MACHAKOS UNIVERSITY

CENTRE FOR OPEN DISTANCE AND E-LEARNING

IN COLLABORATION WITH

SCHOOL OF BUSINESS, ECONOMICS, HOSPITALITY AND TOURISM MANAGEMENT

DEPARTMENT OF ECONOMICS

UNIT CODE: EET 301

UNIT TITLE: MACROECONOMIC THEORY III

MODULE

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MARCH 2024

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MACHAKOS UNIVERSITY

SCHOOL OF BUSINESS, ECONOMICS, HOSPITALITY AND TOURISM MANAGEMENT

DEPARTMENT OF ECONOMICS

COURSE OUTLINE

UNIT CODE: EET 301

UNIT TITLE: MACROECONOMIC THEORY III

CONTACT HOURS: 42

PRE-REQUISITES: EES 200: MATHEMATICS FOR ECONOMISTS II
EET 201: MACROECONOMIC THEORY II

UNIT DESCRIPTION

This course is designed for advanced undergraduates with a sound mathematical preparation. The purpose of the course is to analyze major macroeconomic concepts, problems, policies and equilibrium.

At the end of the course, students are expected to discuss various macroeconomic challenges and the policies that can be used to effectively remedy these challenges. More so, the learners will be able to compute equilibrium variables in the economy such as equilibrium output, employment, interest rates and prices. The learners will also be exposed to the effects of any disturbances on the equilibrium in the economy.

COURSE OBJECTIVES

By the end of the course learners should be able to:

(i) To Explore Basic Macroeconomic Concepts
(ii) To Determine Equilibrium Income
(iii) To Analyze the Multiplier Concept
(iv) To Explore the Demand-Side Equilibrium
(v) To Establish the Effectiveness of Fiscal and Monetary Policies on Demand-Side Equilibrium
(vi) To Analyze the Supply-Side Equilibrium and Disturbances

COURSE CONTENT

LECTURE I: INTRODUCTION AND MEASURES OF ECONOMIC ACTIVITY

- Definition of Basic Concepts.
- National Income Accounting.

LECTURE II: INTRODUCTION TO INCOME DETERMINATION

- The Savings-Investment Balance
- Tax, Consumption and Savings Function
- Determination of Equilibrium Income
- Effects of Disturbances On Equilibrium

LECTURE III: INTRODUCTION TO EQUILIBRIUM INCOME DETERMINATION: THE MULTIPLIER

- Introduction to the Multiplier Concept
- Derivation and Interpretation of Expenditure Multipliers Under Lump Sum Taxes
- Derivation and Interpretation of Expenditure Multipliers When Tax is a Function of Income

LECTURE IV: EQUILIBRIUM NATIONAL INCOME DETERMINATION ON THE PRODUCT MARKET: DEMAND SIDE EQUILIBRIUM

- Derivation of the Equilibrium Condition for Income and Interest Rate in the Product Market
- Derivation of the Investment Function
- Derivation and interpretation of the IS Curve

WEEK V: CONTINUOUS ASSESSMENT TEST 1

LECTURE VI: EQUILIBRIUM NATIONAL INCOME DETERMINATION ON THE MONEY MARKET: DEMAND SIDE EQUILIBRIUM

- Derivation of the Equilibrium Condition for Income and Interest Rate in the Money Market
- Derivation of the LM Curve
- Computation of the General Equilibrium in the Product and Money Markets

LECTURE VII: INCOME AND PRICE LEVEL ON THE DEMAND SIDE

- Derivation of the Demand Curve for an Economy.
- Fiscal and Monetary Policies as Demand Management Policies.
- Analysis of the Effects of Fiscal Policy on Income and Interest Rates.

LECTURE VIII: FISCAL POLICY MULTIPLIER

- Introduction to the Fiscal Policy Multiplier
- Derivation of the Fiscal Policy Multiplier
- Analysis of the Effectiveness of Fiscal Policy

LECTURE IX: MONETARY POLICY EFFECTS ON DEMAND

- Analysis of the Effect of Monetary Policy on Income and Interest Rates.
- Derivation of the Monetary Policy Multiplier.
- Analysis of the Effectiveness of Monetary Policy.
- Fiscal and Monetary Policy Mix effects on Equilibrium Income and Interest Rates.

WEEK X: CONTINUOUS ASSESSMENT TEST II (ONLINE QUIZZ)

LECTURE XI: SUPPLY SIDE EQUILIBRIUM I

- Introduction to the Simple Depression Model
- Derivation of the Perfect Competition and Monopolist's Demand for Labor Functions
- Derivation of the Aggregate Demand for Labor Function

LECTURE XII: SUPPLY SIDE EQUILIBRIUM II

- Derivation of the Aggregate Labor Supply Function
- Equilibrium in the Labor Market

LECTURE XIII: EXPECTATIONS AND AGGREGATE SUPPLY

- Derivation of the Aggregate Supply Curve in the Extreme Keynesian Case.
- Derivation of the Aggregate Supply Curve in the Extreme Classical Case.
- Derivation of the Aggregate Supply Curve Under the General Keynesian Case.

LECTURE XIV: EQUILIBRIUM ANALYSIS IN THE STATIC MODEL

- Determination of Equilibrium Income/Output, Employment, Interest Rates and Price.
- Reaction to Demand disturbances in the Static Model.
- Reaction to Supply Disturbances in the Static Model.

WEEK 15 AND WEEK 16: END OF SEMESTER EXAMINATION PERIOD

COURSE REQUIREMENTS

Students are expected to:

i. Do proper semester registration
ii. Obtain log in credentials from ODEL Centre to enable them access the unit online
iii. Log in onto the online unit.
iv. Actively participate in online lectures
v. Actively participate in ALL e-tivities in each lecture
vi. Attempt self-test activities provided at the end of the lesson

MODE OF DELIVERY

Lectures, PowerPoint Presentations, Group discussions, Questions and Answers sessions, Case Studies, Class presentations

INSTRUCTIONAL MATERIALS AND / EQUIPMENT

Class notes; text books; journals; videos; Smart phones / Tablets / Computers

COURSE ASSESSMENT

i. There shall be Continuous Assessment Test and End of Semester Examination
ii. Continuous Assessment Test (CATs) shall comprise of 30%
iii. Continuous Assessment Test shall comprise of all marks garnered in individual assessments, group tasks and workshops which shall be assigned to you from time to time in the course of our online learning.
iv. End of semester Examination shall comprise 70% (a summative assessment of the content covered in the unit).

Pass mark: 40%

Core Reading Resources/ Materials

1. Krugman, P. & Robin, W. (2021). *Macroeconomics* (6th ed.). Macmillan Higher Education. ISBN: 9781319320164, 2020942110. http://library.lol/main/DFA1CA10088EA05602291872423C5A50
2. Mankiw, N. Gregory (2021). *Principles of Economics* (9th ed.). Cengage Learning. ISBN: 2019941033, 9780357038314, 9780357133705. http://library.lol/main/E4F408FE98ABD6329394D2C9C9DE877F
3. Romer, D. (2018). *Advanced Macroeconomics* (5th ed.). The McGraw Hill. ISBN: 1260185214, 9781260185218. http://library.lol/main/3B9AF2793837DF6767E985633BE2CC37
4. The CORE Team (2022). The Economy: Economics for a Changing World. Core Economics Education. ISBN: 1838165665, 9781838165666. http://library.lol/main/5E3DD6586AFE840C3BDEE3BE9CD8CE3F

LECTURE I: REVIEW OF BASIC MACROECONOMIC CONCEPTS

1.1 Introduction

In this lesson, we will review basic concepts as applied in macroeconomics. We will understand the meaning of macroeconomics as well as the role of macroeconomics. Several concepts in macroeconomics will be reviewed as well as a discussion of the key macroeconomic problems faced by countries and their remedies.

1.2 Lesson Learning Outcomes

By the end of this lecture, you should be able to explain:

1.2.1 Basic Macroeconomic Concepts
1.2.2 The aggregate problem

1.2.1 Definition of Basic Macroeconomic Concepts

An economy

An economy may be defined as a collection of certain institutions or individuals each of whom faces and solves an economizing problem subject to certain constraints.

Micro-economy

This refers to a system of individual activities undertaken by individual agent whose aims are to maximize welfare, utility, production etc.

Macro-economy

This refers to a system of aggregate activities undertaken by the economic agents.

Roles of macroeconomics

The major role of macroeconomics is that it seeks to explain why fluctuation in economic variables occur and investigate policies that cam mitigate (remedy) the fluctuations. Macroeconomic theory therefore, can be considered as the study of economic fluctuations (business cycles).

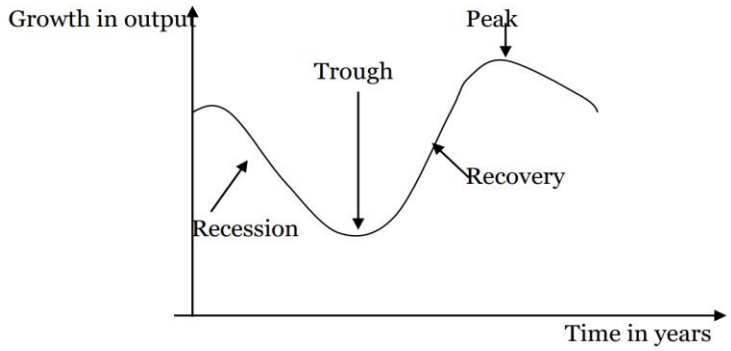


Figure 1.1: Business Cycles

Macroeconomics explains why recession and recoveries do occur in an economy over time.

Recession: These are periods of contracting economic activities i.e. periods when activities like production and employment are falling.

Trough: This is the period of stagnant production. It is the end of recession or the beginning of recovery.

Recovery: This is a period of above-average economic growth following a recession.

Peak: This is a period of increased commercial activity within either a business, market, industry, or economy as a whole. This is the beginning of a recession.

Gross domestic product (GDP): This refers to total current production measures at current prices. The term current in this case refers to one year. GDP therefore, refers to the market value of total goods and services produced in a given geographical area during one year.

Gross national products (GNP): This is income accruing to nationals of a given geographical area. It is the total market value of final goods and services currently produced in and economy using the domestically owned factors of production located in the economy or elsewhere over a given time period e.g. one year.

Therefore, GNP = GDP – payments abroad + receipts from abroad

There are two measurements of GNP or GDP.

i.) Nominal or constant shilling GNP or GDP

ii.) Real or variable shilling GNP or GDP

Nominal GNP or GDP measures the value of output at the prices prevailing in the period the output is produced.

Real GNP or GDP measures the value of output in any given period at same base-year prices. The purpose of measuring real GDP or GNP is to get rid of price effects in nominal GDP or GNP.

Potential output and actual output

- ➔ **Potential output** refers to the total production that is possible when all factors of production are fully and efficiently employed i.e. with an unemployment rate of just under 5% is an estimate of unemployment since 100% employment is literally impossible.
- ➔ **Actual output** refers to the real physical output actually produced in the economy and it fluctuates around potential output as the economy goes through successive recession and recoveries as shown below:

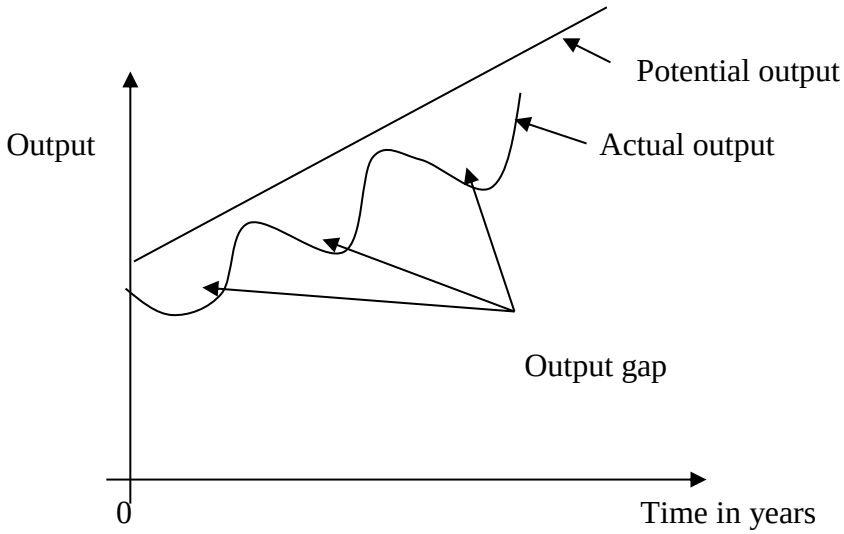


Figure 1.2: Potential and Actual Output

The difference between potential output and actual output is the output gap. The larger the output gap, the greater the unemployment rate and vice versa.

Unemployment rate

This is the fraction of the labour force that cannot find jobs at the prevailing wage rate. Labour force refers to the number of persons aged 18 years or over who is either working or unemployed**.**

Okun's law

This law is named after its discoverer, Arthur Okun who used it to illustrate the effects of macroeconomic policy. The law states that a 3% increase in real GDP generates a 1%-point decrease in the unemployment rate.

This relationship acts as a useful guide to policy because it allows us to ask how a particular growth target will affect the unemployment rate over time.

Inflation rate

This is the percentage change in the average price of all goods in the economy. Inflation like unemployment is a major macroeconomic problem.

Philips curve

This shows the relationship between rates of inflation and unemployment. A British economist by the name A. W. Philips first developed this relationship. The typical Philips curve shows an inverse relationship between unemployment rate and inflation rate as shown in figure 1 (c) below:

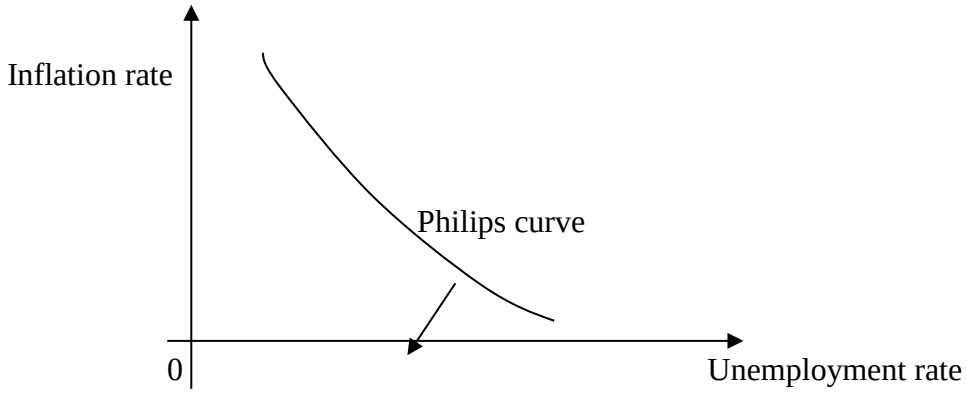


Figure 1.3: Philips Curve

The policy implication of the Philips curve is that less unemployment can always be attained by incurring more inflation or inflation can be reduced by allowing more unemployment.

Interest rates

This refers to the amount charged for a loan by a bank or any other lender per shilling per year expressed as a percentage. It is the cost of borrowing. The interest rate minus the expected rate of inflation gives us the real rate of interest.

Aggregate demand and aggregate supply

Aggregate demand refers to total demand for goods and services in the economy. It is the total expenditure on real output of goods and services in the economy. Aggregate supply relates the general price level to the total output assuming that resources, technology and institutions are given.

Aggregate demand and aggregate supply together determines price and output levels in the economy as shown in the figure 1 (d) below:

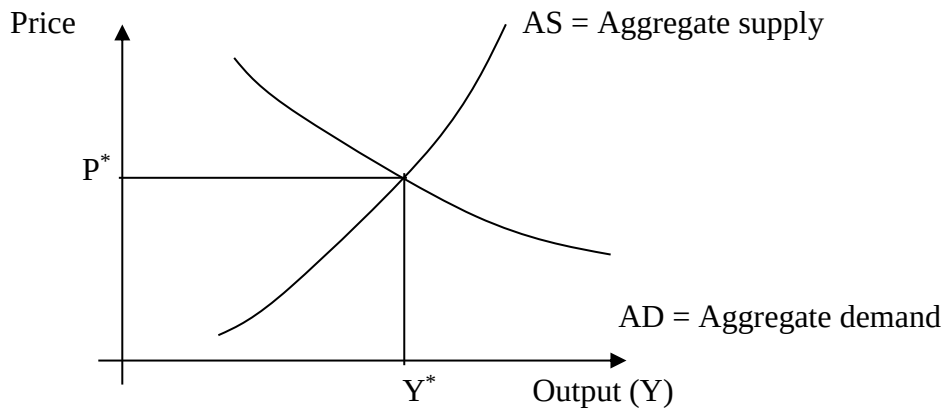


Fig 1.4: Aggregate Demand and Aggregate Supply

Price indices

These measures changes in the general price levels. There are of two types; namely

i.) Consumer price index (CPI) and

ii.) Wholesale price index (WPI)

The consumer price index is the cost of living index, which shows changes in the cost of living over time. The wholesale price index is a measure of the cost of production, which shows how costs of production change over time.

Exchange rate

This refers to the amount of foreign currency that can be purchased with one domestic currency. We will learn more about the basic macroeconomic concepts in e-tivity 1.2.1.

E-tivity 1.2.1

Numbering, pacing and sequencing	**1.2.1**
Title	Definition of Basic Macroeconomic Concepts.
Purpose	The purpose of this e-tivity is to expose you to various macroeconomic concepts.
Summary of overall task	Watch the following video and explain four macroeconomic problems faced by economies as well as their remedies.
Spark	
Individual task	• Briefly discuss the concept of business cycles from these reading materials • Explain the characteristics of each phase of the business cycles on Discussion Forum 1
Interaction begins	• Read through and provide positive and constructive feedback on your colleagues posts in the Discussion Forum 1.

