic aggregate demand curve. In particular, the slope of the DAD curve determines whether a supply shock has a large or small impact on output and inflation.

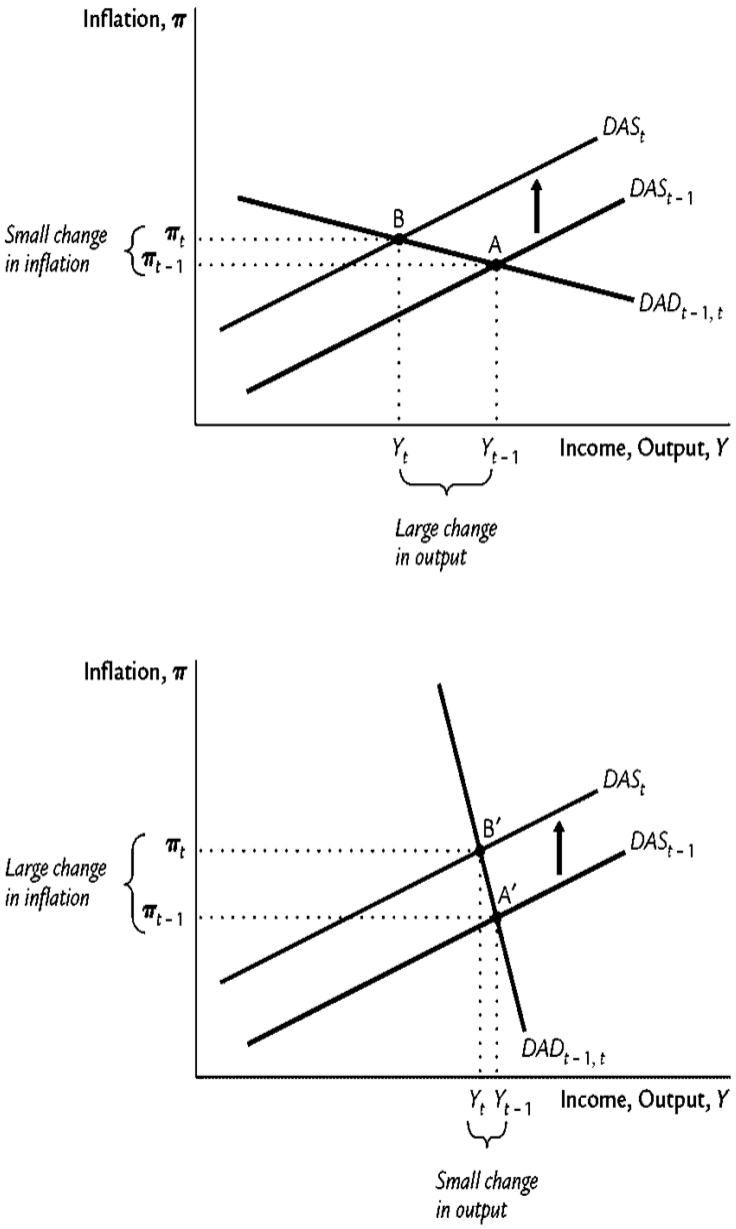
This phenomenon is illustrated in Figure 7.1. In the two panels of this figure, the economy experiences the same supply shock. In panel (a), the dynamic aggregate demand curve is nearly flat, so the shock has a small effect on inflation but a large effect on output. In panel (b), the dynamic aggregate demand curve is steep, so the shock has a large effect on inflation but a small effect on output. Why is this important for monetary policy? Because the central bank can influence the slope of the dynamic aggregate demand curve. Recall the equation for the DAD curve:

Two key parameters here are θ_π and θ_y, which govern how much the central bank's interest rate target responds to changes in inflation and output. When the central bank chooses these policy parameters, it determines the slope of the DAD curve and thus the economy's short-run response to supply shocks.

On the one hand, suppose that, when setting the interest rate, the central bank responds strongly to inflation (θ_π is large) and weakly to output (θ_y is small). In this case, the coefficient on inflation in the above equation is large. That is, a small change in inflation has a large effect on output. As a result, the dynamic aggregate demand curve is relatively flat, and supply shocks have large effects on output but small effects on inflation. The story goes like this: When the economy experiences a supply shock that pushes up inflation, the central bank's policy rule has it respond vigorously with higher

interest rates. Sharply higher interest rates significantly reduce the quantity of goods and services demanded, thereby leading to a large recession that dampens the inflationary impact of the shock (which was the purpose of the monetary policy response)

On the other hand, suppose that, when setting the interest rate, the central bank responds weakly to inflation (((${\theta_\pi}$ is small) but strongly to output ((${\theta_y}$ is large). In this case, the coefficient on inflation in the above equation is small, which means that even a large change in inflation has only a small effect on output. As a result, the dynamic aggregate demand curve is relatively steep, and supply shocks have small effects on output but large effects on inflation. The story is just the opposite as before: Now, when the



Two Possible Responses to a Supply Shock When the dynamic aggregate demand curve is relatively flat, as in panel (a), a supply shock has a small effect on inflation but a large effect on output. When the dynamic aggregate demand curve is relatively steep, as in panel (b), the same supply shock has a large effect on inflation but a small effect on output. The slope of the dynamic aggregate demand curve is based in part on the parameters of monetary policy (θ_π and θ_Y), which describe how much interest rates respond to changes in inflation and output. When choosing these parameters, the central bank faces a tradeoff between the variability of inflation and the variability of output.

economy experiences a supply shock that pushes up inflation, the central bank's policy rule has it respond with only slightly higher interest rates. This small policy response avoids a large recession but accommodates the inflationary shock.

In its choice of monetary policy, the central bank determines which of these two scenarios will play out. That is, when setting the policy parameters θ_π and θ_y, the central bank chooses whether to make the economy look more like panel (a) or more like panel (b) of Figure 7.2. When making this choice, the central bank faces a tradeoff between output variability and inflation variability. The central bank can be a hard-liner inflation fighter, as in panel (a), in which case inflation is stable but output is volatile. Alternatively, it can be more accommodative, as in panel (b), in which case inflation is volatile but output is more stable. It can also choose some position in between these two extremes.

One job of a central bank is to promote economic stability. There are, however, various dimensions to this charge. When there are tradeoffs to be made, the central bank must determine what kind of stability to pursue. The dynamic AD–AS model shows that one fundamental tradeoff is between the variability in inflation and the variability in output. Note that this tradeoff is very different from a simple tradeoff between inflation and output. In the long run of this model, inflation goes to its target, and output goes to its natural level. Consistent with classical macroeconomic theory, policymakers do not face a long-run tradeoff between inflation and output. Instead, they face a choice about which of these two measures of macroeconomic performance they want to stabilize. When deciding on the parameters of the monetary-policy rule, they determine whether supply shocks lead to inflation variability, output variability, or some combination of the two.

7.3.2 Fiscal Policy in the Framework of the Dynamic Macroeconomics

7.3.2.1 Dynamic Fiscal Policy

The behavior of overlapping generations. and solving for the equilibrium transition path of the economy. The difficulties in obtaining either qualitive or quantitative analytical results in any but extremely simple and highly unrealistic dynamic models influenced our decision to use a computer simulation model lo study the dynamics of fiscal policy. Although this methodological approach to analyzing fiscal policy issues is commonplace, the model developed here appears to be unique in that it can be used to study the effects of a wide range of important fiscal policies on intertemporal general equilibria under the assumption of rational expectations. The numerical simulation technique is required because of the complexity of the problems studied here. Nevertheless, the model has few components, and these are easily described. Therefore, the simulation results are highly intuitive and easily understood by tracing the effect of policy changes through the different parts of the model.

Savings, welfare, and the choice of tax base

Would a switch in the tax base from income to consumption in- crease savings and welfare in the long run? How would the outcome be different if the alternative tax base

were labor income, rather than consumption? Do policies that lead to increased savings in the long run also improve individual welfare in the long run?

Efficiency gains from dynamic tux reform

To what extent do policies that improve long-run welfare succeed in doing so through transfers in resources from earlier generations rather than through increases in economic efficiency? Do fiscal policies exist that offer Pareto efficiency gains, that is. that improve the welfare of at least one generation without lowering thar of others? How large arc the efficiency gains or losses from switching lax bases?

"Crowding out " and Deficit

How much private investment is displaced by deficits associated with lax curs of different sizes and durations? How fast does crowding out occur? What is the impact of deficit finance on short- and long-term interest rates? Is it possible for investment to increase when a deficit occurs? How does the type of tax cut that induces a deficit influence the degree of crowding out? How useful are reported government deficits as measures of intergenerational redistribution and fiscal stimulus?

Business tax Incentives

What types of business tax incentives have the greatest "bang for the buck" in terms of increased investment per dollar of revenue loss? What is the impact of investment incentives on the stock market and interest rates? How do adjustment costs to investment influence the efficacy of fiscal policy? How do changes in investment incentives influence the effective base of taxation?

Tax Progressivity

How serious are the efficiency costs of progressive taxation in comparison with the costs of proportional laxation? How much is labor supply and savings reduced by the progressivity of the tax system? How docs increasing the progressivity of different taxes shift the burden of' laxation across generations?

Announcement Effects

Can early announcement of policy changes mitigate or reverse their intended effects? How does the anticipation of different fiscal policy changes affect short-run economic behavior? In what cases is early announcement of a policy shift beneficial?

Demographic Shift

What economic changes, particularly in capital formation and factor prices, should occur when fertility rates undergo major changes? How does such a demographic shift affect the financial viability of social security and the distribution across generations of the burden of financing social security? What changes in the social security system are required to off- set the effects of a major increase in the ratio of retirees to workers?

7.3.2.2 The Need for a Dynamic General Equilibrium Simulation Model

Harberger (1962) was among the first researchers to analyze the effects of fiscal policy using a general equilibrium approach. He was concerned with the effects of a corporate tax in an economy with two production sectors (corporate and noncorporate), two factors of production (capital and labor), and a representative household that supplies the productive factors and purchases the output of the two sectors. Despite the simplicity of his model, it is only possible to obtain general analytical expressions for the effects of taxation in the case of infinitesimal tax change These expressions are quite complicated when there arc nonzero tax rates in the initial economy (Atkinson and Stiglitz. 1980). Simulation analysis is the only alternative available when it is necessary to analyze large policy changes in models that are too complicated for simple analytical solutions. To solve such models, one must specify explicitly the key parameters, such as the elasticity of substitution in production of capital for labor. Obviously, if the model is to be as realistic as possible, the numerical estimates of these parameters should be culled from the empirical literature. Given such a parameterization, one can usually obtain an exact numerical solution for the equilibrium 01' the economy for any given fiscal policy and compare the results for different fiscal policies. This is the essence of the numerical simulation approach. Simulating the model for alternative policies takes the place of the comparative static exercises that are performed with analytical models. In addition, one can conduct sensitivity analysis of the numerical simulation model by examining the impact of plausible variations in parameter values. Often the results of such sensitivity analysis are very robust to reasonable parameter changes, even though this outcome could not be foreseen prior to performing the simulation experiments. In other cases, results are quite sensitive to small changes parameters. This. too, is useful information, for it indicates which parameters need to be empirically estimated most precisely.

7.4 SELF-ASSESSMENT QUESTIONS

7.4.1 Essay Questions

1. What is dynamic economics?
2. Explain the difference between monetary and fiscal policy.
3. Describe the impact of monetary policy under dynamic macroeconomics situation.
4. What are the models of dynamic fiscal policy?

7.4.2 Multiple Choice Questions

1. Monetary policy means:
   a) Control of government on supply of money
   b) Control of private sector on economy
   c) Control on central bank of the country on the supply of the money
2. The use of taxes and government spending to affect the economy:
   a) Monetary Policy
   b) Fiscal Policy

c) Contractionary Policy
d) Expansionary Policy

3. Aplan to reduce aggregate demand and slow the economy:
   a) Contractionary Fiscal Policy
   b) Expansionary Fiscal Policy
   c) Contractionary Monetary Policy
   d) Expansionary Monetary Policy
4. Refers to government revenue, spending, and debt:
   a) Fractional Reserve Banking
   b) Legal Reserves
   c) Fiscal
   d) Reserve system
5. Congress cutting taxes is an example of ....

a) Fiscal Policy
b) Monetary Policy

Answer Key (MCQs)

1) c
2) b
3) a
4) c
5) a

7.5 KEY TERMS

Dynamic economics: we study the economic variables like consumption function, income and investment in a dynamic state.

Monetary policy: It is an economic policy that manages the size and growth rate of the money supply in an economy.

Fiscal policy: It is the use of government revenue collection and expenditure to influence a country's economy.

The interest rate: It is the amount a lender charges for the use of assets expressed as a percentage of the principal.

A progressive tax: It is based on the taxpayer's ability to pay. It imposes a lower tax rate on low-income earners than on those with a higher income.

The crowding out: It effect is an economic theory arguing that rising public sector spending drives down or even eliminates private sector spending.

Demographic: statistical data relating to the population and particular groups within it

RECOMMENDED BOOKS

1. Auerbach, A. J., & Kotlikoff, L. J. (1987). Dynamic Fiscal Policy. Cambridge University Press. (CH#01)
2. Krueger, D. (2005). Dynamic Fiscal Policy. Johann-Wolfgang-Goethe-University Frankfurt aM.
3. Mankive, N. Gregory (2022), Macroeconomics, Harvard University, USA. 11th edition (CH#14)
4. Romer, D. (2012). Advanced Macroeconomics, 4e. New York: McGraw-Hill. Latest edition

LINKS/BIBLIOGRAPHY

- https://www.economicsdiscussion.net/economics-2/dynamic-economics/dynamic-economics-concept-importance-and-limitations/14309#:~:text=In%20dynamic%20economics%20we%20study,rates%20of%20output%20are%20changing.%E2%80%9D 4/9/2020
- https://corporatefinanceinstitute.com/resources/knowledge/economics/monetary-policy/ 10/9/2020
- https://www.investopedia.com/terms/f/fiscalpolicy.asp 18/9/2020

Unit No: 8

DYNAMIC STOCHASTIC GENERAL EQUILIBRIUM MODELS

Written by: Ms. Saima Ashraf

Reviewed by:Dr. Fouzia Jamshaid

CONTENTS

Page

8.1 INTRODUCTION

In this unit, we consider general equilibrium economic model, structure of general equilibrium economic model and general equilibrium in a dynamic environment. Firstly, we need to understand the difference between partial and general equilibrium. Partial equilibrium is a condition of equilibrium in the theory of economics which takes into consideration only a part of the market to attain the equilibrium. It studies the effect of one variable upon the other without considering the effect of other factors. For example, law of demand is studied in relationship with price by keeping all other factors constant. General equilibrium is the equilibrium that studies an economic phenomenon by taking all the aggregate units in the economy into consideration. For example, product prices make demand for each commodity equal to its supply and factor prices make the demand for each factor equal to its supply so that all product markets and factor markets are simultaneously in equilibrium.

For better understanding read Bagliano, F. C., & Bertola, G. (2004). Models for Dynamic Macroeconomics. Oxford University Press on Demand. (CH # 4)

8.2 LEARNING OUTCOMES

At the end of this unit, and having completed the Essential readings and activities, you should be able to understand the:

- highlight the concept of general equilibrium economic model
- familiar with the difference between partial and general equilibrium
- study the structure of general equilibrium economic model
- understanding the concept of growth in dynamic general equilibrium model

8.3 Main Topics to Discuss

8.3.1 General Equilibrium Economic Model

If you go on to take more advanced courses in macroeconomics, you will likely learn about a class of models called dynamic, stochastic, general equilibrium models, often abbreviated as DSGE models. These models are dynamic because they trace the path of variables over time. They are stochastic because they incorporate the inherent randomness of economic life. They are general equilibrium because they consider the fact that everything depends on everything else. In many ways, they are the state-of-the-art models in the analysis of short run economic fluctuations. The dynamic AD–AS model is a simplified version of these DSGE models. Unlike analysts using advanced DSGE models, we have not started with the household and firm optimizing decisions that underlie the macroeconomic relationships. But the macro relationships that this chapter has posited are like those found in more sophisticated DSGE models. The dynamic AD–AS model is a good stepping-stone between the basic model of aggregate demand and aggregate supply and the more complex DSGE models you might see in a more advanced course. The dynamic AD–AS model also yields some important lessons. It shows how various macroeconomic variables—output, inflation, and real and nominal interest rates—respond to shocks and interact with one another over time. It demonstrates that, in the design of monetary policy, central banks face a tradeoff between variability in inflation and variability in output. Finally, it suggests that central banks need to respond vigorously to inflation to prevent it from getting out of control. If you ever find yourself running a central bank, these are good lessons to keep in mind.