E-moderator interventions	1. Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity.
Schedule and time	This task should take two hours.
Next	The Aggregate Problem

1.2.2 The Aggregate Problem

The major issue in an economy is concerned with determining how big the GDP is. To determine the size of an economy's GDP we make use of a set of analytical assumptions underlying national income accounting. There are three such assumptions and we need to examine them one by one.

Assumption (1): Total supply of goods and services must equal total demand for goods and services. This assumption holds on the basis of the argument that goods and services are scarce in the economy and therefore once produced must be consumed.

Let: Y = total supply of goods and services

D = total demand for goods and services

C+I+G+(X-M)

Since total supply equals to total demand then

Y = D = [C+I+G+(X-M)]

Suppose p = price index, then

Y.p = C.p + I.p + G.p + (X-M).p If p = 1

Then, Y=C+I+G+(X-M)

This gives us an **expenditure measure of GDP.**

Assumption (2): The second assumption comes from the observation that goods and services in an economy cannot be produced out of nothing but requires factor inputs. The assumption therefore states that the total value of output must equal total value of inputs. This assumption is clear from Euler's theorem whereby given a production function

Y = f (K, L), Then, Euler's theorem states that:

$Y = \frac{dY}{dK}.K + \frac{dY}{dl}.L$ Where:

$\frac{dY}{dK} = MP_k = r$

$\frac{dY}{dL} = MP_L = W$

Hence, Y = rK + wL this gives us the **value added or output measure of GDP.**

Assumption (3): The third assumption emphasizes the fact that households have limited ways of spending their income.

Therefore, Y = C + S + T + R,

Where:

Y = Income,

C = Consumption,

S = Savings,

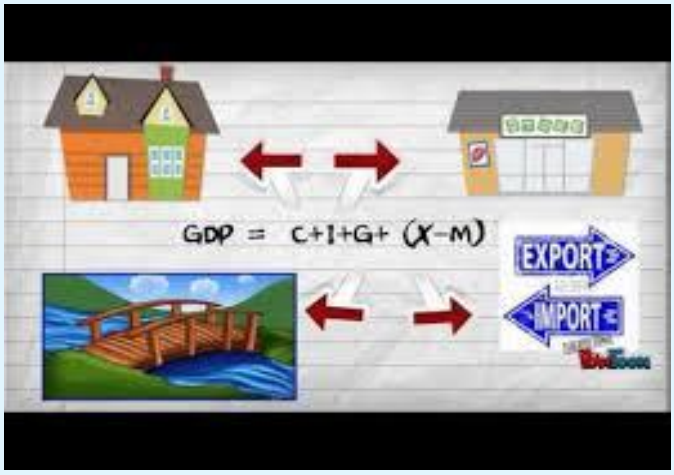
R = Transfer payments

T = Taxes.

This gives us the **income measure of GDP.**

More discussion on national income accounting is explored on e-tivity 1.2.2.

E-tivity 1.2.2

Numbering, pacing and sequencing	**1.2.2**
Title	The Aggregate Problem.
Purpose	The purpose of this e-tivity is to expose you to various measures of national income.
Summary of overall task	Watch the following video and explain the components of the expenditure approach to the measurement of national income.
Spark	
Individual task	• Read the following materials and discuss the three approaches to the computation of national income.
Interaction begins	• Read through and provide positive and constructive feedback on your colleagues posts in the Discussion Forum 1.
E-moderator interventions	1. Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity.
Schedule and time	This task should take two hours.
Next	Introduction to Equilibrium Income Determination

1.3 Summary

In this lecture we have discussed the following:

- ➔ The Key Macroeconomics Concepts and Macroeconomic Problems
- ➔ The Measurement of National Income involves three approaches: the expenditure approach, the income approach and the value added approach.

1.4 Further Activity

	1. Which of the following is not a macroeconomic problem? A. Unemployment B. Inflation C. What to produce D. Balance of payment problem 2. Define the term macroeconomics. 3. Explain four key macroeconomic policy objectives. 4. State and explain Okun's law 5. "Inflation is a necessary evil" explain

1.5 Further Reading

1. Krugman, P. & Robin, W. (2021). *Macroeconomics* (6th ed.). Macmillan Higher Education. ISBN: 9781319320164, 2020942110. http://library.lol/main/DFA1CA10088EA05602291872423C5A50
2. Mankiw, N. Gregory (2021). *Principles of Economics* (9th ed.). Cengage Learning. ISBN: 2019941033, 9780357038314, 9780357133705. http://library.lol/main/E4F408FE98ABD6329394D2C9C9DE877F
3. Romer, D. (2018). *Advanced Macroeconomics* (5th ed.). The McGraw Hill. ISBN: 1260185214, 9781260185218. http://library.lol/main/3B9AF2793837DF6767E985633BE2CC37
4. The CORE Team (2022). The Economy: Economics for a Changing World. Core Economics Education. ISBN: 1838165665, 9781838165666. http://library.lol/main/5E3DD6586AFE840C3BDEE3BE9CD8CE3F

LECTURE II: INTRODUCTION TO EQUILIBRIUM INCOME DETERMINATION

2.1 Introduction

In this lecture you will be introduced to the product-income identity that is useful in analyzing the determination of national output and income levels. We will derive the savings-investment balance and analyze the conditions for the achievement of equilibrium income.

2.2 Lesson Learning Outcomes

By the end of this lecture, the learner should be able to:

2.2.1 Derive the Savings-Investment balance
2.2.2 Derive the Tax, Consumption and Savings Functions
2.2.3 Determine Equilibrium Income

2.2.1 Derivation of the Savings-Investment balance

In national income accounting, GNP can be considered as a flow of income or product. Therefore, the basic identity becomes:

$C + I + G + (X – M) = GNP = C + S + T + R_{f.}$ …… (2.1)

Where:

C = Total value of consumption expenditure

I = total value of investment expenditure

G = Government purchases of goods and services

(X – M) = Net export of goods and services

S = Gross private savings

R_f = Total private transfer payments to foreigners

If we avoid the foreign sector, then the identity becomes:

$C + I + G + (X – M) = GNP = C + S + T$ …… (2.2)

Nominal Y can be broken down into real output (y)and price (p). If we divide through by real output (y) we have:

$\frac{Y}{y} = \frac{y.p}{y} = p$ = Implicit price deflator.

If we deflate all components of nominal output (Y), we obtain real components as follows:

c + i + g = y = c + s + t ……..... (2.3)

If we subtract c from equation (2.3) we obtain:

i + g = s + t …… (2.4)

Equation (2.4) gives us the **savings-investment balance** implicit in the basic GNP identity. On the product side, i + g is the amount of real output that does not go to consumer expenditure while on the income side s + t shows the amount of consumer income that is not spent.

If we rearrange equation (2.4), we obtain the following:

i = s + (t - g) ……..……. (2.5)

Where:

i = total private investment

s = Total private savings

(t – g) = government surplus or government deficit

Equation (2.5) is therefore just another expression for the savings-investment balance.

Planned and realized investment

An examination of planned realized investment is the first step in developing conditions for income to be in equilibrium. The investment component i in equation (2.3) and (2.4) includes both intended/planned investment $(\bar{i})$ and unintended/unplanned investment Δinv **Planned investment** $(\bar{i})$ is investment that is part of the producer's plans while **unplanned investment** refers to unplanned investment that results from unexpected change in the level of consumption demand. This is the realized investment.

The investment component in equation (2.4) therefore becomes

$$i = \bar{i} + \Delta inv \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.6)$$

Replacing equation (2.6) for i in equation (2.4), we obtain:

$$\bar{i} + \Delta inv + \bar{g} = s + t \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.7)$$

If we include the real consumption component, we obtain:

$$c + i + \Delta inv + \bar{g} = c + s + t \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.8)$$

Equation (2.8) is the first condition for the level of income (y) to be in equilibrium.

The Δinv component is the balancing item in the identity. This is because if for example there is an increase in c, then the Δinv will be negative thus canceling out the increase in c on the LHS.

On the RHS the increase in c is cancelled by a decrease in s. Therefore, the equality is maintained all through. Let us explore more on the savings-investment balance on e-tivity 2.2.1.

E-tivity 2.2.1

Numbering, pacing and sequencing	**2.2.1**
Title	The Savings-Investment Balance.
Purpose	The purpose of this e-tivity is to enable you derive the Savings-Investment Balance.
Summary of overall task	Read this article and explain the Savings-Investment Balance.
Spark	

Individual task	• Read the following article and discuss the condition for equilibrium income determination on Discussion Forum 2.
Interaction begins	Read through and provide positive and constructive comments on your colleagues posts in the Discussion Forum 2.
E-moderator interventions	1.Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity.
Schedule and time	This task should take two hours.
Next	Tax, Consumption and Savings function

2.2.2 Tax, Consumption and Savings Functions

The second step in developing condition for equilibrium income is the recognition that tax payments, consumption and savings are all increasing function of the level of income.

More specifically, tax revenue is a function of the gross income i.e.

$$t = t\,(y);\ t^{/} > 0 \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (2.9)$$

While consumption and savings are function of disposable income, (y – t (y)) i.e.

$$c = c\,(y - t(y));\ c^{/} > 0 \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (2.10)$$

$$\text{and } s = s\,(y - t(y));\ s^{/} > 0 \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (2.11)$$

Equation (2.9) gives the change in tax revenue following a change in income while equation (2.10) and (2.11) split disposable income into consumption and savings. Graphically, these relationships are represented in Figure 2.1.

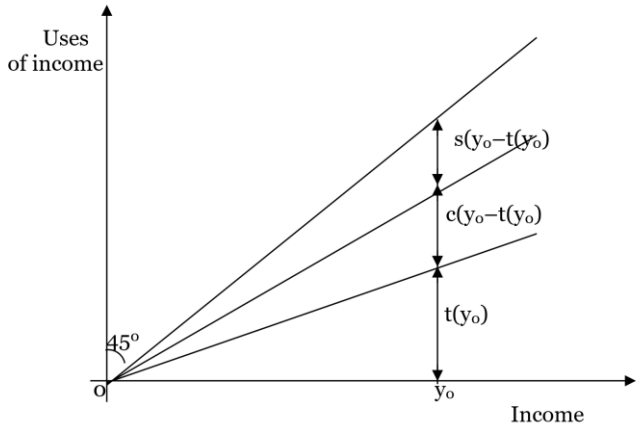


Figure 2.1: Uses of income

From Figure 2.1, we can make the following observations:

- The sum of uses of income [c + t + s] equals the income for any given level like y_0.
- As income increases, each of the wedges showing c, s and t gets wider so that in general an increase in y leads to increase in t, c and s.

E-tivity 2.2.2 discusses the tax, consumption and savings functions further.

E-tivity 2.2.2

Numbering, pacing and sequencing	**2.2.2**
Title	Tax, Consumption and Savings Functions
Purpose	The purpose of this e-tivity is to expose you to the Tax, Consumption and Savings Functions.
Summary of overall task	Watch the following video and explain the relationship between disposable income, consumption and savings.

Spark	
Individual task	• Based on the knowledge that you will acquire from watching this video, explain four non-income determinants of consumption and savings
Interaction begins	• Read through and provide positive and constructive feedback on your colleagues posts in the Discussion Forum 2.
E-moderator interventions	1. Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity.
Schedule and time	This task should take two hours.
Next	Determination of Equilibrium Income

2.2.3 Determination of Equilibrium Income

In this section, we bring together the material developed in the last two sections into a simple model of determination of equilibrium income.

Equation (2.7) gave us the saving-investment balance; $i + \Delta inv + \bar{g} = s + t$, income is at equilibrium when $\Delta inv = 0$,

So that $i + \bar{g} = s + t$ ..... (2.12)

Equation (2.12) is the equilibrium condition for income (y) and may be presented as follows:

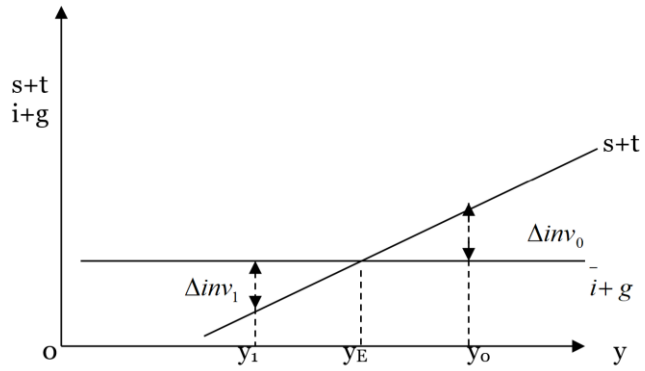


Figure 2.2: Equilibrium Income

Income is in equilibrium at y_E where $\bar{i} + g = s + t$ satisfying equilibrium condition shown in equation (2.12). At any other level of income say y_1, $\bar{i} + g > s + t$ meaning there is excess demand over supply. Producers or suppliers will therefore expand output to meet the unexpected increase in demand and as they do so income will rise towards y_E.

At the income level y_0, $\bar{i} + g < s + t$ meaning supply exceed demand. Producers will therefore cut down production and income will fall to y_E. Therefore, the equilibrium income y_E is a stable equilibrium.

1. Effects of an increase in desire to save

Having seen that the equilibrium level of income determined by equation (2.12) is stable, it is useful to examine the effects of shifts in the savings function on equilibrium level of income. More

specifically we examine the effects of an increase in the desire to save under two separate circumstances:

i.) When $\bar{i}$ and g are independent of y and

ii.) When $\bar{i}$ and g are increasing function of y.

a) **When $\bar{i}$ and g are independent of y**

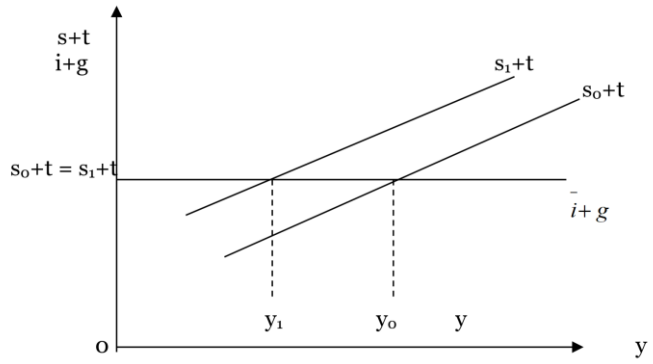


Figure 2.3: Effect of an increase in the desire to save

The increase in the desire to save is shown by an upward shift in the s+t function from s_0+t to s_1+t.

With the new saving function, and initial income y_0 : s+t > $\bar{i}+g$.

This makes producers to cut production so that income falls to y_1. Therefore, where $\bar{i}+g$ is fixed exogenously, an increase in the desire to save leads to unchanged level of s+t but a lower level of income.

b) When $\bar{i}$ and g are increasing function of y (the paradox of thrift)

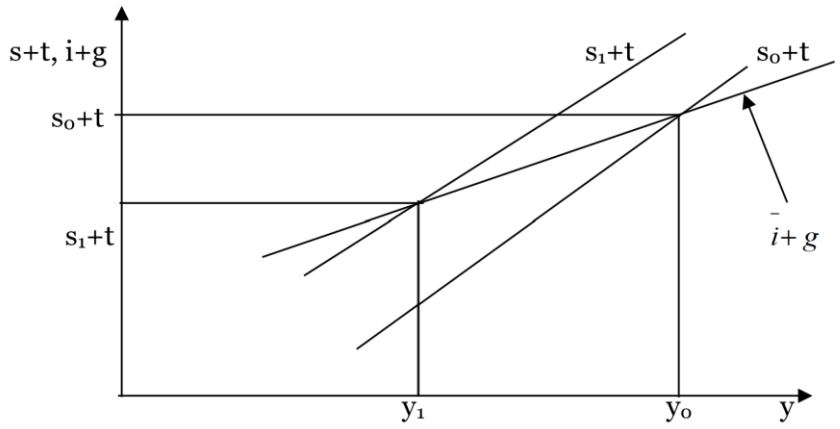


Figure 2.4: Effect of an increase in desire to save

The increase in the desire to save causes a fall in income from y_0 to y_1 and reduces the level of realized s+t. The realized s+t fall, income reduces as well as the level of planned investment ($\bar{i}$); This is so called the **paradox of thrift**.

2. The effects of an increase in planned investment

If the level of planned investment shifts autonomously, then income rises from y_0 to y_1 as shown in Figure 2.5.

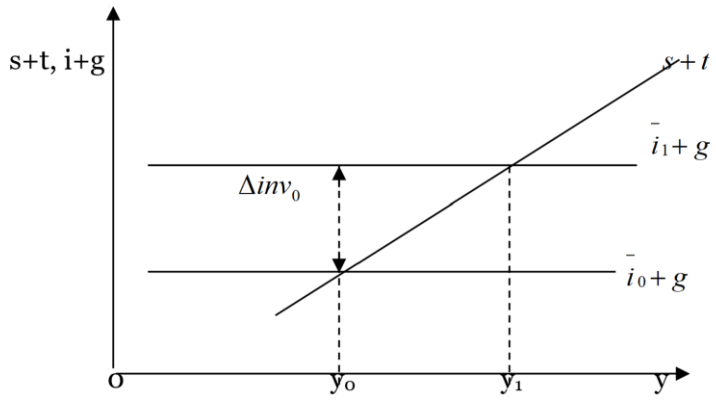


Figure 2.5: Effect of an increase in planned investment

The increase in $\bar{i}$ makes $\bar{i}+g > s+t$ at the initial income y_0.This implies that excess demand over supply and therefore producers tend to increase production thereby raising income towards y_1. However, the size of the increase in y, following an increase in $\bar{i}$ or g depends on the slope of s+t function as shown in Figure 2.6.

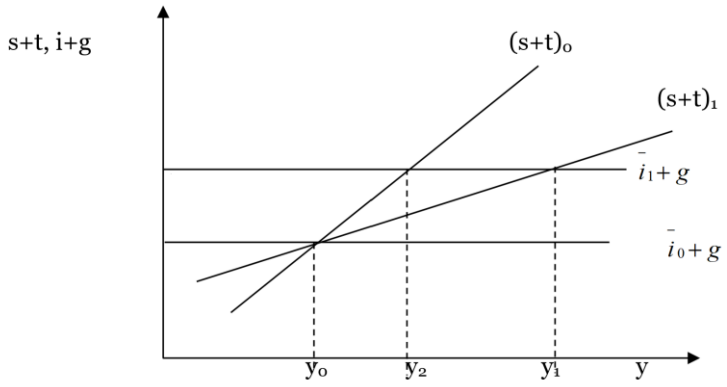


Figure 2.5: Effect of an increase in planned investment

With the flat $(s+t)_1$ function, income rises from y_0 to y_1 following a shift of investment from $\bar{i}_0$ to $\bar{i}_1$. With the steep $(s+t)_0$ function, the same shift in investment raises income from y_0 to y_2. This observation takes us to the consideration of the multiplier.

2.3 Summary

In this lecture, we have derived the savings-investment balance which acts as the condition for equilibrium income determination. We have also analyzed the effects of several disturbances on equilibrium income.

2.4 Further Activity

	1. Analyze the effect of an increase in planned investment on equilibrium income when i and g are increasing functions of income. **2.** Explain and illustrate the concept of the paradox of thrift.

2.5 Further Reading

1. Krugman, P. & Robin, W. (2021). *Macroeconomics* (6th ed.). Macmillan Higher Education. ISBN: 9781319320164, 2020942110. http://library.lol/main/DFA1CA10088EA05602291872423C5A50

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3. Romer, D. (2018). *Advanced Macroeconomics* (5th ed.). The McGraw Hill. ISBN: 1260185214, 9781260185218. http://library.lol/main/3B9AF2793837DF6767E985633BE2CC37
4. The CORE Team (2022). The Economy: Economics for a Changing World. Core Economics Education. ISBN: 1838165665, 9781838165666. http://library.lol/main/5E3DD6586AFE840C3BDEE3BE9CD8CE3F

LECTURE III: INTRODUCTION TO EQUILIBRIUM INCOME DETERMINATION: THE MULTIPLIER

3.1 Introduction

In this lecture we will discuss the derivation of several multipliers such as investments multiplier, government expenditure multiplier and tax multiplier under different assumptions of the tax function.

3.2 Lesson Learning Outcomes

By the end of this lecture, the learner should be able to:

3.2.1 Derive the Multipliers Under Lump Sum Taxes
3.2.2 Derive the Multipliers When Tax is a Function of Income

3.2.1 Derivation of the Expenditure Multipliers Under Lump Sum Taxes

Expenditure multipliers are useful in telling us the amount by which equilibrium income will change when aggregate demand component change by one unit. In this section, we shall develop multipliers

for changes in investment and government purchases and also for shifts in the tax schedules beginning with an economy where taxes are levied as lump- sum.

When taxes are a fixed sum, $\bar{t}$, then basic equilibrium condition becomes:

$$c(y-\bar{t})+\bar{i}+g=y=c(y-\bar{t})+s(y-\bar{t})+\bar{t} \quad \text{..... (3.1)}$$

Eliminating the consumption component, we get:

$$\bar{i}+g=y-c(y-\bar{t})=s(y-\bar{t}))+\bar{t} \quad \text{..... (3.2)}$$

From equation (3.2):

$$y=c(y-\bar{t})+\bar{i}+g \quad \text{..... (3.3)}$$

We can derive general expression showing changes in y following changes in $\bar{t}$, $\bar{i}$ and g by differentiating that expression to obtain:

$$dy=c^{/}(dy-d\bar{t})+d\bar{i}+dg$$

$$dy=c^{/}dy-c^{/}d\bar{t}+d\bar{i}+dg$$

$$dy-c^{/}dy=-c^{/}d\bar{t}+d\bar{i}+dg$$

$$dy(1-c^{/})=-c^{/}d\bar{t}+d\bar{i}+dg$$

$$dy=\frac{-c^{/}d\bar{t}+d\bar{i}+dg}{1-c^{/}}$$

Equation (3.4) is a general multiplier expression.

To obtain the multiplier for $d\bar{i}$, we set $d\bar{t}$ and dg equals to zero and then divide by $d\bar{i}$ to obtain:

$$\frac{dy}{d\bar{i}}=\frac{1}{1-c^{/}}$$

Equation 3.5 is the **Investment Multiplier.**

Example

If $c^{/} = 0.7$ then $\frac{dy}{d\bar{i}} = \frac{1}{1-0.7} = 3.3$

i.)**Interpretation**

A unit increase in investment demand yields 3.3 units increase in income and vice versa.

Government Expenditure Multiplier

From equation (3.4);

$$dy = \frac{-c^{/} d\bar{t} + d\bar{i} + dg}{1-c^{/}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.4)}$$

To obtain the multiplier for government expenditure, we set $d\bar{t}$ and $d\bar{i}$ equals to zero and then divide by dg to obtain:

$$\frac{dy}{dg} = \frac{1}{1-c^{/}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \text{(3.6)}$$

(3.6) is the expression for **government expenditure multiplier.**

Example

If $c^{/}$ = 0.7, then

$\frac{dy}{dg} = \frac{1}{1-0.3} = 3.33$

Interpretation

A unit increase in government expenditure yields 3.3 units increase in income and vice versa.

Tax Multiplier

From equation (3.4);

$$dy = \frac{-c^{/} d\bar{t} + d\bar{i} + dg}{1-c^{/}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.4)}$$

To obtain the tax multiplier, we set dg and $d\bar{i}$ equals to zero and then divide by $d\bar{t}$ to obtain:

$$\frac{dy}{d\bar{t}} = \frac{-c'}{1-c'} \quad \text{..... (3.7)}$$

(3.7) is the expression for tax multiplier.

Example

If $c^{/}$ = 0.7, then

$$\frac{dy}{d\bar{t}} = \frac{-0.7}{1-0.7} = -2.33$$

Interpretation

A unit increase in taxes yields 2.33 units decrease in income and vice versa.

The Balanced Budget Multiplier

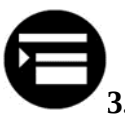
The balance budget exists when $dg = d\bar{t}$ and if this is substituted into equation (3.4) while setting $d\bar{i}$ equals to zero, we get:

$$dy = \frac{-c^{/}dg + dg}{1-c^{/}} = \frac{dg(1-c^{/})}{1-c^{/}}$$

Hence balanced budget multiplier:

$$\frac{dy}{dg} = \frac{(1-c^{/})}{1-c^{/}} = 1$$

This tells us that if government expenditure changes by one shilling, output also increase by one shilling.



3.2.2 Multipliers When Taxes are a Function of Income

When tax revenues are an increasing function of income, then the basic equilibrium condition becomes:

$$c(y-t(y))+\bar{i}+g=y=c(y-(y))+s(y-t(y))+t(y) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.8)$$

Eliminating the consumption component, we obtain:

$$\bar{i}+g=y-c(y-t(y))=s(y-t(y))+t(y) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.9)$$

To obtain the general form of the multiplier with a given tax structure, we differentiate the LHS of equation (3.8) to obtain:

$$dy=c^{/}(dy-t^{/}dy+d\bar{i}+dg$$

$$dy=c^{/}(1-t^{/})dy+d\bar{i}+dg$$

$$dy-c^{/}(1-t^{/})dy=d\bar{i}+dg$$

$$dy[1-c^{/}(1-t^{/})]=d\bar{i}+dg$$

$$dy=\frac{d\bar{i}+dg}{1-c^{/}(1-t^{/})} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.10)$$

Equation (3.10) is the general equilibrium multiplier expression and the introduction of the tax has reduced the multiplier. Diagrammatically, this can be presented as in Figure 3.1.

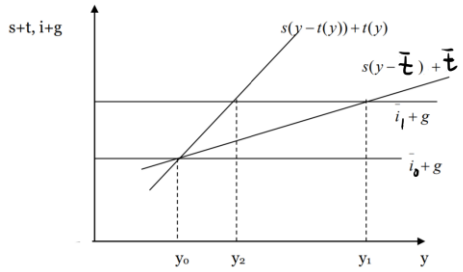


Figure 3.1: Effect of Taxation on Equilibrium Income

We can observe that with tax revenues fixed at $\bar{t}$, an increase in investment demand from $\bar{i}_0$ to $\bar{i}_1$ raises equilibrium income from y_o to y_1. When tax revenues are an increasing function of income, the same investment increase only raises y from y_o to y_2. The presence of the tax function therefore

reduces the increase in disposable income relative to those in total income. The tax system therefore acts as **a <u>built-in-stabilizer,</u>** reducing the change in income due to a change in investments and government expenditure.

<u>The Tax Rate Multiplier</u>

The tax rate multiplier is very relevant in stabilization policy decision involving tax changes. The tax function can be simplified by assuming that tax revenues are proportional to income so that; $t(y)=_T y$ where $_T$=% tax rate. The basic equilibrium condition now becomes:

$$y = c(y - {}_T y) + \bar{i} + g \quad \text{……..…….} \quad (3.11)$$

Since $d({}_T y)$ is approximately equal to ${}_T\, dy + y d_T$ then the differential of equation (3.11) becomes:

$$dy = c'(dy - {}_T\, dy + y d_T) + d\bar{i} + dg$$

$$= c'(1 - {}_T) dy + y d_T + d\bar{i} + dg$$

Therefore:

$$dy = \frac{d\bar{i} + dg - c' y d_T}{1 - c'(1 - {}_T)} \quad \text{……} \quad (3.12)$$

(3.12) is the general expression for the multiplier.

Holding g and i constant, the tax rate multiplier is given as:

$$\frac{dy}{d_T} = \frac{-c'y}{1 - c'(1 - T)} \quad \text{……..……} \quad (3.13)$$

<u>Investments Multiplier</u>

From:

$$dy = \frac{d\bar{i} + dg - c' y d_T}{1 - c'(1 - {}_T)}$$

Holding g and T constant, the Investments multiplier is given as:

$$\frac{dy}{d\bar{i}} = \frac{1}{1-c^{/}(1-_T)} \quad \text{..... (3.14)}$$

Government Expenditure Multiplier

From:

$$dy = \frac{d\bar{i} + dg - c^{/} y d_T}{1-c^{/}(1-_T)}$$

Holding i and T constant, the government expenditure multiplier is given by:

$$\frac{dy}{dg} = \frac{1}{1-c^{/}(1-_T)} \quad \text{..... (3.15)}$$

We will explore more on the multipliers on e-tivity 3.2.1

E-tivity 3.2.1

Numbering, pacing and sequencing	**3.2.1**
Title	Introduction to Equilibrium Income Determination: The Multiplier.
Purpose	The purpose of this e-tivity is to expose you to the derivation of expenditure multipliers.
Summary of overall task	Read this article and discuss the various types of expenditure multipliers.

Spark	
Individual task	• Watch the following video and explain the meaning of government expenditure multiplier on Discussion Forum 3.
Interaction begins	• Read through and provide positive and constructive feedback on your colleagues posts in the Discussion Forum 3.
E-moderator interventions	1. Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity.
Schedule and time	This task should take two hours.
Next	Determination of Equilibrium Income

3.3 Summary

We have analyzed the derivation and computation of the following multipliers: Investments Multiplier, Government Expenditure Multiplier, Tax Rate Multiplier as well as the Balanced Budget Multiplier. We have also learnt how to interpret each of these multipliers for policy implications.

3.4 Further Activity

	Compute the investments, tax rate and government expenditure multiplier given that: $$c' = 0.7 \; and \; T = 0.25$$ Comment on your results in comparison to the case of lump sum taxes

3.5 Further Reading

1. Krugman, P. & Robin, W. (2021). *Macroeconomics* (6th ed.). Macmillan Higher Education. ISBN: 9781319320164, 2020942110.
   http://library.lol/main/DFA1CA10088EA05602291872423C5A50
2. Mankiw, N. Gregory (2021). *Principles of Economics* (9th ed.). Cengage Learning. ISBN: 2019941033, 9780357038314, 9780357133705.
   http://library.lol/main/E4F408FE98ABD6329394D2C9C9DE877F
3. Romer, D. (2018). *Advanced Macroeconomics* (5th ed.). The McGraw Hill. ISBN: 1260185214, 9781260185218.
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4. The CORE Team (2022). The Economy: Economics for a Changing World. Core Economics Education. ISBN: 1838165665, 9781838165666.
   http://library.lol/main/5E3DD6586AFE840C3BDEE3BE9CD8CE3F

LECTURE IV: EQUILIBRIUM NATIONAL INCOME DETERMINATION IN THE PRODUCT MARKET: DEMAND SIDE EQUILIBRIUM

4.1 Introduction

In this lecture we introduce ourselves to the demand side of the economy. This involves finding the equilibrium value of interest (r) and output demanded (y) by consumers, businesses and the government given the price level. We will also be exposed to the derivation of equilibrium in the product markets.

4.2 Lesson Learning Outcomes

By the end of this lecture, the learner should be able to:

4.2.1 Derive the Equilibrium Condition for Income and Interest Rate in the Product Market.

4.2.2 Derive the Investment Function.

4.2.3 Derive the IS Curve using the Four Quadrant Diagram.

4.2.1 Equilibrium Condition for Income and Interest Rate in the Product Market

Equilibrium in the Product market is given by:

$$y = c(y - t(y)) + i + g \quad \text{..... (4.1)}$$

Where:

y = Real GNP

c = Real consumption expenditure as a function of real disposable income.

t = Real tax revenue as a function of real GNP.

i = Real investment.

g = Real government purchase of goods and services.

4.2.2 Investment demand and the interest rates

In the previous analysis, we assumed that investment (i) was exogenously given. In this section, we seek to find what determines i. We start by assuming that, the level of investment depends on the market rate of interest (r).

This seems reasonable because, in order to invest, a firm can either borrow or use its own funds. Whichever the case, the cost of borrowing can be measured by the interest rate the firm has to pay or forego receiving in case it uses its own funds.

Therefore, $i = i(r)$; $i' < 0$ ……. (4.2)

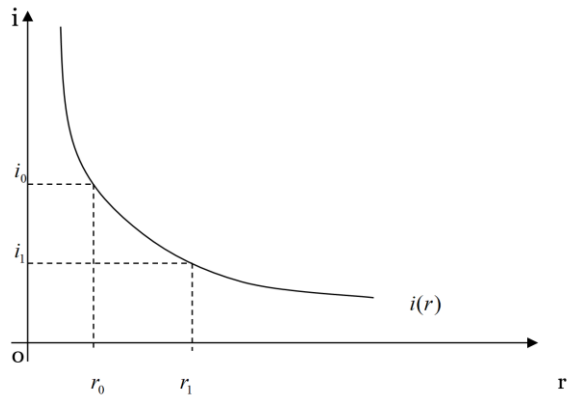


Figure 4.1: The investment function

Figure 4.1 shows investment (i) as a negative function of interest rate (r).

If we substitute equation (4.2) into equation (4.1) we obtain:

$$y = c(y - t(y)) + i(r) + g \quad \text{……..... (4.3)}$$

4.2.3 Derivation of the IS Curve using the Four Quadrant Diagram

Equation (4.3) describes pairs of r and y values which maintain equilibrium in the product market – IS curve. The IS curve traces the r and y pairs that keeps the money market in equilibrium. The relationship between interest rate (r) and income (y) can be presented in directly as in Figure 4.2 below.

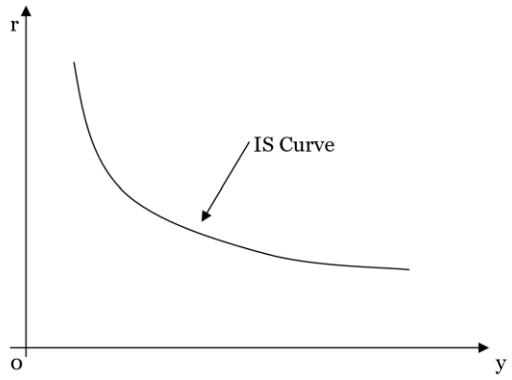


Figure 4.2: The IS Curve

The logic behind the inverse relationship between r and y is that as r rises, investments drop and thus through the multiplier reduces y.

Mathematically, we can also derive the IS curve by totally differentiating equation (4.3) holding g constant to obtain:

$$\partial y = c'(\partial y - t'\partial y) + i'\partial r$$

$$= c'\partial y - c't'\partial y + i'\partial r$$

$$= c'(1-t')\partial y + i'\partial r$$

$$\partial y - c'(1-t')\partial y = i'\partial r$$

$$\partial y(1-c'(1-t')\partial = i'\partial r$$

$$\partial y = \frac{i'\partial r}{1-c'(1-t')}$$

$$\frac{\partial y}{\partial r} = \frac{i'}{1-c'(1-t')}$$

Hence; $\frac{\partial r}{\partial y} = \frac{i - c'(1-t')}{i'}$ since $1-c'(1-t') > 0$ and $i' < 0$, then it follows that $\frac{\partial r}{\partial y} < 0$ or negatively sloped.