8.3.2 Structure of General Equilibrium Economic Model

The dominant macro model has for some time been the Dynamic Stochastic General Equilibrium model, or DSGE, whose name points to some of its outstanding characteristics. “General” indicates that the model includes all markets in the economy. “Equilibrium” points to the assumptions that supply and demand balance out rapidly and unfailingly, and that competition reigns in markets that are undisturbed by shortages, surpluses, or involuntary unemployment. “Dynamic” means that the model looks at the economy over time rather than at an isolated moment. “Stochastic” corresponds to a specific type of manageable randomness built into the model that allows for unexpected events, such as oil shocks or technological changes, but assumes that the model’s agents can assign a correct mathematical probability to such events, thereby making them insurable. Events to which one cannot assign a probability, and that are thus truly uncertain, are ruled out.

AND HOW DOES IT WORK?

The agents populating DSGE models, functioning as individuals or firms, are endowed with a kind of clairvoyance. Immortal, they see to the end of time and are aware of anything that might possibly ever occur, as well as the likelihood of its occurring; their decisions are always instantaneous yet never in error, and no decision depends on a previous decision or influences a subsequent decision. Also assumed in the core DSGE model is that all agents of the same type – that is, individuals or firms – have identical needs and identical tastes, which, as "optimizers," they pursue with unbounded self-interest and full knowledge of what their wants are. By employing what is called the "representative agent" and assigning it these standardized features, the DSGE model excludes from the model economy almost all consequential diversity and uncertainty – characteristics that in many ways make the actual economy what it is.

The DSGE universe makes no distinction between system equilibrium, in which balancing agent-level disequilibrium forces maintains the macroeconomy in equilibrium, and full agent equilibrium, in which every individual in the economy is in equilibrium. In so doing, it assumes away phenomena that are commonplace in the economy: involuntary unemployment and the failure of prices or wages to adjust instantaneously to changes in the relation of supply and demand. These phenomena are exceptional and call for special explanation. It then explains how this model became so popular in policymaking and provides references for the same. There is also a discussion of economist's interpretation of DSGE models.
It is amazing to see all this debate enfold. But again, the problem is not with models. The problem is with economists and some super-economists who just sold this model all over the world. The limitations were just put on the backburner. In moderation years it looked too good to be true as it fitted so well. And in times like this again it looks too good to be true as it nothing really fits and is unbelievable that we let this model go this far.

Structure

By applying dynamic principles, dynamic stochastic general equilibrium models contrast with the static models studied in applied general equilibrium models and some computable general equilibrium models.

DSGE models share a structure built around three interrelated "blocks": a demand block, a supply block, and a monetary policy equation. Formally, the equations that define these blocks are built on micro foundations and make explicit assumptions about the behavior of the main economic agents in the economy, i.e.

households, firms, and the government. The preferences (objectives) of the agents in the economy must be specified. For example, households might be assumed to maximize a utility function over consumption and labor effort. Firms might be assumed to maximize profits and to have a production function, specifying the amount of goods produced, depending on the amount of labor, capital and other inputs they employ. Technological constraints on firms' decisions might include costs of adjusting their capital stocks, their employment relations, or the prices of their products.

Below is an example of the set of assumptions a DSGE is built upon

- Perfect competition in all markets
- All prices adjust instantaneously
- Rational expectations
- No asymmetric information
- The competitive equilibrium is Pareto optimal
- Firms are identical and price takers
- Infinitely lived identical price-taking households

to which the following frictions are added:
Distortionary Taxes (Labor Taxes) - to account for not lump-sum taxation
Habit persistence (the period utility function depends on aquasi-difference of consumption) Adjustment Costs on Investments - to make investments less volatile Labor Adjustment Costs - to account for costs firms face when changing the level of employment. The models' general equilibrium nature is presumed to capture the interaction between policy actions and agents' behavior, while the models specify assumptions about the stochastic shocks that give rise to economic fluctuations. Hence, the models are presumed to "trace more clearly the shocks' transmission to the economy.

8.3.3 Growth in Dynamic General Equilibrium Model

Dynamic stochastic general equilibrium modeling is a method in macroeconomics that attempts to explain economic phenomena, such as economic growth and business cycles, and the effects of economic policy, through econometric models based on applied general equilibrium theory and microeconomic principles.

As a practical matter, people often use the term "DSGE models" to refer to a class of econometric, quantitative models of business cycles or economic growth called real business cycle (RBC) models. Considered to be classic quantitative DSGE models are the ones proposed by Kydland & Prescott, and Long & Plosser. Charles Plosser has stated that DSGE models are an "update" of RBC models.

REAL BUSINESS CYCLE MODELS

RBC models belong to a class of models called Dynamic Stochastic General Equilibrium (DSGE) Models. They are dynamic because investment is a key endogenous variable, which facilitates the smoothing of household consumption over time. They are stochastic because an exogenous shock process is introduced to trigger fluctuations in the endogenous variables around their balanced growth paths (that is, a business cycle). RBC models consider exogenous shocks to productivity and/ or government expenditure (i.e. real shocks). The model is written in discrete time because business cycles are fluctuations with a periodicity of between 2 and 8 years. It is a general equilibrium model, that is, households and firms are maximizing utility and profit respectively, and markets clear.

THE LUCAS CRITIQUE

"The 'Lucas critique' - Lucas's contribution to macro econometric evaluation of economic policy - has received enormous attention and been completely incorporated in current thought. Briefly, the 'critique' implies that estimated parameters which were previously regarded as 'structural' in econometric analysis of economic policy actually depend on the economic policy pursued during the estimation period (for instance, the slope of the Phillips curve may depend on the variance of non-observed disturbances in money demand and money supply). Hence, the parameters may change with shifts in the policy regime. This is not only an academic point, but also important for economic-policy recommendations. The effects of policy regime shifts are often completely different if the agents' expectations adjust to the new regime than if they do not. Nowadays, it goes without saying that the effects of changing expectations should be taken into account when the consequences of a new policy are assessed - for instance, a new exchange rate system, a new monetary policy, a tax reform, or new rules for unemployment benefits.

"When Lucas's seminal article (1976) was published, practically all existing macro econometric models had behavioral functions that were in so-called reduced form; that is, the parameters in those functions might implicitly depend on the policy regime. If so, it is obviously problematic to use the same parameter values to evaluate other policy regimes. Nevertheless, the models were often used precisely in that way: Parameters estimated under a particular policy regime were used in simulations with other policy rules, for the purpose of predicting the effect on crucial macroeconomic variables. With regime-dependent parameters, the predictions could turn out to be erroneous and misleading.

8.3.3 SELF-ASSESSMENT QUESTIONS

8.4.1 Essay Questions

1. What is the difference between partial and general equilibrium? discuss in detail.
2. What is dynamic, stochastic, general equilibrium models?
3. Explain the structure of general equilibrium economic models and how it works?
4. Discuss growth in dynamic general equilibrium mode.

8.4.2 Multiple Choice Questions

1. The stochastic models mean:
   a) They incorporate the inherent randomness of economic life
   b) The variables change over time
   c) Never change variables
   d) None of these
2. Dynamic model means:
   a. These models trace the path of variables over time.
   b. These models trace the path of variables over period.
   c. Never change variables
3. General equilibrium analyzes the economy as a.
   a) Whole
   b) Single
   c) Partial
4. The DSGE stand for
   a) Dynamic, stochastic, general equilibrium models
   b) Demand and supply general equilibrium models
   c) Dommer, Solow growth equilibrium models

Answer Key (MCQs)

1) a
2) a
3) a
4) a

8.3 Key Terms

General equilibrium: It analyzes the economy as a whole, rather than analyzing single markets like with partial equilibrium analysis.

Partial equilibrium: It is a condition of economic equilibrium which takes into consideration only a part of the market (with all other parts remaining constant) to attain equilibrium.

Dynamic equilibrium: It means equilibrium in an economy that is changing over time.

Stochastic: They incorporate the inherent randomness of economic life.

DSGE models: It means dynamic, stochastic, general equilibrium models

Economic growth: It is an increase in the production of economic goods and services, compared from one period of time to another

RECOMMENDED BOOKS

1. Bagliano, F. C., & Bertola, G. (2004). Models for Dynamic Macroeconomics. Oxford University Press on Demand. (CH # 4)
2. Mankiw, N. G. (2020). Principles of Macroeconomics. Cengage Learning. Harvard University, USA. 9th edition (CH #18)
3. Romer, D. (2012). Advanced Macroeconomics, 4e. New York: McGraw-Hill. Latest edition
4. Stachurski, J. (2009). Economic Dynamics: theory and computation. MIT Press.