The IS curve may also be traced using the four quadrant diagram as shown in the Figure 4.3.

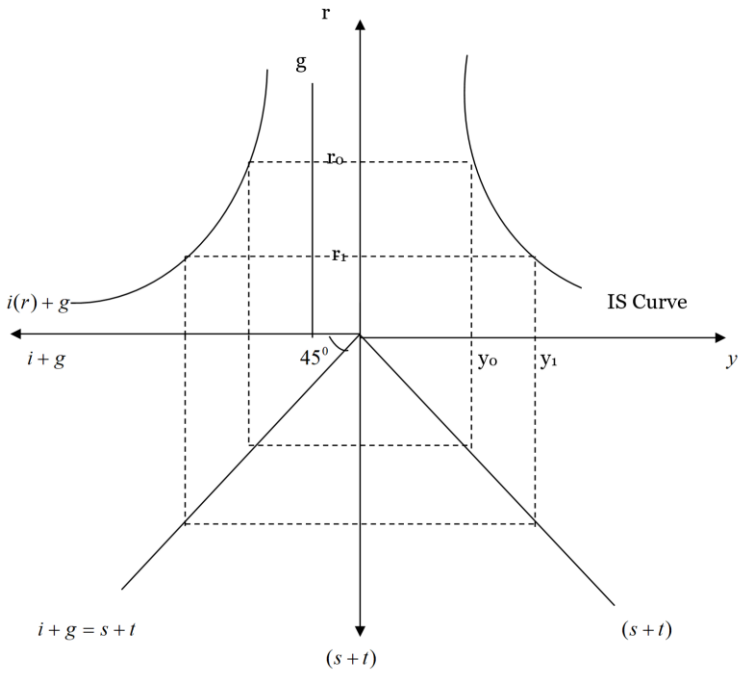


Figure 4.3: Derivation of the IS Curve using the Four Quadrant Diagram

The 45^0 line equates s + t and i + g thereby ensuring that there is equilibrium in the product market. The SE quadrant shows savings and taxes as increasing function of income. In the NW quadrant, fixed government purchases (g) and investment which is a decreasing function of interest rate is plotted. To come up with an IS curve, we select any interest rate say r_0 and trace back to determine the corresponding level of income (y_o).

Numerical Example

Given the following equation, derive the expression for the IS curve.

$C = 100 + 0.8Y^d$ (Consumption function)

I = 10- 10r (Investment function)

G = 10 (Government purchases)

T = 0.25 (Tax rate)

Solution

IS curve shows equilibrium in the product market, which is given as:

$$y = c\,(y\text{-}t(y)) + i(r) + g$$

=100 + 0.8(y-0.25y) +10 –10r +10

=100 + 0.8y-0.2y +10 –10r +10

=120+0.6y-10r

y - 0.6y= 120 - 10r

y (1-0.6) = 120 –10r

0.4y = 120- 10r

$$y = \frac{120}{0.4} - \frac{10r}{0.4}$$

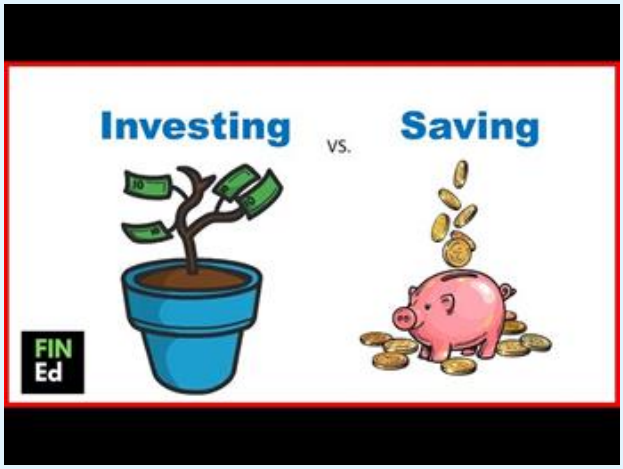
$$y = 300 - 25r \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (4.4)$$

(4.4) is the expression for the IS Curve.

Let’s explore the derivation of the IS Curve using the four quadrant diagram further on e-tivity 4.2.3.

E-tivity 4.2.3

Numbering, pacing and sequencing	**4.2.3**
Title	Derivation of the IS Curve using the Four Quadrant Diagram
Purpose	The purpose of this e-tivity is to expose you to the derivation of the IS Curve using the Four Quadrant Diagram.
Summary of overall task	Watch this video in order to enhance your understanding on the derivation of the IS curve.

Spark	
Individual task	• Derive the IS Curve using the four quadrant diagram. Refer to the video above.
Interaction begins	• Read through and provide positive and constructive feedback on your colleagues posts in the Discussion Forum 4.
E-moderator interventions	1. Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity.
Schedule and time	This task should take two hours.
Next	Equilibrium National Income Determination in the Money Market.

4.3 Summary

In this Lecture we have learnt the following:

- That the IS curve represents equilibrium in the product market
- We have also learnt how to derive the slope of the IS curve (the IS curve has a negative slope)
- The derivation of the IS curve using the four quadrant diagram has also been discussed.

4.4 Further Activity

	Using the four-quadrant diagram show the effect of the following on equilibrium r and y. i.)An increase in the desire to save ii.)An increase in government purchases

4.5 Further Reading

1. Krugman, P. & Robin, W. (2021). *Macroeconomics* (6th ed.). Macmillan Higher Education. ISBN: 9781319320164, 2020942110.
   http://library.lol/main/DFA1CA10088EA05602291872423C5A50
2. Mankiw, N. Gregory (2021). *Principles of Economics* (9th ed.). Cengage Learning. ISBN: 2019941033, 9780357038314, 9780357133705.
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LECTURE V: EQUILIBRIUM NATIONAL INCOME DETERMINATION IN THE MONEY MARKET: DEMAND SIDE EQUILIBRIUM

5.1: Introduction

In this lecture we introduce ourselves to the demand side of the economy. This involves finding the equilibrium value of interest (r) and output demanded (y) by consumers, businesses and the government given the price level. We will also be exposed to the derivation of equilibrium in the money market after which we will discuss the general equilibrium in the product and money markets.

5.2 Lesson Learning Outcomes

By the end of this lecture, the learner should be able to:

5.2.1 Derive the Equilibrium Condition for Income and Interest Rate in the Money Market

5.2.2 Derive the LM Curve

5.2.3 Compute the General Equilibrium in the Product and Money Markets

5.2.1 Equilibrium Condition for Income and Interest Rate in the Money Market

The money market, like all other markets has both a demand side and a supply side. The demand for money comprises of speculative demand $l(r)$ and transactions demand (ky) hence:

$$\frac{m}{p} = l(r) + k(y); \qquad l^{'} < 0 \text{ and } k^{'} > 0 \text{ ....}(5.1)$$

Where: m = Money stock

p = Price level

l = Speculative demand for money which is a negative function of interest rate.

k = Transactions demand for money which is a positive function of income.

$\frac{m}{p}$ = Real money balances.

We can therefore rewrite equation (5.1) as;

$$\frac{m}{p} = m(r, y) \quad \text{..... (5.2)}$$

If we plot the demand for real balances ($\frac{m}{p}$) against the interest rate (r), we get a different curve for each level of income (y) as shown in Figure 5.1 .

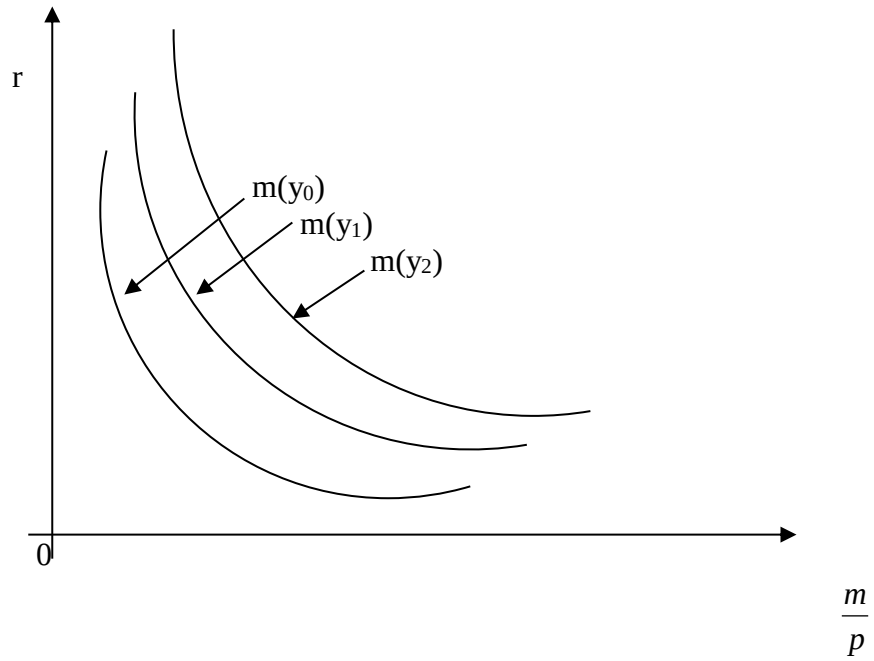


Figure 5.1: Money Demand

At any given y, say y_o, which means transactions demand is fixed, then as r rises, speculative demand falls reducing total demand. Similarly, at any given r, meaning speculative demand is fixed, as y rises, transactions demand also increases thereby increasing total demand.

On the supply side, money supply is exogenously given by the central bank: hence $m = \bar{m}$ where m = money supply.

If we plot the demand for money and supply of money together, we obtain equilibrium in the money market as shown in Figure 5.2.

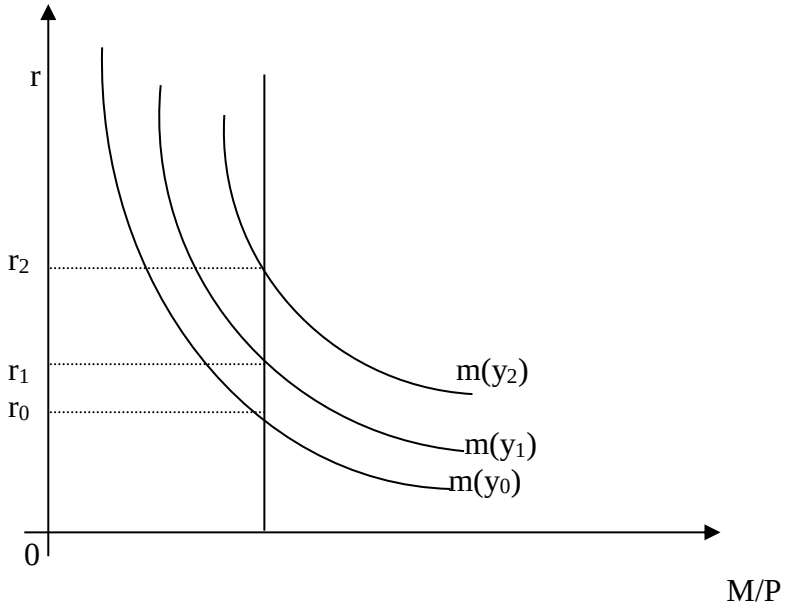


Figure 5.2: Equilibrium in the money market

Given the price level, the real money supply is given by $\frac{\bar{m}}{p}$ while the demand for money is represented by the functions m (y_0), m (y_1) and m (y_2).

From Figure 5.2, we observe that as income rises from y_0 to y_2, interest rates also rises from r_1 to r_2 while the money market is in equilibrium. This is because, when income rises, transaction demand rises and at same time some holders of interest earning bonds need to shift into money due to higher transaction needs.

This leads to a reduction of demand in the bonds market, which drives bond prices down and interest rates up. Therefore, the relationship between income (y) and the interest rate (r) is positive and gives us the **LM curve**.

The LM curve therefore traces the r and y pairs at which the money market is in equilibrium. This is shown in Figure 5.3.

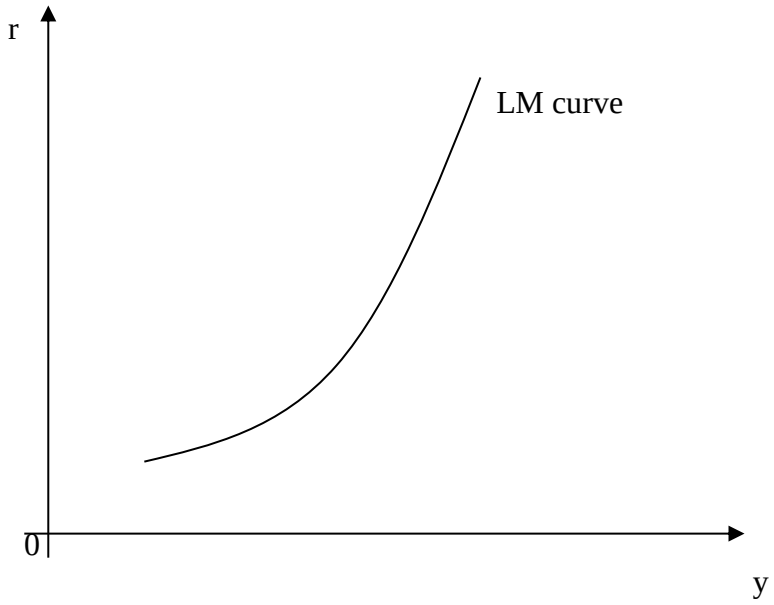


Figure 5.3: The LM Curve

5.2.2 Derivation of the LM Curve using the four quadrant diagram

Mathematically, we can derive the LM curve by differentiating the money market equilibrium condition; $\frac{\bar{m}}{P} = l(r) + k(y)$

If totally differentiated, we obtain:

$$l'dr + k'dy = o \text{ Since } d\bar{m} = o$$

$$l'dr = -k'dy$$

$$\frac{dr}{dy} = -\frac{k'}{l'}$$

since $k' > 0$ and $l' < 0$ then $\frac{dr}{dy} = -\frac{k'}{l'} > 0$

and thus the LM curve has a **positive slope.**

The LM curve may also be traced using the four- quadrant diagram as shown in Figure 5.4.

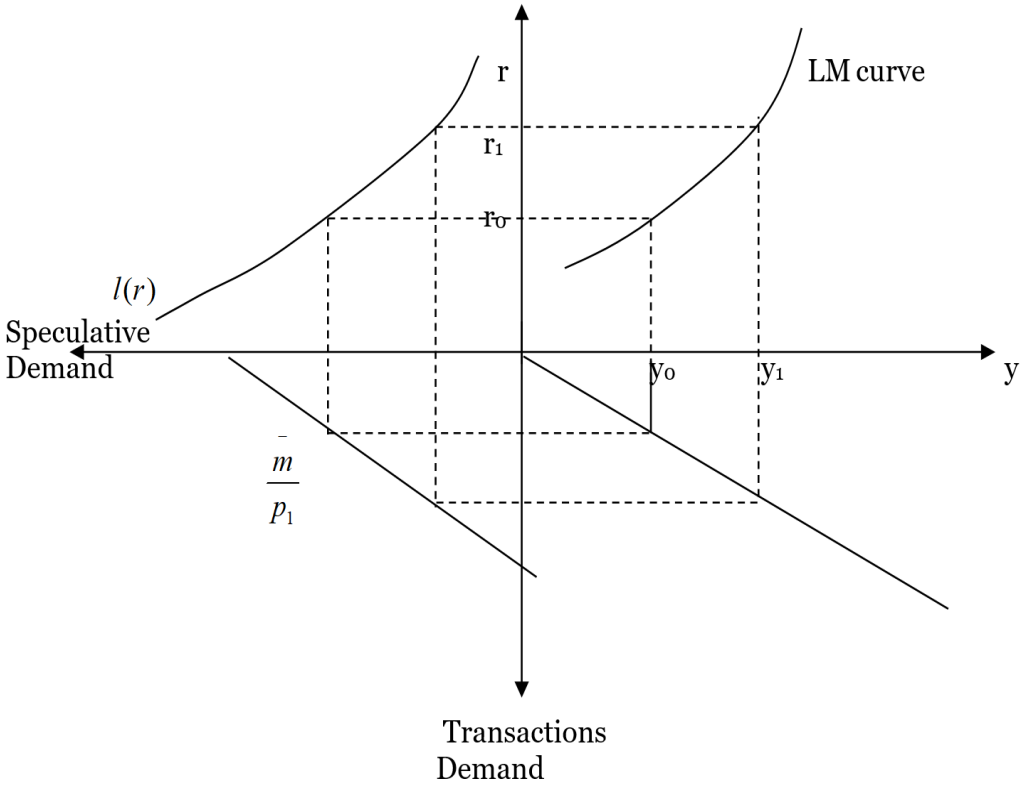


Figure 5.4: Derivation of the LM Curve.

In the SE quadrant, the transactions demand is shown as an increasing function of income. In the NW quadrant, the speculative demand is shown as a negative function of interest rate while in the SW quadrant the equilibrium condition equating total supply of money to total demand is drawn.

The LM curve is derived in the NE quadrant by taking any level of interest rate and then tracing back to get the corresponding level of income.

Numerical example

Given the following equations, derive the LM curve equation.

L = Y-100r (Real money demand)

$\bar{m}$ = 295 (Real money supply)

Solution

At equilibrium in the money market;

Money demand = Money supply

Y-100r = 295

Thus, Y = 295 +100r. This is the equation for the LM curve.