LINKS/BIBLIOGRAPHY

- https://en.wikipedia.org/wiki/Partial_equilibrium 21/6/2020
- https://larspsyll.wordpress.com/2017/06/16/what-is-it-that-dsge-models-really-explain/ 21/6/2020
- https://en.wikipedia.org/wiki/Dynamic_stochastic_general_equilibrium 22/6/2020
- https://www.investopedia.com/terms/g/general-equilibrium-theory.asp 22/6/2020
- http://personal.lse.ac.uk/vernazza/_private/RBC%20Models.pdf 23/06/2020
- https://conversableeconomist.blogspot.com/2012/11/robert-lucas-and-lucas-critique.html 23/06/2020

Unit No: 9

DYNAMIC MACROECONOMICS IN OPEN ECONOMY

Written by: Ms. Saima Ashraf

Reviewed by: Dr. Fouzia Jamshaid

CONTENTS

Page

9.1 INTRODUCTION

In this unit, we shall consider several open economy models that exhibit dynamic behavior. We shall start with the income expenditure model. This model assumes a fixed exchange rate. Simplicities, it will allow us to set the scene and illustrate, in the simplest possible terms, how instability may occur, but is less likely to occur in an open economy in comparison to a close done. We then do the same in the context of the IS-LM model, extending it to the open economy, but considering the situation under both a fixed and a flexible exchange rate. This forms the basis of the Mundell–Fleming model. This model was originally concerned with the relative impact of monetary and fiscal policy under fixed and floating exchange rate regimes, but with perfect capital mobility. It has become the standard model of open economy macroeconomics, and so we shall investigate its dynamic properties in some detail – for models with some capital mobility and for situations of perfect capital mobility. We shall find that the assumption about the degree of capital mobility is quite important to the dynamic results.

For better understanding read Shone, R. (2002). Economic Dynamics: Phase diagrams and their economic application. Cambridge University Press. (CH #12)

9.2 LEARNING OUTCOMES

Aty the end of this unit, and having completed the Essential readings and activities, you should be able to understand the:

- understanding of the dynamics of a simple expenditure model
- explanation of the balance of payments and the money supply
- describe Fiscal and monetary expansion under fixed exchange rates
- highlight the Fiscal and monetary expansion under flexible exchange rates
- understanding of the Open economy dynamics under fixed prices and floating

9.3 Main Topics to Discuss

9.3.1 The Dynamics of a Simple Expenditure Model

The simplest macroeconomic model for an open economy is the one where prices are assumed constant, and so we need not distinguish between real and nominal variables.

E =C+I+G+NX

Expenditure, E, is the sum of

- consumption expenditure, C
- investment expenditure, I
- government expenditure G
- expenditure on net exports, NX (net exports = exports- imports)

We make four behavioral assumptions with respect to consumption expenditure, net taxes, investment expenditure and imports.

- C =a +b Y^d a > 0,0 < b < 1(C is assumed to be a linear function of disposable income)
- Y^d =Y −T (Yd, is defined as the difference between income, Y, and net taxes, T)
- T = T_0−tY 0 < t < 1 (net taxes is linearly related to income) **(Eq 9.1)**
- I =I_0 +jY j > 0 (Investment expenditure is positively related to the income)
- M =M_0 +mY 0 < m < 1 (government spending and exports as exogenous)

Dynamic assumption to adjust model over time

We assume that national income will adjust continuously over time in response to the excess demand in the goods market.

$\frac{dY}{dt}$= λ(E−Y) λ>0 (**Eq 9.2)**

In other words, when expenditure exceeds income, then there will be pressure in the economy for income to rise. This is because firms can sell all they wish, and with stocks running down then they will expand their production, take on more labor and so raise the overall level of economic activity and vice versa. Equilibrium in this model is therefore defined to be a situation where income is not changing, or where E =Y.

Substituting the equations in (9.1) into equation (9.2), we obtain the following differential equation.

$\frac{dY}{dt}$ = λ (a−bT_0+ I_0 +G+X− M_0)−λ[1−b(1−t) −j+m] Y = λ A−λ[1−b(1−t) −j+m]Y

(Eq9.3)

First consider equilibrium in this model. This requires $\frac{dY}{dt}$ =0, i.e.

λA−λ[1−b(1−t) −j+m] Y =0 (where A denotes all autonomous expenditures)

$Y^* = \frac{A}{1-b(1-t)-j+m}$ **Figure: 9.1** **(Eq 9.4)**

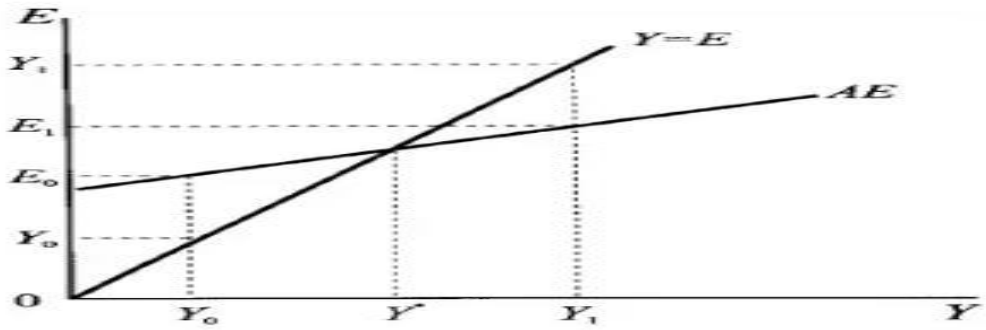


Figure: 9.1

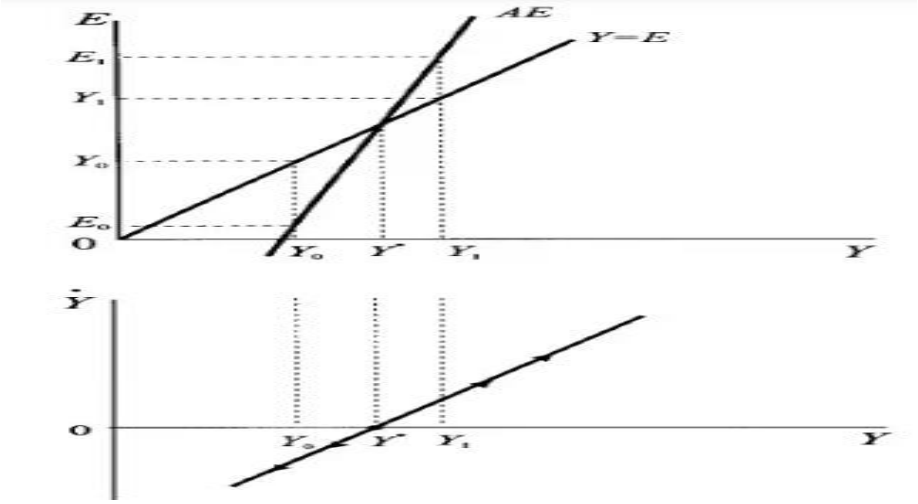
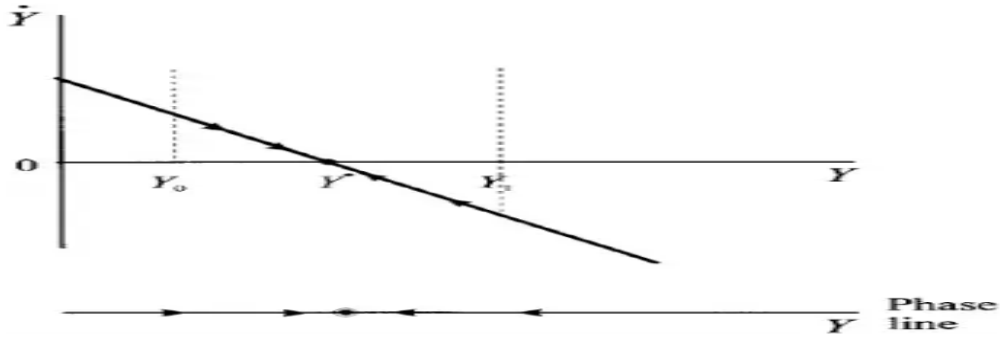


Figure: 9.2



Since there is only one equilibrium, one fixed point, in this model then the situation will either be globally stable or globally unstable. Two situations are illustrated in figures 9.1 and 9.2. In figure 9.1 the growth line is negatively sloped. Hence, for than the equilibrium level, income will rise; while for income above the equilibrium level, income will fall. Hence, the fixed point is a stable one. In figure 9.2, on the other hand, the growth line is positively sloped. In this case, if income is below the equilibrium level then it will decline and decline continually. If, on the other hand, income is above the equilibrium level, then income will rise continually. In other words, the equilibrium is globally unstable. It is clear from the differential equation in (9.3) that the slope of the growth line will be negative if b(1−t) +j−m < 1. This also ensures that the simple expenditure multiplier, k, is positive, i.e.

$$K = \frac{1}{1-b(1-t)-j+m} > 0$$

But there is no reason for b(1−t) +j−m <1. Take the closed economy first and assume that income begins initially below the equilibrium level. As illustrated in figure 9.2 at Y =Y_0, the change in income is negative and income would decline. The reason is that at this initial level of income, income exceeds aggregate expenditure (Y_0 > AE_0). There is a buildup of stocks and so firms lay off workers. Because h is high, they lay off quite several workers. But the loss in income of the workers means that they in turn have less disposable income. With a high marginal propensity to spend, this means a major cut in consumer spending. But this will itself lead to a further excess supply of goods, and so firms will respond with further cuts. Hence, the economy goes into continuous decline. If income had begun above the equilibrium level, at Y =Y1, with stocks running down, then firms would expand their production, disposable income would rise, and consumption expenditure would rise. The economy would expand. Of course,

once it reached full employment, then this would eventually manifest itself in rising prices.

9.3.2 The Balance of Payments and the Money Supply

The balance of payment and money supply are interrelated variables.

1. The Balance of Payments (BOP)

We define the balance of payments in real terms.

bp=nx+cf (real net exports, nx, + real net capital flows, cf) **(Eq 9.5)**

Net exports in nominal terms, NX = (value of exports - value of imports)

Making a clear distinction between real and nominal variables we have

NX=Px−Pz (x is real exports and z real imports)

Defining S as the spot exchange rate expressed as domestic currency per unit of foreign currency, and letting P∗ denote the price level abroad, then.

$$NX=Px-SP^{*}z$$

Dividing throughout by P to bring everything into real terms.

$$\frac{NX}{P}=\frac{Px}{P}-\frac{SP^{*}z}{P} \; or \; nx=x-Rz \qquad \textbf{(Eq 9.6)}$$

(R= SP^{*}P and R is real exchange rate)

Export

Real exports depend on income abroad and the real exchange rate(competitiveness). We assume a simple linear function.

X = x_0 +f R f > 0 **(Eq 9.7)**

The constant x_0 can be considered as relating to income abroad, but we shall be holding this constant throughout. The second term captures competitiveness. Suppose the home currency depreciates, so S rises and hence so does R. Then domestic prices fall relative to those abroad and hence exports are stimulated. There is then a positive relationship between real exports and the real exchange rate.

Import

In the case of real imports, we assume

Rz = z_0 + my – g R 0 < m < 1, g > 0 **(Eq 9.8)**

where m is the marginal propensity to import, and real imports decline with a devaluation of the domestic currency (a rise in S).

Real net export NX or (export- Import or Eq 9.7-9.8)

nx = (x_0 +f R) - (z_0 + my – g R)

= (x_0 - z_0) + (f + g) R -m y

= n x_0 + (f + g) R – m y (where: n x_0 = (x_0 - z_0)) **(Eq 9.9)**

Real net capital flows (cf)

cf = cf_0 +v(r−r∗) v > 0 **(Eq 9.10)**

where cf_0 is real net capital flows independent of interest rates, and r and r∗ are the nominal interest rates at home and abroad (constant exchange rate and prices at home and abroad).

Combining net exports and capital flow equation (substitute eq 9.9 and 9.10 in 9.5)

bp=nx+cf

= n x_0 + (f + g) R – m y + cf_0 +v(r−r∗)

= b P_0 + (f + g) R – m y +v(r−r∗) where (b P_0= n x_0 + cf_0) **(Eq 9.11)**

- Balance of payments equilibrium occurs when bp=0
- Balance of payments deficit when bp < 0
- Balance of payments surplus when bp > 0.

Under the assumption of fixed exchange rates, the BP curve denotes combinations of income and interest rates for which the balance of payments is in equilibrium. Setting bp=0 and expressing the result as r a function of y, we have

$$r = \left[r^* - \frac{bP_0+(f+g)R}{v}\right] + \left(\frac{m}{y}\right)y \quad \textbf{(Eq 9.12)}$$

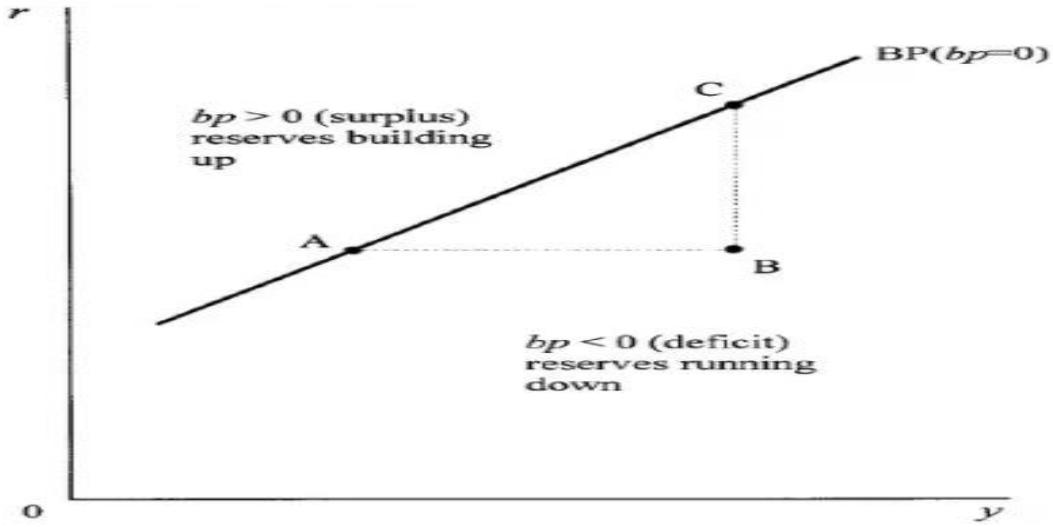
hence the BP curve is, in general, positively sloped. But also note that if bp < 0 then

b P_0 + (f + g) R – m y +v(r−r∗)< 0

$$r < \left[r^* - \frac{bP_0 + (f+g)R}{v}\right] + \left(\frac{m}{y}\right)y$$

In other words, below the BP curve the balance of payments is in deficit, while above the BP curve the balance of payments is in surplus. This information is displayed in figure 9.3.

Figure # 9.3



If the economy is below the BP curve, then the balance of payments is in deficit. What is occurring in this situation is a running down of the country's reserves. Such a situation can persist in the short term, but not necessarily in the medium and long term. A similar situation arises in the case of a surplus, which occurs above the BP curve. Here the economy is adding to its reserves. The implication of the change in the reserve position of the economy depends on several factors. These include:

- The change in the money supply resulting from a change in the reserves.
- The extent to which the authorities sterilize the impact on the money supply.
- Whether a change in the parity rate is considered a possibility.

Special Cases

- If v=0 then the BP curve is vertical at income level
- If v=∞ there is perfect capital mobility, and the BP curve is horizontal at r =r∗
- Not perfect, capital mobility then the BP curve is positively sloped.

However, there are two further categories

- the BP curve is steeper than the LM curve
- the BP curve is less steep than the LM curve

2. The Money Supply in An Open Economy

Here we consider just the narrow definition of money, the money base, and denoted M_o, and a broader definition of money supply, namely M1. Specifically

$M_o = C_p +$ CBR

Ms = C_p+ D **(Eq 9.13)**

were

- M_o=money base
- C_p=cash held by the public
- CBR=commercial bank reserves at the Central Bank
- Ms=money supply (here M1)
- D=sight deposits

We assume a simple money multiplier relationship between Ms and M0, i.e.