5.2.3 Equilibrium in the Product and Money Markets

We have already derived the equilibrium in the product market (IS curve) and in the money market (LM curve). If we take the IS and the LM equations and solve simultaneously, we obtain a single pair of r and y that gives equilibrium in both markets. This corresponds to the point where the IS and LM curves intersect as shown in Figure 5.5.

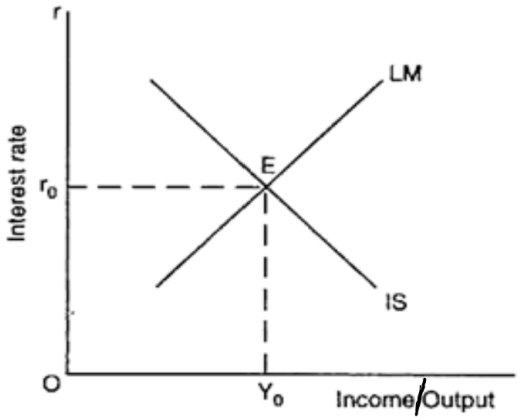


Figure 5.5: Simultaneous equilibrium in the goods and the money market

- **Numerical example**

The following equations describe a certain economy.

$C = 100 + 0.8Y^d$ (Consumption function)

$I = 10 - 10r$ (Investment function)

$G = 10$ (Government purchases)

$T = 0.25$ (Tax rate)

$L = Y - 100r$ (Real money demand)

$M = 295$ (Real money supply)

- **Required**

i.) IS and LM equations.

ii.) r and y pairs at which the two markets are both in equilibrium.

Solution

i.) IS Equation

$Y = C + I + G$

$=100 + 0.8(Y - 0.25Y) + 10 - 10r + 10$

$=120 + 0.6Y - 10r$

$Y - 0.6Y = 120 - 10r$

$$Y = \frac{120}{0.4} - \frac{10r}{0.4}$$

$Y = 300 - 25r$ -IS equation.

LM Equation

Money demand = Money supply

$Y - 100r = 295$

$Y = 295 + 100r$ -LM equation

For the two markets to be in equilibrium;

IS =LM

$300 - 25r = 295 + 100r$

$125r = 5$

$r = 5/125 = 0.04$

Hence r = 4% (**Equilibrium interest rate**)

To obtain income (y), substitute r into either the IS or LM equation. If we use the IS equation, then:

$Y = 300 - 25r$ but r = 4%

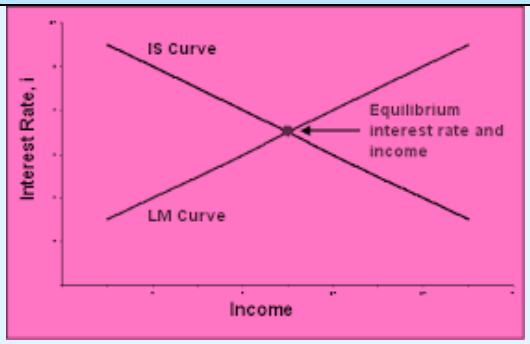
$= 300 - 25(4/100)$

$= 300 - 1 = 299$ (**Equilibrium Income**).

Therefore, the two markets are in equilibrium when r = 4% and Y = 299

Derivation of the LM Curve is further discussed on e-tivity 5.2.2.

E-tivity 5.2.2

Numbering, pacing and sequencing	5.2.2
Title	Derivation of the LM Curve
Purpose	To enable you derive the LM Curve
Brief summary of overall task	Watch this video on the derivation of the LM Curve
Spark	 TO BE EDITED
Individual task	✎ Explain the meaning of the LM Curve ✎ Graphically derive the LM Curve Make reference to the video above and post your answers on the Discussion Forum 5.
Interaction begins	Provide constructive feedback on your class mates views and ideas on Discussion Forum 5.
E-moderator interventions	1. Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity
Schedule and time	This task should take two hours
Next	Income and Price Level on the Demand Side

5.3 Summary

In this lecture, we have learnt that equilibrium in the money market is achieved when money demand equals money supply. We also derived the LM curve which represents equilibrium in the money market. We have also explored the simultaneous equilibrium in both the goods and money markets and established that this occurs at the point of intersection of the LM and IS curves.

5.4 Further Activity

1. Using the four-quadrant diagram to discuss the effect of the following on equilibrium interest rate (r) and income (y).
   i.) An increase in money supply.
   ii.) An increase in the price level.
2. Given the following equations for a certain economy:

$Y = C + I + G + X$ (Income identity)
$C = 100 + 0.9Y^d$ (Consumption function)
$I = 200 - 500r$ (Investment function)
$X = 100 - 0.12Y - 500r$ (Net export)
$G = 200$ (Government purchases)
$T = 0.2$ (Tax rate)
$L = Y - 100r$ (Real money demand)
$M = 800$ (Real money supply)

- **Required**

(a) Derive equations for IS and LM curves
(b) Determine the r and y pair at which the two markets are clearing
(c) Compute the values of C, I, X and L

5.5 Further Reading

1. Krugman, P. & Robin, W. (2021). *Macroeconomics* (6th ed.). Macmillan Higher Education. ISBN: 9781319320164, 2020942110.
   http://library.lol/main/DFA1CA10088EA05602291872423C5A50
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   http://library.lol/main/5E3DD6586AFE840C3BDEE3BE9CD8CE3F

LECTURE VI: INCOME AND PRICE LEVEL ON THE DEMAND SIDE

6.1 Introduction

In the previous lecture, we have studied how the intersection of the IS and LM curves determine the level of income and interest rate given the price level P_o. In this lecture, we shall vary the price level P so that we may analyze the effects of the price change on equilibrium output demanded Y.

We will derive the demand curve for the economy and then examine how fiscal policy may be employed to manage demand in an economy.

6.2 Lesson Learning Outcomes

By the end of this lecture, the learner should be able to:

6.2.1 Derive the Demand Curve for an Economy.

6.2.2 Explore Fiscal and Monetary Policies as Demand Management Policies.

6.2.3 Analyze the Effects of Fiscal Policy on Income and Interest Rates.

6.2.1 Derivation of the Demand Curve for an Economy

In the previous lectures, the following equilibrium conditions were developed:

Product market: $s(y-t(y))+t(y)=i(r)+g=i(r)+g$

Money market: $\frac{\bar{m}}{p}=l(r)+k(y)$

We have been taking prices as given and therefore, we easily solved for equilibrium r and y. We shall now drop the assumption of price being fixed and see what happens to Y as we change P.

To analyze the effects of price level changes on Y, we use the four – quadrant diagram:

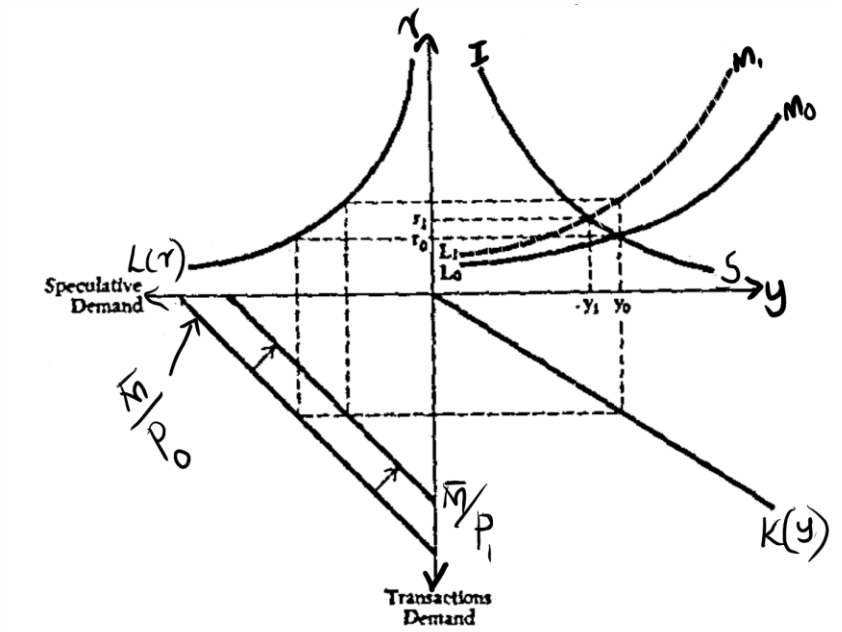
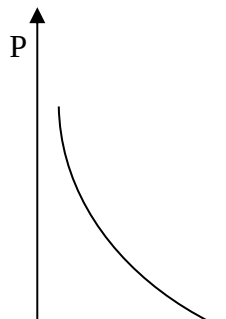


Figure 6.1: Effect of a price increase on r and y

The money market equilibrium condition is first drawn because the price level enters the money market and not the product market. The IS curve is superimposed to give equilibrium (r_o, y_o). Therefore, at price P_o, equilibrium is at (r_o, y_o). If price rises from P_0 to P_1, without money supply $\bar{m}$ changing, then the real money supply shifts inward from $\frac{\bar{m}}{p_0}$ to $\frac{\bar{m}}{p_1}$. This shifts the LM curve from LM_0 to LM_1 changing equilibrium to (r_1, y_1).

The economy therefore settles at (r_1, y_1). The logic behind this is very simple. The rise in the price level shrinks the real money supply leaving excess demand in the money market at any given income level. This excess demand pushes interest rates up thereby reducing investment demand. The drop in investment reduces income from y_0 to y_1 through the multiplier process.

Therefore, the relationship between output demand (y) and prices in the economy is inverse as shown in the Figure 6.2:



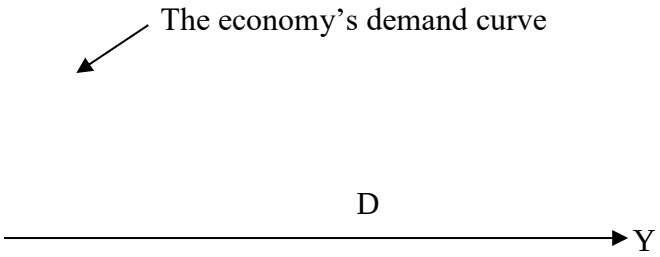


Figure 6.2: The economy's demand curve

The demand curve is derived by asking what happens to equilibrium output demanded as the price level changes allowing other variables such as r to adjust to their equilibrium levels.

This brings out three important points about the demand curve:

- Changes in equilibrium variables such as r and y on the demand side of the economy as a result of price changes causes movements along the demand curve.
- Changes in exogenous variables on the demand side of the economy such as government expenditure, money supply, tax schedule, savings function or k(y) cause shifts in the demand curve.
- The demand curve does not reflect the ordinary substitution effects of a rising price reducing demand. Rather, the rising aggregate price level, P, reduces equilibrium output demanded, y, by tightening the interest rate and thus reducing investment.

6.2.2 Fiscal and Monetary policies in Demand Management

Monetary and fiscal policies are generally thought of as demand management policies. This means that the objective of the two policies is to maintain output near full employment and stability in the prices. This is because excess demand causes inflation and insufficient demand causes unemployment and deflation.In the case of excess demand as shown in Figure 6.3, the objective of the two policies will be to reduce demand from D_0D_0 to D_1D_1 thus keeping prices at P_0 and output at full employment Y_F.

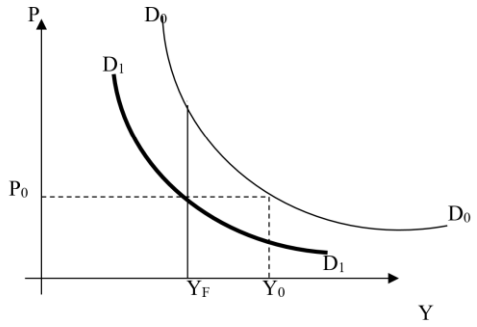


Figure 6.3

However, if there is a shortage in demand as shown in Figure 6.4, then the objective of the two policies will be to increase demand from D_0D_0 to D_1D_1 keeping prices at P_0 and output at Y_F.

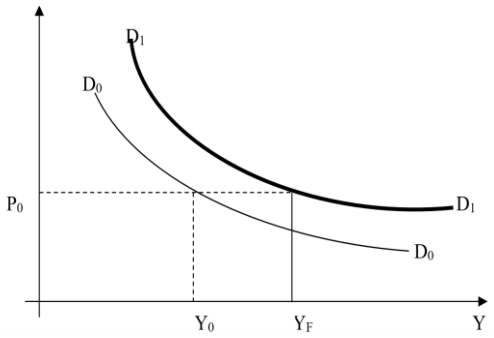


Figure 6.4

6.2.3 Effect of Fiscal Policy on Income and Interest Rates

In analyzing the effects of fiscal policy changes on g and t on equilibrium y, we use a four quadrant diagram for the IS curve. Since fiscal policy changes do not affect the LM curve, we can just add a fixed LM curve to the r, y quadrant to get the initial equilibrium point r_o, y_o corresponding to an initial price level.

The fiscal policy changes will then shift the IS curve along the LM curve changing equilibrium output demanded, y, and the interest rate, r.

Now suppose with the initial level of government purchases, g_0 and tax schedule, the resulting output level y_0, is below full employment.

This means there is a lot of unemployment in the economy. The objectives of fiscal policy in this case will be to increase demand through:

(i) An increase in government expenditure (g) or

(ii) A reduction or cut in tax rate

a) Effects of an increase in government expenditure on y

If there is an increase in g from g_0 to g_1 without taxes changing, then the IS curve will shift from IS_0 to IS_1 as shown in the Figure 6.5

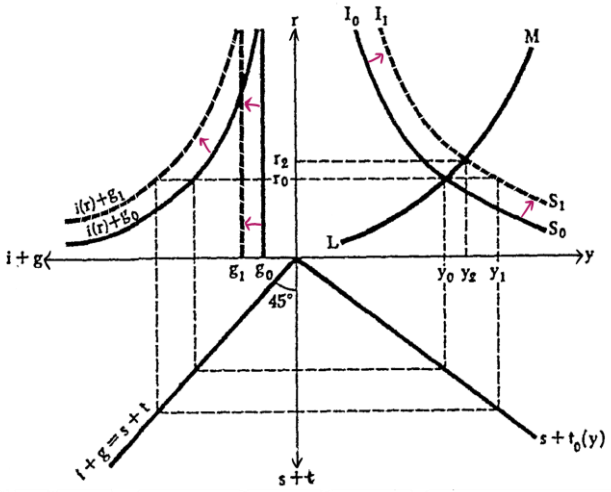


Figure 6.5: Effect of an Increase in Government Expenditure

The increase in g from g_0 to g_1 adds directly to y through the multiplier so that y increases from y_0 to y_1. This increase in y causes excess demand in the money market thereby causing interest rates to rise from r_0 to r_2. The increase in r, causes investment to fall and through the multiplier y falls from y_1 to y_2. The economy therefore settles at (r_2, Y_2).

b) **Effects of a tax cut on y**

Permanently reducing tax rates or increasing transfer payments instead of increasing government purchases, could obtain the same effects on the level of r and y.

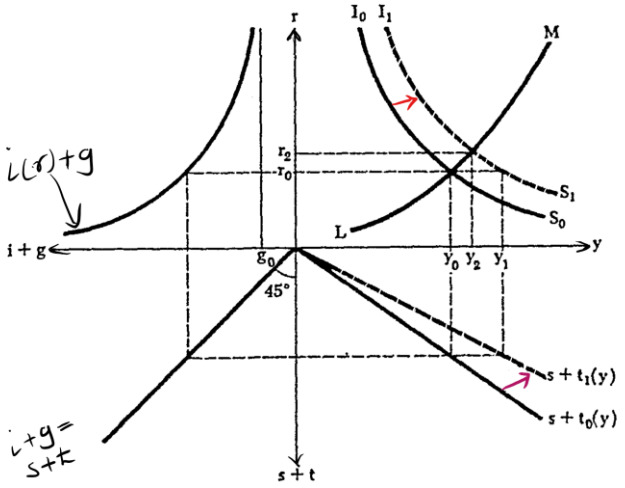


Figure 6.6: Effect of a tax cut

When the rate of interest is r_0, the IS curve is IS_0. If we impose the LM curve we obtain y_0. A cut in the tax rate, shifts the s + t function out from s + t_0 (y) to s + t_1 (y). As a result, the IS curve shifts to IS_1 and income rises to y_1. The increase in income causes excess demand in the money market forcing interest rates to rise. The increase in r reduces investment and so through the multiplier, y falls to y_2. The economy therefore settles at (r_2, y_2)

E-tivity 6.2.3 discusses the effects of fiscal policy on equilibrium income and interest rates.

E-tivity 6.2.3

Numbering, pacing and sequencing	**6.2.3**
Title	Effect of Fiscal Policy on Income and Interest Rates
Purpose	To enable you explore the effects of fiscal policy on equilibrium income and interest rates.
Brief summary of overall task	Watch this video on the effects of fiscal policy on the IS-LM framework.

Spark	
Individual task	Analyze the effects of a contractionary fiscal policy on Discussion Forum 6. Make reference to the video above.
Interaction begins	Provide constructive feedback on your class mates views and ideas on Discussion Forum 6.
E-moderator interventions	1. Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity
Schedule and time	This task should take two hours
Next	Fiscal Policy Multiplier

6.3 Summary

In this lecture, we have learnt the following:

- ✓ The Economy's Demand Curve has a negative slope.
- ✓ Fiscal and monetary policies can be employed to regulate (increase of decrease aggregate demand) in order to achieve the desired macroeconomic goals.
- ✓ Expansionary and Contractionary Fiscal Policy affects the IS curve and equilibrium income.