Ms=qM_o (**Eq 9.14)**

Return to the money base M_o= C_p+ CBR. This is the money base from the point of view of Central Bank liabilities. It is possible to consider a consolidated banking system from the point of view of the asset side. The money base from the asset side denotes Central Bank Credit, CBC, and international reserves, IR. Thus

M_o= C_p+ CBR = CBC+IR (**Eq 9.15)**

Ms = q(CBC+IR) (**Eq 9.16)**

Money base can occur from two sources:

- Open market operations which operate through changes in CBC.
- Changes in the foreign exchange reserves that, under a fixed exchange rate, is equal to the balance of payments.

Open market operations, ΔCBC, can usefully be thought of in terms of two components. (a) Open market operations which have nothing to do with the balance of payments, denoted μ, and which we shall refer to as autonomous open market operations. (b) A component that is responding to the change in the reserves. Let, then.

ΔCBC = μ − λΔIR $0 \leq \lambda \leq 1$ (**Eq 9.17)**

where λ denotes the sterilisation coefficient. If λ=0 then regardless of the change in reserves, no sterilisation occurs; if λ = 1, then we have perfect sterilisation. Thus, for a surplus on the balance of payments and a rise in the money base of ΔIR, the Central Bank reduces the money base by an equal amount. If the country has a deficit, leading to a reduction in the money base, then the Central Bank increases the money base by an equal amount. Where some, but not perfect, sterilisation occurs, then $0 < \lambda < 1$

We are now able to consider the money supply in more detail.

Ms=q(CBC+IR)

ΔMs=q(ΔCBC+ΔIR)

=q(μ−λΔIR+ΔIR)

=q[μ+(1−λ) ΔIR]

Hence

$$\frac{\Delta Ms}{p} = \frac{\mu q}{p} + \frac{q(1-\lambda)\Delta IR}{p} \quad \textbf{(Eq 9.18)}$$

Consider the two extreme cases:

i. μ=0 and λ=0, no autonomous open market operations and no sterilization

ii. $\mu = 0$ and $\lambda = 1$ no autonomous open market operations and perfect sterilization

It should be noted that retaining the assumption of an exogenous and constant money supply for an open economy is equivalent to assuming no autonomous open market operations and perfect sterilization (i.e. case (ii)

9.3.3 Fiscal and Monetary Expansion under Fixed Exchange Rates

Fiscal expansion

In a dynamic context, the BP curve is the condition for which bp = 0. There is no equivalent to the adjustment functions in the goods market or the money market. Why is this? The exchange rate, S, is assumed to be fixed. Prices at home, P, and abroad, $P*$, are assumed constant. Hence the real exchange rate, $R=SP*/P$, is constant. Once income and interest rates are determined by the dynamics of the goods market and the money market, the balance of payments is automatically determined from.

$bp= b P_0 + (f + g) R – m y +v(r-r*)$

But this is a short-run result. Why? Because a deficit leads to a fall in the reserves and hence to a reduction in the money supply, while a surplus lead to a rise in the reserves and hence to an expansion in the money supply. In the long run, with no sterilisation, interest rates and income will change until the deficit/surplus is eliminated. Geometrically, the LM curve will shift until it intersects the IS curve on the BP curve. All three curves intersect at the same point and the situation is shown in figure 9.4, in which it should be noted that the BP curve is less steep than the LM curve.

Figure # 9.4

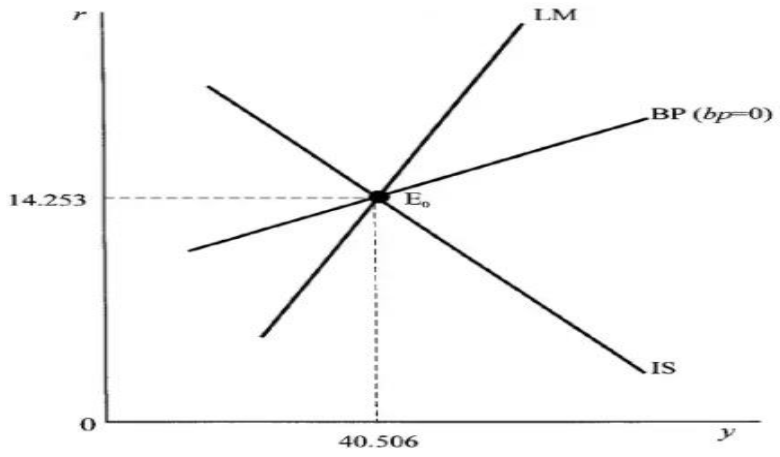
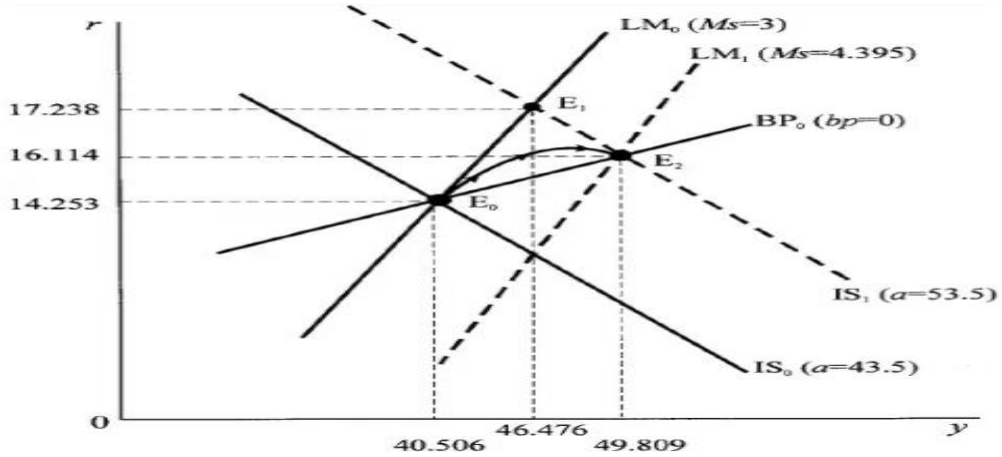


Figure # 9.5



Consider a rise in autonomous spending because of a rise in government spending as shown in figure 9.5. In the short run the economy moves from equilibrium point E0 to E1. Since the money market always clears, or is very quick to clear, then the economy moves along either the LM curve or close to it. At E1 the economy is in surplus. This follows from the new IS curve intersects the LM curve above the BP curve. In the case of no sterilisation, then the money supply will rise, the LM curve will shift right, and this will continue until the balance of payments becomes zero once again. This requires the final LM curve to cut the BP curve and the IS curve on the BP curve as shown by LM1 in figure, where all three curves (IS1, LM 1 and BP0) all intersect at point E2.

As the economy goes into surplus the money supply will rise so shifting the LM curve right, income will adjust, and the interest rate will be brought down because of the monetary expansion. The expected trajectory, therefore, is shown by the path indicated in figure 9.5 on which the arrow heads are marked.

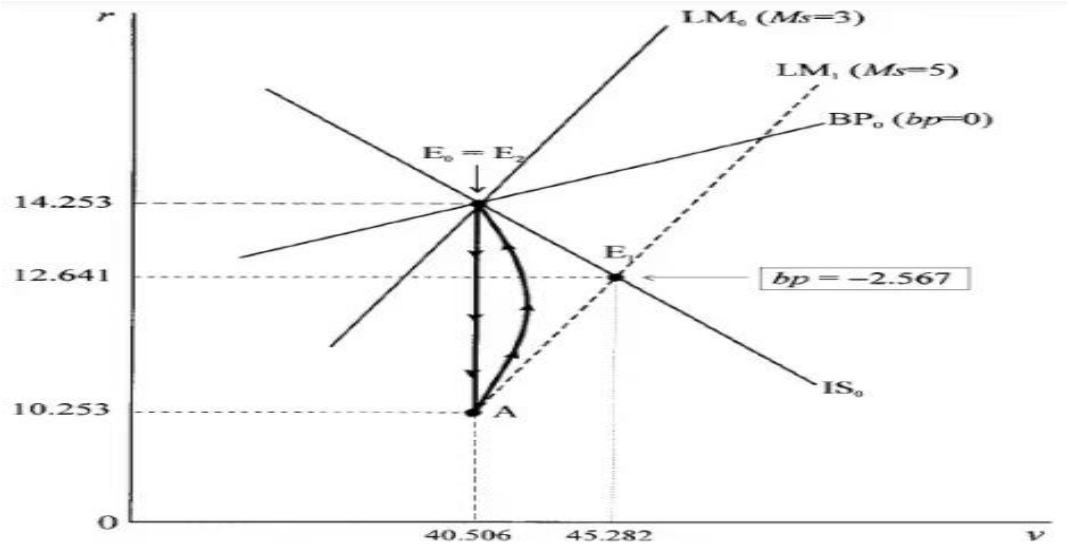
Monetary expansion

Consider next a monetary expansion and suppose Central Bank credit is raised from zero to CBC = 2, raising the money supply from Ms=3 to Ms=5. This results in a new LM curve where the deficit on the balance of payments results because LM1 cuts IS0 below the BP curve, as shown in figure 9.6. In the long run, however, the deficit leads to a fall in international reserves and a fall in the money supply, shifting the LM curve back to LM0. The final equilibrium, E2, is the same as E0.

Two forces come into operation, with a fall in the rate of interest investment rises which, through the multiplier, raises the level of income. Simultaneously, however, the deficit leads to a fall in international reserves and a fall in the money supply. The economy moves along a shifting LM curve, with a trajectory shown by the arrows pointing from

position A to E2. How 'bowed out' the trajectory is depending on the extent to which the money supply is slow to fall as a result of the deficit Also, the trajectory will be more bowed out the more the Central Bank engages in any sterilisation in an attempt to move the economy at point E1.

Figure # 9.6



9.3.4 Fiscal and Monetary Expansion under Flexible Exchange Rates

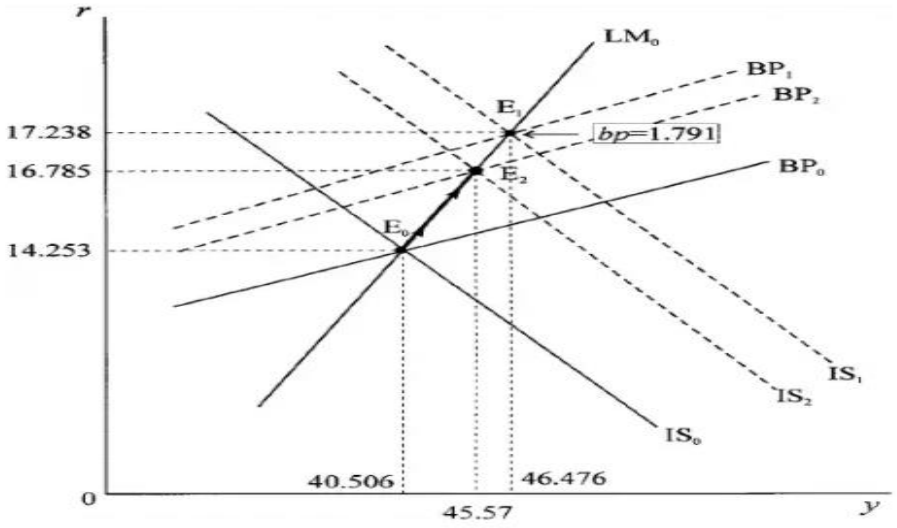
Fiscal Expansion

Whatever is happening in the economy, the exchange rate will vary so that the balance of payments is always in equilibrium, bp=0. If we assume instantaneous adjustment in the foreign exchange market and the money market, then the full impact of any change in the economy will initially fall on interest rates and the exchange rate. Only over time will the economy adjust to the situation as income changes. The BP curve will shift continuously so that it always passes through the intersection between the IS and LM curves as shown in figure 9.7. The resulting surplus on the balance of payments leads to an immediate appreciation of the domestic currency. The BP curve shifts up, and the resulting appreciation results in the IS curve shifting left to IS2.

In dynamic adjustment, we assume instantaneous adjustment in all asset markets (money and foreign exchange), but slow adjustment in the goods market. The initial impact of the fiscal expansion is to move the economy to point E1, with a trajectory moving along LM0 from E0 to E1, as shown in figure 9.7. Because of the surplus, the domestic currency appreciates shifting the BP curve up to BP1. The BP1 passes through point E1, which it

must do to eliminate any surplus on the BOP. The appreciation leads to an appreciation of the real exchange rate, a fall in R, that reduce net exports which in turn decline in income through the multiplier impact. Fall in income reduce demand for money then fall in interest rate. Thus, the interest rate falls, however, the amount of net capital inflows declines and so the exchange rate must depreciate. This shifts the BP curve down from BP1 to BP2 which occurs as the IS curve shifts from IS1 to IS2

Figure # 9.7



The appreciation leads to an appreciation of the real exchange rate, a fall in R, that reduce net exports which in turn decline in income through the multiplier impact. Fall in income reduce demand for money then fall in interest rate. Thus, the interest rate falls, however, the amount of net capital inflows declines and so the exchange rate must depreciate. This shifts the BP curve down from BP1 to BP2 which occurs as the IS curve shifts from IS1 to IS2

Monetary Expansion

A monetary expansion under imperfect capital mobility and under perfect capital mobility is illustrated in figures 9.8 and 9.9, respectively. The adjustment is similar in both cases. A rise in the money supply shifts the LM curve right to LM1 and moves the economy from point E0 to point E1 where the BOP is in deficit. Since the exchange rate is flexible and adjusts instantaneously, it will depreciate, shifting the BP curve down from BP0 to BP1, where it intersects both the IS curve and LM curve at point E1. The depreciation leads to a rise in the real exchange rate that stimulus net exports which shift IS curve to right. Figure 9.8 shows rise in the rate of interest leads to an appreciation of the exchange rate, but not

enough to swamp the original depreciation. The economy accordingly moves to point E2. Figure 9.9 shows the depreciation leads to a shift right in the IS curve to IS1, but this will cut the LM1 curve on the original BP curve because interest rates will have to be brought back into line with world interest rates, which is accomplished by an expected appreciation of the currency, which returns BP1 to BP0.

In case of dynamic analysis, the immediate impact of the monetary expansion is a sharp drop in the rate of interest, to point A on LM1. This is because the money market adjusts immediately, while the goods market is yet to alter. But there is another immediate result. The sharp fall in the rate of interest leads to a major depreciation of the exchange rate. There will be another BP curve (not shown) that passes through point A. As the goods market adjusts to the lower interest rate, stimulating investment, and through the multiplier stimulating the level of income, the economy will move to point E1, the movement taking place along LM1 and the BP curve continuously adjusting upwards until BP1 is reached. In the longer run, however, the depreciation which originally occurred will begin to shift the IS curve because of the stimulus to net exports. This will lead to a further movement along LM1 and a further shift up in the BP curve until the economy moves to point E2.

Figure # 9.8

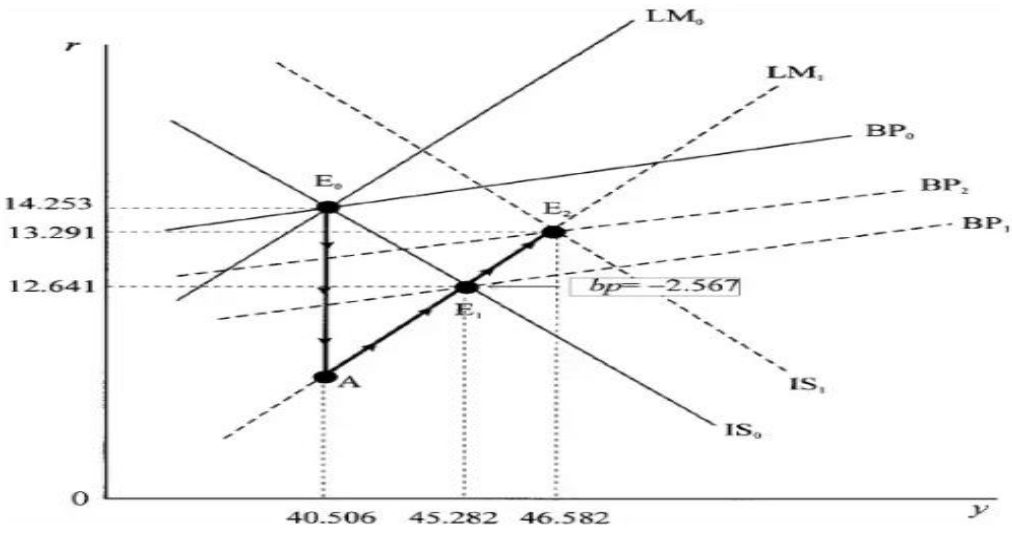
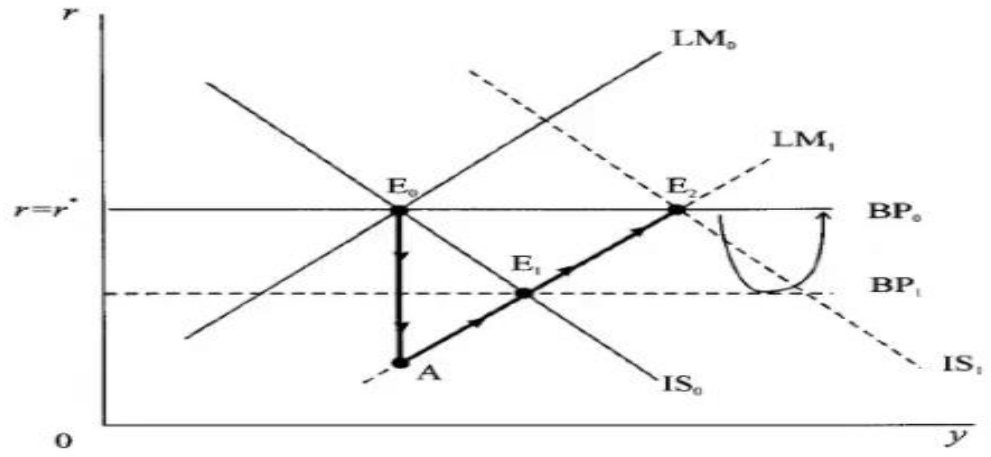