6.4 Further Activity

	Use the four-quadrant diagram to analyze the effects of the following on y and r i.) A decrease in g ii.) An increase in t

6.5 Further Reading

1. Krugman, P. & Robin, W. (2021). *Macroeconomics* (6th ed.). Macmillan Higher Education. ISBN: 9781319320164, 2020942110.
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LECTURE VII: FISCAL POLICY MULTIPLIER

7.1 Introduction

This lecture involves the derivation, calculation and interpretation of the fiscal policy multiplier. The conditions necessary for the effectiveness of fiscal policy are also explored here.

7.2 Lesson Learning Outcomes

At the end of this lesson, the learner should be able to:

7.2.1: Derive the Fiscal Policy Multiplier

7.2.2: Analyze the Effectiveness of Fiscal policy

7.2.1 Derivation of the Fiscal Policy Multiplier

In Lecture six, we established that an increase in g leads to an increase in y. we now seek to determine the amount which y will change following a unit change in g. This is possible only if we calculate the **Fiscal Policy Multiplier**.

The fiscal policy multiplier tells us the amount by which equilibrium income will change when g or t changes by one unit.

Recall the two equilibrium condition given as:

Product market: $y = c(y - t(y)) + i(r) + g$ ……..... (7.1)

Money market: $\frac{\bar{m}}{P} = l(r) + k(y)$ …….. (7.2)

To observe the effects of change in g on y, totally differentiate equation (7.1) to obtain:

$dy = c'(dy - t'dy) + i'dr + dg$ …….. (7.3)

Where: $c' = mpc = \frac{dc}{dy} > 0$

$$t' = \frac{dt}{dy} < 0$$

$$i' = \frac{di}{dr} < 0$$

From equation (7.3) we can have:

$$dy - c'(dy - t'dy) = i'dr + dg \quad \text{……..…….. (7.4)}$$

Rearranging we obtain:

$$dy - c'dy + c't'dy = i'dr + dg$$

Where:

$dy - c'dy$ = Additional savings or change in savings.

$c't'dy$ = Change in taxes.

From equation (7.4), factor out dy so that:

$$(1 - c'(1-t)')dy = i'dr + dg \quad \text{…….. (7.5)}$$

We can obtain the expression for dr from money market:

$$\frac{\bar{m}}{P} = l(r) + k(y)$$

Let $\frac{\bar{m}}{P} = m$ so that the equilibrium condition in the money market becomes:

$$0 = l'dr + k'dy$$

$$l'dr = -k'dy$$

$$dr = -\frac{k'}{l'}dy$$

Substituting this expression for dr into equation (7.5) we get:

$$\left[1 - c'(1-t')\right]dy = i'(-\frac{k'}{l'}dy) + dg \quad \text{…… (7.6)}$$

$$\left[1 - c'(1-t')\right]dy = -i'(-\frac{k'}{l'}dy) = dg$$

$$\left[1 - c'(1-t')\right]dy + \frac{i'k'}{l'}dy = dg$$

$$\left[1 - c'(1-t') + \frac{i'k'}{l'}\right]dy = dg$$

$$dy = \frac{dg}{1 - c^{'}(1 - t^{'}) + \frac{i^{'}k^{'}}{l^{'}}}$$

$\frac{dy}{dg} = \frac{1}{1 - c^{'}(1 - t^{'}) + \frac{i^{'}k^{'}}{l^{'}}}$ This is the expression for **Fiscal Policy multiplier.**

Numerical example

Given the following equations, calculate the fiscal policy multiplier and interpret it.

C = 100 + 0.8Y^d (Consumption function)

I = 10– 10r (Investment function)

L = Y-100r (Real money demand)

G = 10 (Government purchases)

T = 0.25 (Tax rate)

M = 295 (Real money supply)

Solution

Fiscal policy multiplier is given by:

$$\frac{dy}{dg} = \frac{1}{1 - c^{'}(1 - t^{'}) + \frac{i^{'}k^{'}}{l^{'}}}$$

$c^{'}$ = 0.8, $t^{'}$ = 0.25, $i^{'}$ = -10, $k^{'}$ = 1, $l^{'}$ = -100

Hence: $\frac{dy}{dg} = \frac{1}{1 - 0.8(1 - 0.25) + -\frac{-1-(1)}{-100}}$

$$\frac{dy}{dg} = \frac{1}{1 - 0.8(0.75) + 0.1}$$

$$\frac{dy}{dg} = \frac{1}{0.5}$$

= 2

Interpretation

An increase in government purchases by one unit will increase equilibrium output by two units.

7.2.2: Effectiveness of Fiscal Policy

Effectiveness of fiscal policy is determined by the slope of the IS Curve. The IS curve can have different slopes depending on the slope of the investment function.

Slopes of an IS curve

Equilibrium in the product market is given as:

$$y = c(y - t(y)) + i(r) + g$$

Differentiating we get:

$$dy = c'(dy - t'dy) + i'dr + dg$$

Thus: $(1 - c'(1-t)')dy - dg = i'dr$

So that, $dr = \frac{[1 - c'(1-t')]dy}{i'} - \frac{1}{l'}dg$

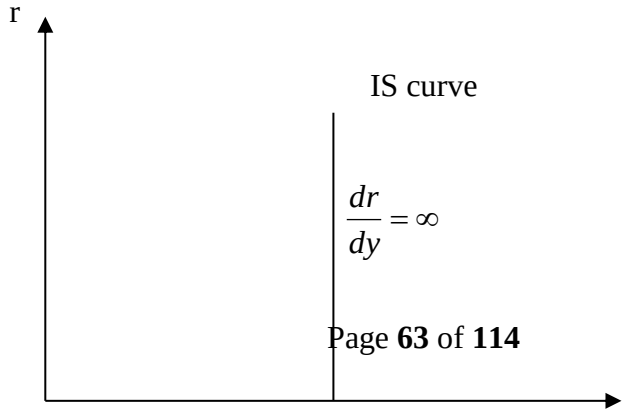
Since in equilibrium, the above is true, and then it is also true that:

$$r = \frac{[1 - c'(1-t')]y}{i'} - \frac{1}{l'}g$$

So that $\frac{dr}{dy} = \frac{[1 - c'(1-t')]}{i'}$

We can now get various slopes of IS curve by assigning different values of the parameters i'.

If $i' = 0$, then $\frac{dr}{dy} = \infty$ and hence, the IS curve will be vertical as shown in Figure 7.1:



Y

Figure 7.1

If $i^{'} = -\infty$, then, $\frac{dr}{dy} = \frac{1 - c^{'}(1 - t^{'})}{i^{'}} = 0$ Meaning that the IS curve is horizontal as shown in Figure 7.2.

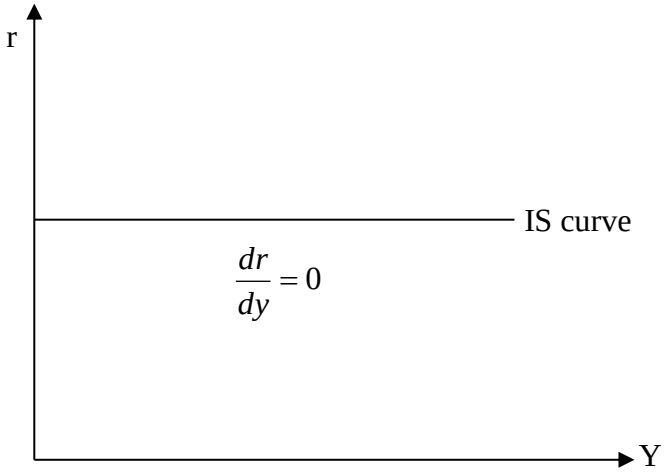


Figure 7.2

If $0 > i^{'} > -\infty$, then the IS curve will be downward sloping as shown in Figure 7.3.

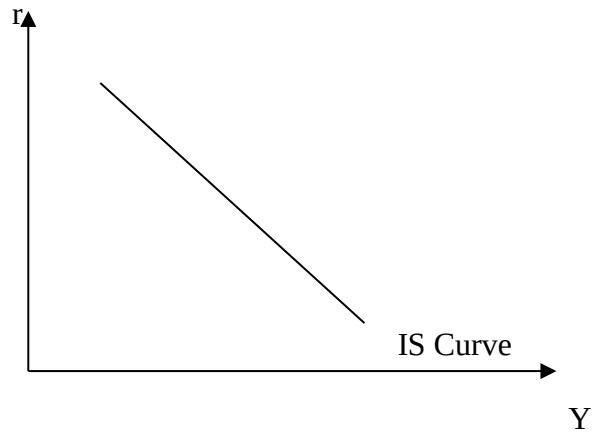
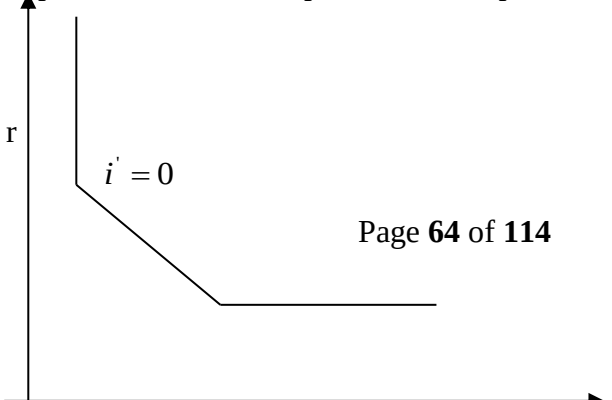


Figure 7.3: Slope of the IS Curve

Therefore, the slope of the IS curve depend on the slope of the investment function.



$0 > i^{'} > -\infty$

$i^{'} = -\infty$ IS Curve

Y

Figure 7.4

Effectiveness of Fiscal Policy

Fiscal policy is most effective in changing y when the IS curve is vertical as shown in Figure 7.5.

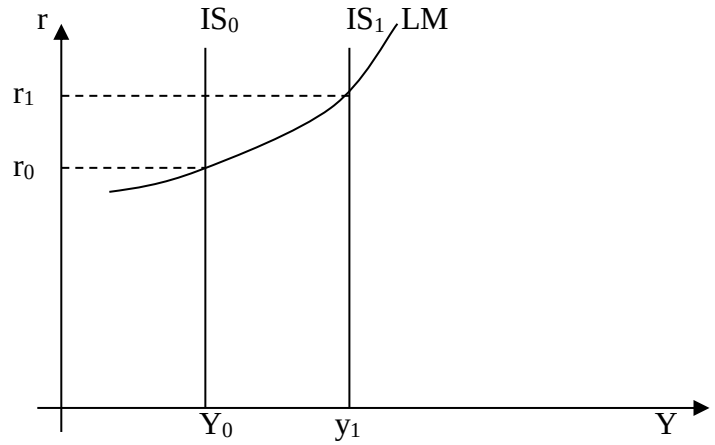
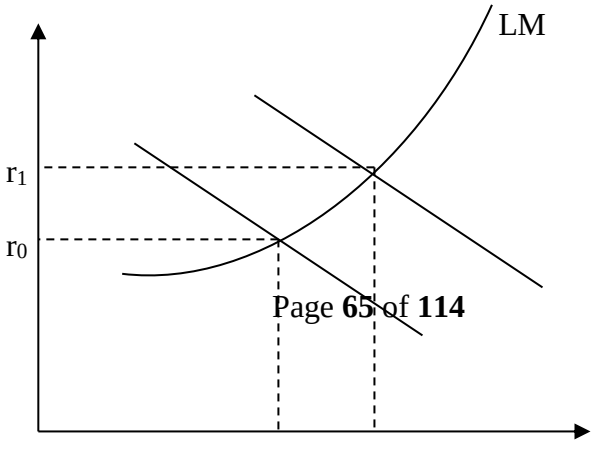


Figure 7.5

When the IS curve is horizontal i.e. when $i^{'} = -\infty$, then $\frac{dy}{dg} = 0$. This is true if you look at the expression: $\frac{dy}{dg} = \frac{1}{1 - c^{'}(1 - t^{'}) + \frac{i^{'}k^{'}}{l^{'}}}$ if $i^{'} = -\infty$ then $\frac{dy}{dg} = 0$ hence no change in y.

Therefore, the fiscal policy is not effective when IS curve is *horizontal.*

When IS curve is downward sloping, the fiscal policy use will increase y but not as much as when IS curve is vertical. This is shown in Figure 7.6



IS_1

IS_0

y_0 y_1 Y

Figure 7.6

Let's analyze the effectiveness of fiscal policy further on e-tivity 7.2.2.

E-tivity 7.2.2

Numbering, pacing and sequencing	**7.2.2**
Title	Effectiveness of Fiscal Policy in the IS-LM Model
Purpose	To enable you analyze the effectiveness of Fiscal Policy in the IS-LM Model.
Brief summary of overall task	Watch this video on the effectiveness of fiscal policy in the IS-LM Model.
Spark	
Individual task	Discuss the circumstances under which Fiscal policy is: **Very Effective, Fairly Effective and Ineffective** on Discussion Forum 7. Make reference to the video above.
Interaction begins	Provide constructive feedback on your class mates views and ideas on Discussion Forum 7.
E-moderator interventions	1. Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity
Schedule and time	This task should take two hours
Next	Monetary Policy Effects on Demand

7.3 Summary

In this lecture we have learnt how to derive and compute the fiscal policy multiplier. We also established that fiscal policy effectively is influenced by the slope of the IS Curve.

7.4 Further Activity

	Given the following information: $c^{'} = 0.8,\ t^{'} = 0.25,\ i^{'} = -10,\ k^{'} = 1,\ l^{'} = -100$ i.) Compare the effectiveness of fiscal policy under the three categories of the slope of the IS Curve. ii.) Under which category is fiscal policy most effective?

7.5 Further Reading

1. Krugman, P. & Robin, W. (2021). *Macroeconomics* (6th ed.). Macmillan Higher Education. ISBN: 9781319320164, 2020942110.
   http://library.lol/main/DFA1CA10088EA05602291872423C5A50
2. Mankiw, N. Gregory (2021). *Principles of Economics* (9th ed.). Cengage Learning. ISBN: 2019941033, 9780357038314, 9780357133705.
   http://library.lol/main/E4F408FE98ABD6329394D2C9C9DE877F
3. Romer, D. (2018). *Advanced Macroeconomics* (5th ed.). The McGraw Hill. ISBN: 1260185214, 9781260185218.
   http://library.lol/main/3B9AF2793837DF6767E985633BE2CC37
4. The CORE Team (2022). The Economy: Economics for a Changing World. Core Economics Education. ISBN: 1838165665, 9781838165666.
   http://library.lol/main/5E3DD6586AFE840C3BDEE3BE9CD8CE3F

LECTURE VIII: MONETARY POLICY EFFECTS ON DEMAND

8.1 Introduction

In Lecture seven, we studied the fiscal policy effects on demand using the Hicksian IS-LM framework. We also looked at the circumstances under which the fiscal policy use may be effective in generating desired changes in real output, y. In this lecture, we shall use the same Hicksian IS-LM framework to analyze the monetary policy effect on demand. The monetary policy multiplier will be derived and the effectiveness of monetary mix will also be looked at.

Lesson Learning Outcomes

By the end of this lecture, the learner should be able to:

8.2.1 Analyze the effect of Monetary Policy on Income and Interest Rates

8.2.2 Derive the Monetary Policy Multiplier

8.2.3 Analyze the Effectiveness of Monetary Policy

8.2.4 Explain the meaning of Fiscal and Monetary Policy Mix and show effects on r and y.

8.2.1 Effect of Monetary Policy on Income and Interest Rates

To analyze the effects of monetary policy change in money supply $\bar{m}$, we make use of the four-quadrant diagram. We shall derive the LM curve and then superimpose the IS curve to determine the initial r_0 and y_0 given the price level p_0 and the initial level of money supply $\bar{m}_0$. The monetary policy change will shift the LM curve, changing the interest rate and the equilibrium output demanded.

More specifically, an increase in money supply will shift the LM curve to the right as shown in Figure 8.1:

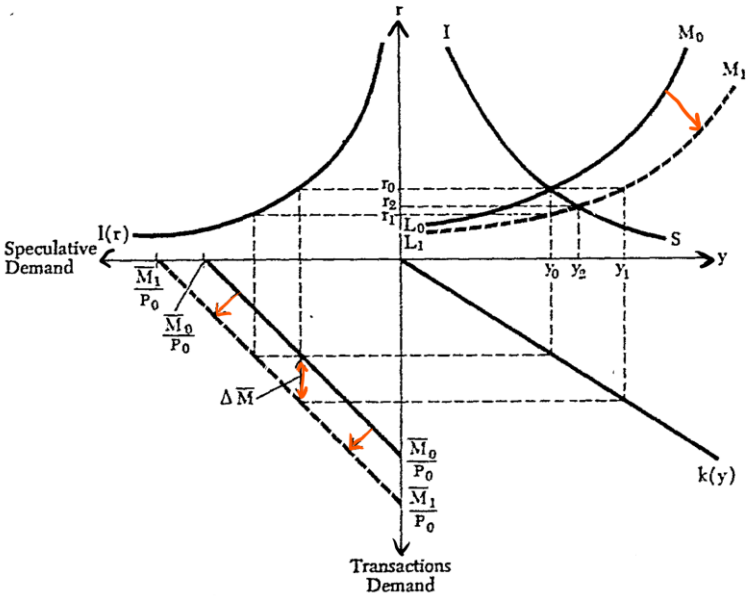


Figure 8.1: Effect of an increase in money supply on y and r

The Figure 8.1 shows the effects of an increase in money supply from $\bar{m}_0$ to $\bar{m}_1$. This increase in money supply shifts the real money supply out from $\frac{\bar{m}_0}{P_0}$ to $\frac{\bar{m}_1}{P_0}$. At the initial output y_0, the increase in money supply pushes interest rates down from r_0 to r_1 to maintain equilibrium in the money market. This drop in interest rate increases investment demand thereby raising the level of output along the IS curve. The increase in income in turn raises the transactions demand for money thus pulling the interest rate up. In the end the economy settles at (r_2, y_2) with both the product market and money market in equilibrium.