Figure # 9.9



9.3.5 Open Economy Dynamics under Fixed Prices and Floating

If a purely domestic recession strikes our small open economy, this will ... Under independent floating the exchange rate is market determined. ... The impotence of monetary policy under fixed exchange rates ... Thus, economic policy is crucial for the dynamic adjustment of the closed economy.

9.4 Self-Assessment Questions

9.4.1 Essay Questions

1. What are the dynamics of a simple expenditure model?
2. Explain the relationship between BOP and money supply.
3. Explain Fiscal and monetary expansion under fixed or flexible exchange rates.
4. Discuss open economy dynamics under fixed prices and floating exchange rates.

9.4.2 Multiple Choice Questions

1. In M1 definition of money supply, (Ms = C_p+ D) $C_p$is
   a) Cash held by the public
   b) Consumption of the people
   c) Cash flow of public sector

2. If v=0 then the BP curve
   a) Vertical
   b) Horizontal
   c) Positive

3. Net exports in nominal terms, NX is
    a) Value of export + value of import
    b) Value of exports - value of imports

4. Balance of payments deficit when
    a) bp=0
    b) bp < 0
    c) bp > 0.

Answer Key (MCQs)

1) a
2) a
3) b
4) b

9.5 Key Terms

The balance of payments (BOP): A statement of all transactions made between entities in one country and the rest of the world over a defined period, such as a quarter or a year.

Money supply: The sum of currency in circulation plus commercial bank demand deposits and sometimes savings bank time deposits.

Monetary policy: Activities of a central bank designed to influence financial variables such as the money supply and interest rates.

Fiscal policy: It focuses on government taxation and expenditures.

Exchange rate: Rate at which the domestic currency may be converted into (sold for) a foreign currency such as the U.S. dollar.

Flexible exchange rate: The exchange value of a national currency that is free to move up and down in response to shifts in demand and supply arising from international trade and finance.

Managed float: A fluctuating exchange rate that allows central bank intervention to reduce erratic currency fluctuations.

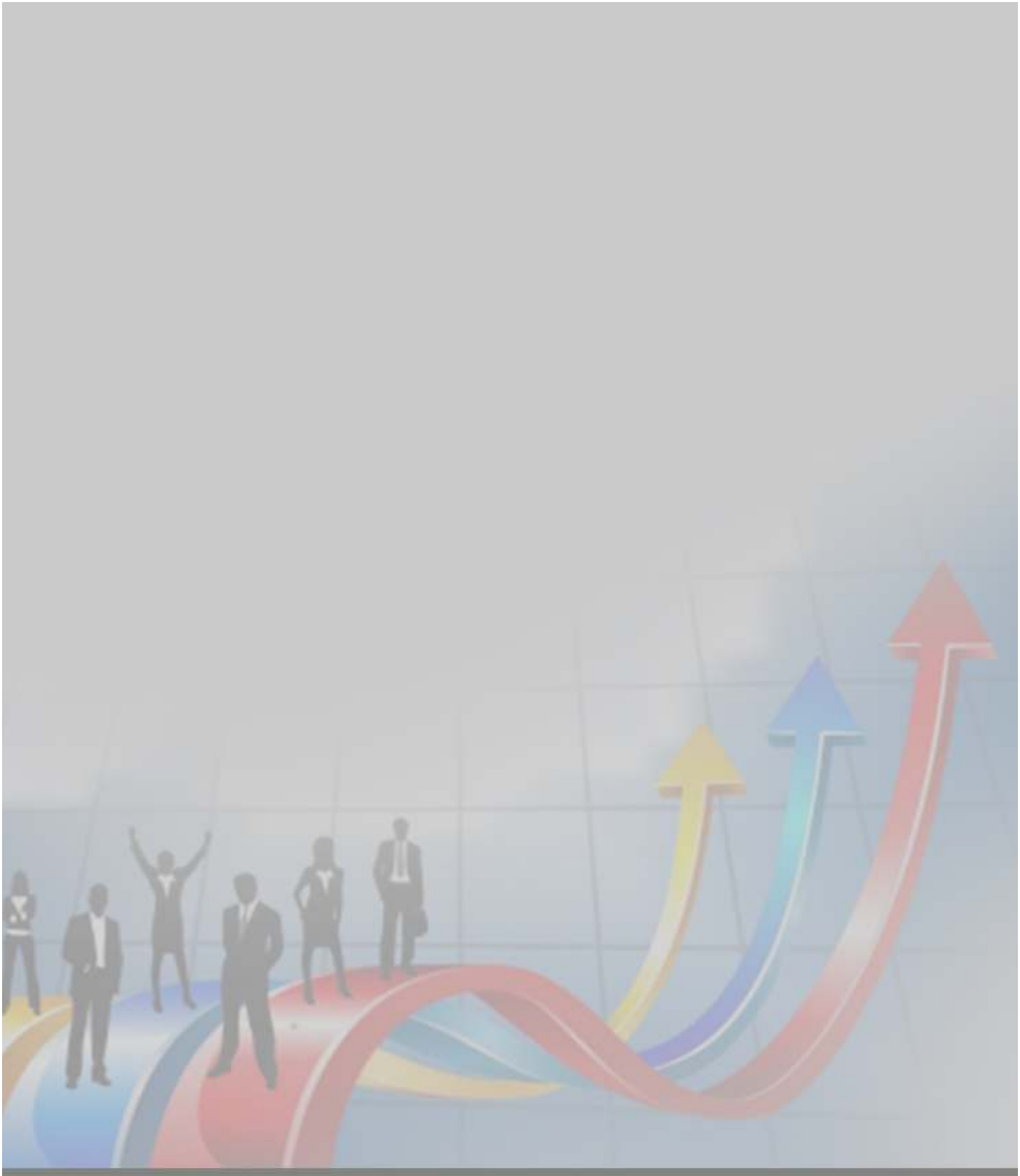
Open economy: An economy that practices foreign trade and has extensive financial and nonfinancial contacts with the rest of the world.

RECOMMENDED BOOKS

1. Bagliano, F. C., & Bertola, G. (2004). Models for Dynamic Macroeconomics. Oxford University Press on Demand. (CH # 4)
2. Mankiw, N. G. (2020). Principles of Macroeconomics. Cengage Learning. Harvard University, USA. 9th edition (CH #16)
3. Romer, D. (2012). Advanced Macroeconomics, 4e. New York: McGraw-Hill. Latest edition
4. Shone, R. (2002). Economic Dynamics: Phase Miagrams and their Economic Application. Cambridge University Press. (CH#12)

LINKS/BIBLIOGRAPHY

- https://www.investopedia.com/terms/b/bop.asp 8/6/2020
- http://web.econ.ku.dk/personal/henrikj/Teaching/Makro1-E2003/Chapter24.pdf 10/6/2020
- http://www.mit.edu/~14.02/S05/Ch21.pdf 10/6/2020



PRINCIPLES OF MACROECONOMICS