8.2.2 Derivation of the Monetary Policy Multiplier

The **Monetary Policy multiplier** tells us the amount by which equilibrium output changes when money stock changes by one unit taking into account the interaction between the goods and money markets. It is different from the money multiplier. The money multiplier tells us the amount by which money stock changes when high-powered money changes by one unit.

To develop the multiplier for the change in money supply (m) on output (y), we start with equilibrium conditions in product and money market.

Product market: $y = c(y - t(y)) + i(r) + g$

Money market: $\frac{\bar{m}}{P} = m = l(r) + k(y)$

Differentiating the money market equilibrium condition we obtain:

$$\frac{d\bar{m}}{P} = dm = l' dr + k' dy$$

$$dm = l' dr + k' dy$$

$$l' dr = dm - k' dy$$

$$dr = \frac{dm}{l'} - \frac{k' dy}{l'}$$

Differentiating the product market equilibrium condition, we obtain:

$$dy = c'(dy - t' dy) + i' dr + dg$$

$$= c'(1 - t')dy + i' dr + dg$$

Holding g constant we get:

$$dy = c'(1 - t')dy + i' dr$$

Substituting the expression for dr we obtain:

$$dy = c'(1 - t')dy + \frac{i'}{l'} dm - \frac{i' k'}{l'} dy$$

$$dy - c'(1 - t')dy + \frac{i' k'}{l'} dy = \frac{i' dm}{l'}$$

$$[1 - c'(1 - t') + \frac{i' k'}{l'}]dy = \frac{i' dm}{l'}$$

$$dy = \frac{\frac{i'}{l'}}{1 - c'(1 - t') + \frac{i' k'}{l'}} dm$$

Hence: $\frac{dy}{dm} = \frac{\frac{i'}{l'}}{1 - c'(1 - t') + \frac{i'k'}{l'}}$

This is the multiplier expression for the money supply change or the **monetary policy multiplier.**

The denominator is the same as the one for the fiscal policy multiplier.

Numerical example

Given the following equations from a certain economy:

$C = 100 + 0.8Y^d$ (Consumption function)

$I = 10 - 10r$ (Investment function)

$L = Y-100r$ (Real money demand)

$G = 10$ (Government purchases)

$T = 0.25$ (Tax rate)

$M = 295$ (Real money supply)

Required

i.) Calculate the monetary multiplier policy and interpret it.

ii.) Suppose equilibrium income increases by 40, by how much must real money stock increases for the new level of income to be in equilibrium.

Solution

(i) $\frac{dy}{dm} = \frac{\frac{i'}{l'}}{1 - c'(1 - t') + \frac{i'k'}{l'}}$

But $c' = 0.8,\ t' = -.25,\ i' = -10,\ k' = 1,\ l' = -100$

Therefore; $\frac{dy}{dm} = \frac{\frac{-10}{-100}}{1 - 0.8(1 - 0.25) + \frac{-10(1)}{-100}}$

$$= \frac{0.1}{1-0.8+0.2+0.1}$$

$$= 0.2$$

Interpretation:

An increase in money supply by one shilling will increase equilibrium income by 0.2 shillings or 20 cents.

(ii) We use the following expression:

$$dy = \frac{\frac{i'}{l'}}{1-c'(1-t')+\frac{i'k'}{l'}}dm$$

but $\frac{\frac{i'}{l'}}{1-c'(1-t')+\frac{i'k'}{l'}} = 0.2$

Hence $dy = 0.2dm$

Since, $dm = 40$ then

$$0.2dm = 40$$

Hence $dm = 40/0.2 = 200$

Therefore, money stock must increase by 200.

8.2.3: Effectiveness of Monetary Policy

Effectiveness of monetary policy depends on the slope of the LM Curve.

Slope of the LM Curve

The money market equilibrium condition is given by:

$$\frac{\bar{m}}{P} = m = l(r) + k(y)$$

Differentiating, it we obtain:

$dm = l^{'}dr + k^{'}dy$

$dr = \frac{dm}{l^{'}} - \frac{k^{'}dy}{l^{'}}$

If the above expression is true, then it is also true that:

$r = \frac{m}{l^{'}} - \frac{k^{'}}{l^{'}}y$ This is the expression for the LM curve with the slope given by:

$\frac{dr}{dy} = -\frac{k^{'}}{l^{'}} > 0$

The slope of the LM curve determines the effectiveness of monetary policy.

If we assign various values to the parameter $l^{'}$, we obtain different slopes of the LM curve.

From the expression $\frac{dr}{dy} = -\frac{k^{'}}{l^{'}}$; if $l^{'} = 0$ then $\frac{dr}{dy} = \infty$ and LM curve is vertical as shown in Figure 8.2:

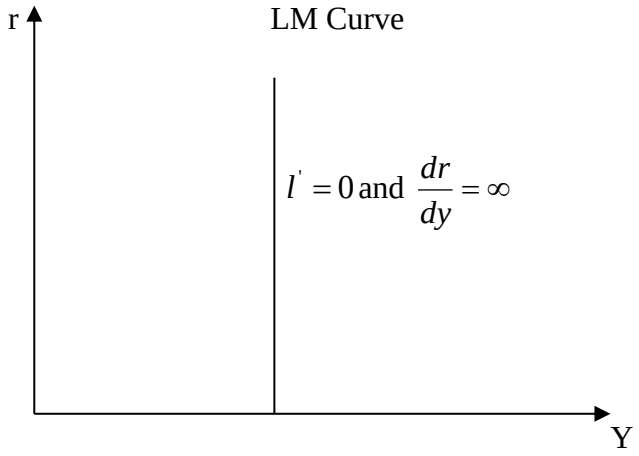


Figure 8.2

A vertical LM curve implies that the speculative demand for money is insensitive to changes in interest rates.

When $l^{'} = -\infty$ implying that the speculative demand for money is very sensitive to changes in interest rates, then $\frac{dr}{dy} = -\frac{k^{'}}{l^{'}}$ =0 meaning that the LM curve is horizontal.

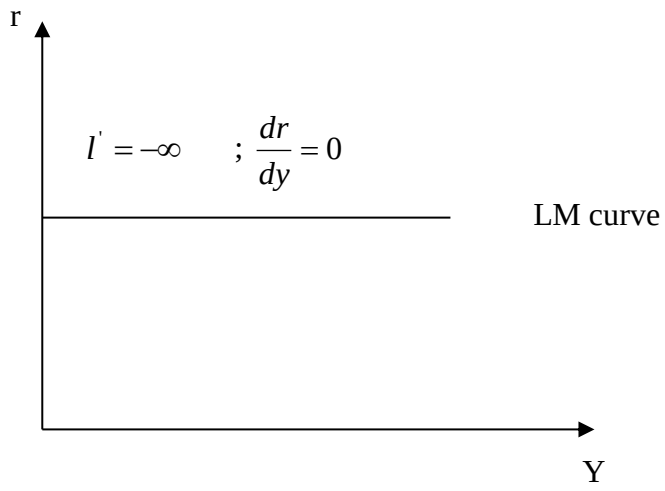


Figure 8.3

When: $0 > l' > -\infty$ then the LM curve is upward sloping i.e. $\frac{dr}{dy} = -\frac{k'}{l'} > 0$

Hence:

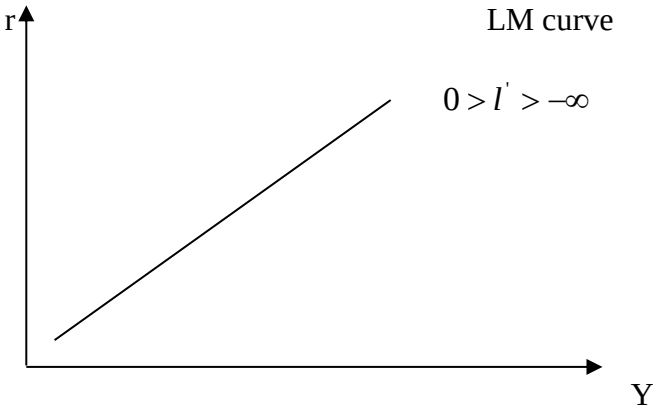


Figure 8.4

The shape of the LM curve put together yields:

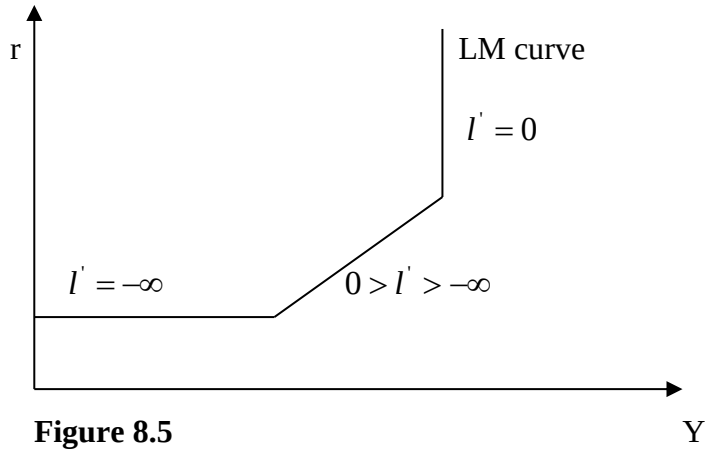


Figure 8.5

Effectiveness of Monetary Policy

The monetary policy is more effective in the changing output when the LM curve is vertical as shown in the Figure 8.6.

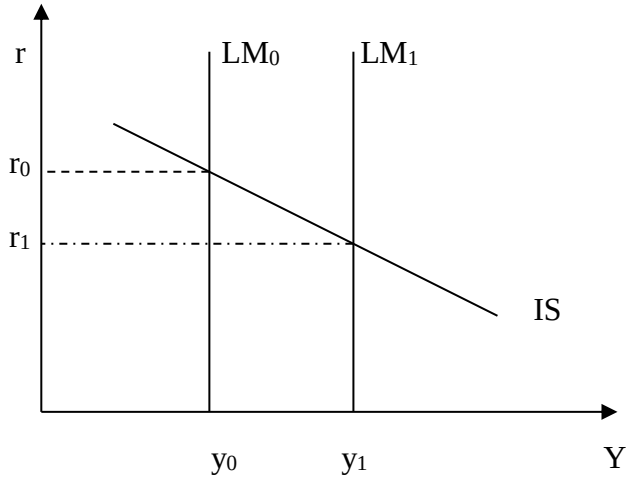


Figure 8.6

The monetary policy use shifts the LM curve to the right thereby raising y from y_0 to y_1.

We can prove that monetary policy is more effective in changing y when LM is vertical by looking at the expression:

$$\frac{dy}{dm} = \frac{\frac{i^{'}}{l^{'}}}{1 - c^{'}(1 - t^{'}) + \frac{i^{'}k^{'}}{l^{'}}}$$

In the RHS multiply up and down by $l^{'}$ to obtain:

$$\frac{dy}{dm} = \frac{i^{'}}{l^{'}(1 - c^{'}(1 - t^{'})) + i^{'}k^{'}}$$

if we let $l^{'} = 0$, then $\frac{dy}{dm} = \frac{1}{K'}$ thereby giving us a higher value of the multiplier. Hence Monetary policy is very effective.

When $l^{'} = -\infty$, then $\frac{dy}{dm} = 0$: Hence, when the LM Curve is Horizontal, Monetary policy is ineffective.

When $0 > l^{'} > -\infty$, then $\frac{dy}{dm} = \frac{i^{'}}{l^{'}(1-c^{'}(1-t^{'}))+i^{'}k^{'}}$: Hence when the LM Curve is positively sloped, Monetary Policy is fairly effective but not as effective as when $l^{'} = 0$ (LM is vertical).

8.2.4 Monetary and Fiscal Policy Mix

We have seen how the two policies can be used separately to attain specific objectives. The two policies can also be used together especially when the aim is to change the composition of equilibrium output and not its size. This is known as a **policy mix**.

Suppose for instance, the economy is experiencing interest rates that are too high to encourage investments, to correct the situation in this economy, a policy mix may be used to leave y unchanged but change investments and consumption. More specifically, the following policies may be employed simultaneously:

i.) Fiscal policy; tax rate increase and

ii.) Monetary policy; money supply increase

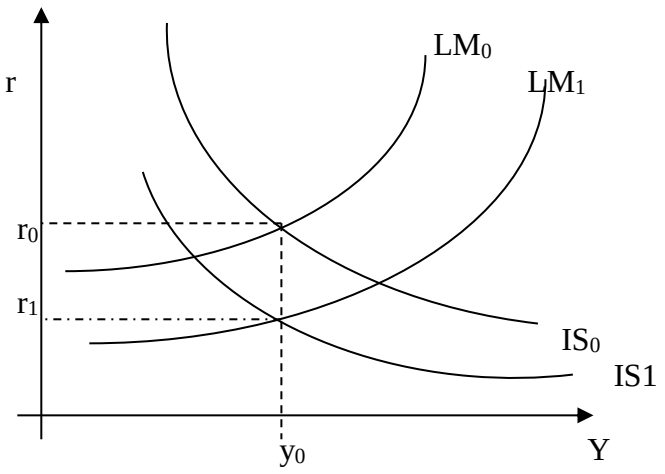


Figure 8.7

At (r_0, y_0), the interest rate r_0, is so high and discourages investment. If we increase tax rate, the IS curve shifts to IS_1 thereby causing disequilibrium in the money market at the initial interest rate r_0.

To ensure equilibrium in the money market, money supply is increased thereby shifting the LM curve to LM_1. This combination of increase in tax rate and increase in money supply brings the following results:

ii.) Output remains unchanged at y_0.

iii.) Interest rates falls from r_0 to r_1 thereby encouraging investment in the economy

More discussion on the policy mix is presented on e-tivity 8.2.4.

E-tivity 8.2.4

Numbering, pacing and sequencing	**8.2.4**
Title	Fiscal and Monetary Policy Mix.
Purpose	To enable you analyze Fiscal and Monetary Policy Mix.
Brief summary of overall task	Watch this video on Fiscal and Monetary Policy Mix.
Spark	
Individual task	Analyze and discuss the effect of a tax cut accompanied by a tight monetary policy on Discussion Forum 8. Make reference to the video above.
Interaction begins	Provide constructive feedback on your class mates views and ideas on Discussion Forum 8.
E-moderator interventions	1. Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity
Schedule and time	This task should take two hours
Next	Supply Side Equilibrium I (Labor Demand)

8.2 Summary

In this Lecture, we have covered the following:

- The Derivation of the Monetary Policy Multiplier
- Monetary Policy is most effective when the LM curve is vertical
- Fiscal and Monetary policy mix can be implemented to attain desired macroeconomic goals

8.3 Further Activity

Given the following equations:

$Y = C + I + G + X$

$C = 100 + 0.9Y^d$	(Consumption function)
$I = 200 – 500r$	(Investment function)
$M = 0.8Y – 2000r$	(Real money demand)
$X = 100 - 0.12Y – 500r$	(Net export)
$G = 200$	(Government purchases)
$T = 0.2$	(Tax rate)
$L = 800$	(Real money supply)

Required

1. Derive equation for IS and LM curves.
2. Compute the r and y at which the two markets are clearing
3. Compute the values of C, I, X and M.
4. Calculate the monetary and fiscal policy multipliers and interpret them.

8.4 Further Reading

1. Krugman, P. & Robin, W. (2021). *Macroeconomics* (6th ed.). Macmillan Higher Education. ISBN: 9781319320164, 2020942110. http://library.lol/main/DFA1CA10088EA05602291872423C5A50
2. Mankiw, N. Gregory (2021). *Principles of Economics* (9th ed.). Cengage Learning. ISBN: 2019941033, 9780357038314, 9780357133705.

http://library.lol/main/E4F408FE98ABD6329394D2C9C9DE877F
3. Romer, D. (2018). *Advanced Macroeconomics* (5th ed.). The McGraw Hill. ISBN: 1260185214, 9781260185218.
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LECTURE IX: SUPPLY SIDE EQUILIBRIUM I

9.1 Introduction

In the previous lectures, we developed the demand side of the economy taking the price P as exogenously determined. We derived the product market and money market equilibrium conditions and used the equations to find r and y pairs at which the two markets are clearing.

In this lecture, we will be introduced to the supply side of our skeletal macro economy by introducing demand and supply in the labor market.

9.2 Lesson Learning Outcomes

At the end of this lecture, the learner should be able to:

9.2.1 Understand the simple depression model

9.2.2 Derive the perfect competition and monopolist's demand for labor functions

9.2.3 Derive the aggregate demand for labor function

9.2.1 The Simple Depression Model

To begin, let's look for the moment at an economy such that of the depression in the 1930s. The labor supply is more or less unlimited, so that a demand increase can expand output y and employment N without raising the price level. This means therefore that prices are rigid in this model.

This essentially gives us a supply curve which is an horizontal line at P_0 in Figure 9.1, with equilibrium output y_0.

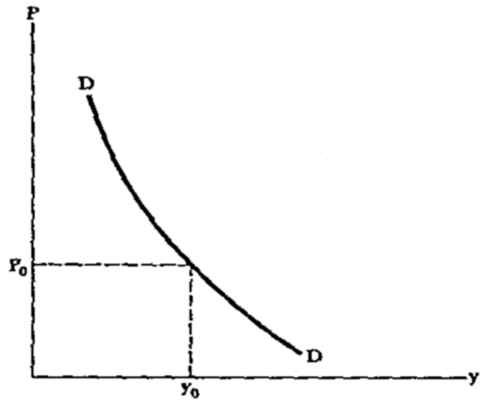


Figure 9.1: The Aggregate Demand Curve

We can next introduce a short-run production function for real output:

$$y = y(N, \bar{k});\ \frac{dy}{dN} > 0 \quad \text{.......} \quad (9.1)$$

The function tells us that, in the short run, the level of output y is a function of employment N. The rest of the factor inputs are fixed. For any level of y, the production function gives the level of employment N needed to produce this y.

This gives us a complete depression model. The presence of massive unemployment implies that an increase in demand will be followed by an increase in output and employment without raising prices and wages as shown in Figure 9.1. The production of the resulting equilibrium output y_0 gives employment of N_0 persons presumably far less than the total labor force as shown in Figure 9.2.

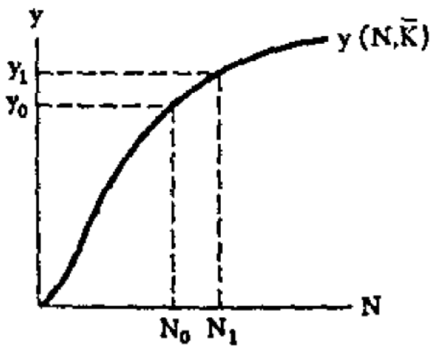


Figure 9.2: The short-run production function

In this case, if government purchases were increased, the IS curve would shift out and the demand curve of Figure 9.1 would shift to D_1D_1 in Figure 9.3, equilibrium output would rise to y_1 and employment would rise to N_1 as shown in Figure 9.2.

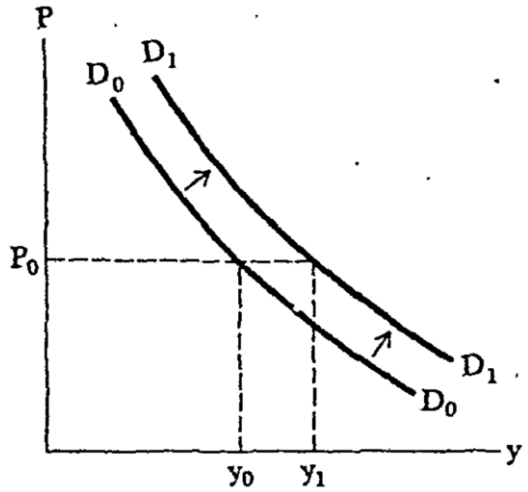


Figure 9.3: Demand shift in the depression model

This depression model adds an exogenous price assumption;

$P = P_0$. ..... (9.2)

The major difficulty with this analysis is that the assumption of a fixed price level is not acceptable if labor supply is not elastic. This is known from empirical observation. In the 1930s up to 1960s, when there was reasonable unemployment, an increase in demand leads to an increase in output without raising prices.

However, after 1965, unemployment was below 4% and therefore an increase in demand was followed with an increase in prices.

Empirical records in an economy with low unemployment suggests that increasing demand leads to raising prices while reduction in demand reduces prices or inflation.

Intuitively, we should be able to imagine the quantitative relationship between prices, wages and level of employment that would occur when an economy is at or near full employment. If demand for goods suddenly rises above supply, prices will begin to rise.

Higher prices will mean higher profits to producers and so they would expand production by hiring more labor. The increased demand for labor will take the form of employers offering higher money wage to hire more labor.

Presumably, however, the workers will be interested in purchasing power of their money wages. An increase in price therefore will reduce the workers' real wages and cause a reduction in the supply of labor offered at a given money wage. Another way to look at this is that the effect of an increase in demand for labor stimulated by an increase in the price level is likely to be dampened by the reduction in labor supply caused by the falling real wage.

Thus, common sense tells us that there is a close relationship between prices, wages and the level of employment and this relationship is more complex than the simple depression model.

So far, we have developed the product market and the money market. In order to establish the relationship between prices, wages and employment, we introduce a third market; the Labor market.

9.2.2 The Demand for Labor function

a) Perfect Competitive case

The production function presented in Figure 9.2 shows that output is an increasing function of employment (N). However, y increases at an increasing rate with the first additions of labor to the fixed capital stock. But after some level of employment shown as N_1, y begins to increase at a decreasing rate showing diminishing marginal return as the fixed capital is spread over more and more workers. From the production function, we can derive the average product of labor; AP_L, $(\frac{y}{N})$ and marginal product of labour; MP_L, $(\frac{dy}{dN})$ as shown in Figure 9.4:

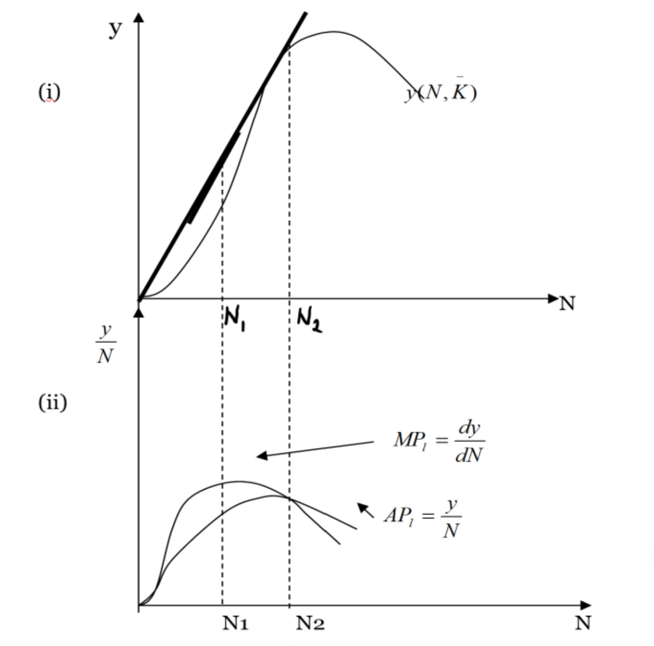


Figure 9.4: The production function and its derivatives.

The average product of labor is presented by the slope of a line from the origin to any point on the production function. As shown in the Figure 9.4, as employment increases AP_L first increases and then decreases. The MP_L is the slope of the production function and is shown by the slope of the tangent to the production function at each point N.

From Figure 9.4 the following observation can be made:

$$\Delta R = p.\frac{dy}{dN}.\Delta N$$

Where: $p.\frac{dy}{dN}$ or p. MP_L = value of the marginal product of labor (VMPL)

The increase in cost to a firm hiring extra labor is given by: $\Delta C = W.\Delta N$ where

W = money wage.

If $\Delta R > \Delta C$ then any profit maximizing firm will hire extra labor. However, if $\Delta R < \Delta C$ then a profit maximizing firm will not hire more labor. Therefore, the firm will hire labor until $\Delta R = \Delta C$ and

$$W = p.\frac{dy}{dN} \quad \text{…………………………………………………………………….…… (9.3)}$$

or $w = \frac{W}{p} = \frac{dy}{dN}$ ………………………………………………………………… (9.4)

We shall develop the demand for labor from equation (9.3)

Suppose the firm faces the market wage W_0. It will employ labor until; $p.\frac{dy}{dN} = W_0$. If the wage falls, then the firm will increase employment to maintain equation (9.3).

Equation (9.3) therefore can be considered as:

i.) The real wage the firm will offer $w = \frac{dy}{dN}$ or

ii.) The money wage the firm will offer $W = p.\frac{dy}{dN}$

These relationships are shown in Figure 9.5:

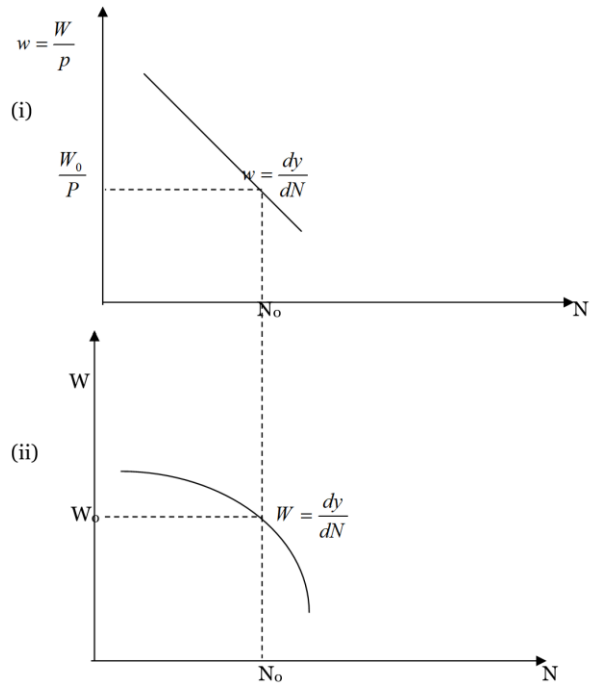


Figure 9.5: Perfect competitive firms demand for labor.

b) Monopolistic Case

A perfectly competitive firm faces a given price determined by market forces while a monopolist chooses the price-quantity combination that maximizes profit. Therefore, the demand curve for the monopolist can be written as:

$$p = p\left\{y(N, \bar{K})\right\}, \; p' < 0 \quad \text{..... (9.5)}$$

Total revenue is given by:

$$R = y(N,\bar{K}) \bullet p\left\{y(N,\bar{K})\right\} \text{..}(9.6)$$

To obtain a change in R following a change in N, we differentiate equation (9.6): thus,

$$\frac{dR}{dN} = y\frac{dp}{dy} \bullet \frac{dy}{dN} + p\frac{dy}{dN}$$

$$= p\frac{dy}{dN}\left(1 + \frac{y}{p}\frac{dp}{dy}\right)$$

But the last term in the bracket is elasticity of demand, thus:

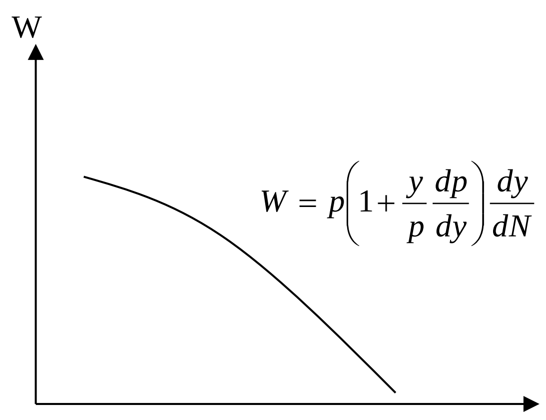
$$\frac{dR}{dN} = p\left(1 + \frac{y}{p}\frac{dp}{dy}\right)\frac{dy}{dN} \text{..} (9.7)$$

The marginal cost of hiring a new worker is still W and so the monopolist will maximize profits a when:

$$W = p\left(1 + \frac{y}{p}\frac{dp}{dy}\right)\frac{dy}{dN} \text{..} (9.8)$$

$$W = P\left(1 + \frac{1}{e}\right)\frac{\partial y}{\partial N} \text{..} (9.10)$$

Therefore, the monopolist's demand curve for labor is the competitive firm's demand for labor shifted left by the factor: 1 + 1/e and is as shown in Figure 9.6:



N

Figure 9.6: Monopolistic firm's demand for labor.

9.2.3 The Aggregate Demand for Labor

An economy has a mixture of monopolistic and competitive firms and therefore the aggregate demand for labor will be the horizontal sum of several industrial demand curves. It will be given as:

$$w = \frac{W}{p} = f(N) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9.11)$$

$$\text{Or } W = p.f(N) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9.12)$$

Graphically the demand for labor is as shown in Figure 9.7:

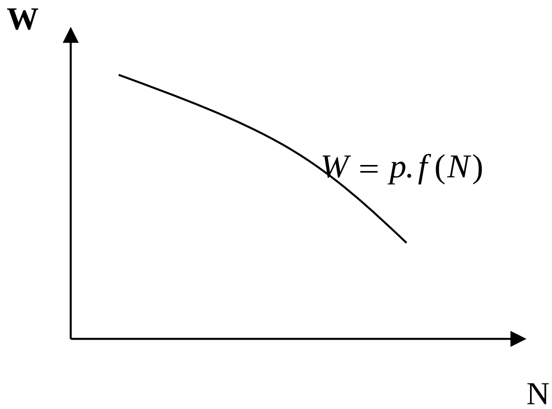


Figure 9.7: The Aggregate demand for labor.

There are two important things to note about the aggregate demand curve:

- The negative slope reflects the diminishing marginal productivity of labour as more labor is added to the fixed capital stock.
- Since profit-maximizing firms are interested in the real wage they pay then price enters the money wage version of the demand function (9.12) multiplicatively.

Let us discuss the labor demand function more on e-tivity 9.2.3.

E-tivity 9.2.3

Numbering, pacing and sequencing	**9.2.3**
Title	The Demand for Labor Function.

Purpose	To enable you explore the demand for labor function.
Brief summary of overall task	Watch this video on the labor demand function.
Spark	
Individual task	With reference to the video above: ✎ Explain why the demand for labor function is negatively sloped ✎ Discuss the factors that shifts the labor demand function All your answers should be posted on the Discussion Forum 9.
Interaction begins	Provide constructive feedback on your class mates views and ideas on Discussion Forum 9.
E-moderator interventions	1. Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity
Schedule and time	This task should take two hours
Next	Supply Side Equilibrium II (Labor Supply)

9.3 Summary

In this lecture we have learnt that:

✓ Labor demand is inversely related to the real wage rate hence the labor demand function has a negative slope

- ✓ The labor demand function for both perfect competitive market and monopoly are negatively sloped. However, the slopes have different magnitudes.

9.4 Further Activity

	**(i)** Using the simple depression model demonstrate the effects of a decrease in taxation on real output and demand **(ii)** Derive the demand for labor for a competitive firm. **(iii)**Derive the demand for labor for the Monopolist Case

9.5 Further Reading

1. Krugman, P. & Robin, W. (2021). *Macroeconomics* (6th ed.). Macmillan Higher Education. ISBN: 9781319320164, 2020942110.
   http://library.lol/main/DFA1CA10088EA05602291872423C5A50
2. Mankiw, N. Gregory (2021). *Principles of Economics* (9th ed.). Cengage Learning. ISBN: 2019941033, 9780357038314, 9780357133705.
   http://library.lol/main/E4F408FE98ABD6329394D2C9C9DE877F
3. Romer, D. (2018). *Advanced Macroeconomics* (5th ed.). The McGraw Hill. ISBN: 1260185214, 9781260185218.
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4. The CORE Team (2022). The Economy: Economics for a Changing World. Core Economics Education. ISBN: 1838165665, 9781838165666.
   http://library.lol/main/5E3DD6586AFE840C3BDEE3BE9CD8CE3F

LECTURE X: SUPPLY SIDE EQUILIBRIUM II

10.1Introduction

In the previous lectures, we developed the demand side of the economy taking the price P as exogenously determined. We derived the product market and money market equilibrium conditions and used the equations to find r and y pairs at which the two markets are clearing.

In this lecture, we will be introduced to the supply side of our skeletal macro economy by introducing demand and supply in the labor market.

10.2 Lesson Learning Outcomes

At the end of this lecture, the learner should be able to:

10.2.1 Derive the Aggregate Labor Supply Function

10.2.2 Illustrate Equilibrium In The Labor Market

10.2.1 The Aggregate Labor Supply function

We did not make any assumption about price or wage expectations of employers on the demand side of the labor market. This is because employers are assumed to have good information about prices charged and wage rates paid. Therefore, the employer knows at any time the real product wage to be $\frac{W}{p}$ where W is the money wage and p is the price charged on the products. The workers however do not have good information concerning price level as employers.

There is therefore the price they expect (p^e) and the actual price (p). To develop the supply side of the labour market, the following question must be answered:

i.) How rapidly or competently do the worker's expectation of the future prices p^e adjust to changes in the actual price level p?

ii.) Is the nominal wage rate rigid or flexible over time?

- If there is immediate and correct adjustment of p^e to changes in p then that is taken to be the **classical case** in which the supply of labor depend only on the real wage w. It is known as the classical case because it stems from the traditional theory of consumer behavior and was at the roots of the pre-Keynesian school of macro-economic thinking which Keynes dubbed as "classical" in 1936.

- If there is no adjustment of p^e to changes in p then labor supply will be a function of the money wage W corresponding to the extreme **Keynesian case.**

We will find that while the hypothesis that labor supply is a function of the real wage only maybe correct but very difficult to verify in the long-run. However, the assumption that labor supply is a function of money wage W, may be a more useful hypothesis for explaining actual short-run variations in employment. This is the extreme **Keynesian case**.

The Individual's Work-Leisure Decision

We begin by assuming that the worker seeks to allocate the hours available between work and leisure so that his objective function becomes:

Max. $U = u(y^e, S)$; $\frac{du}{dy^e}, \frac{du}{dS} > 0$ …………………………………………………… (10.1)

s.t.

$y^e = \frac{W}{p^e}.(T - S) = w^e$ ………………………………………………………….……… (10.2)

Where:

U = Utility

y^e = Real earnings from work/ expected real income.

S = Leisure

T = total number of working hours.

T – S = Number of working hours.

P^e = Expected price level.

W^e = Expected real wage.

The work-leisure decision may be presented as shown in Figure 10.1:

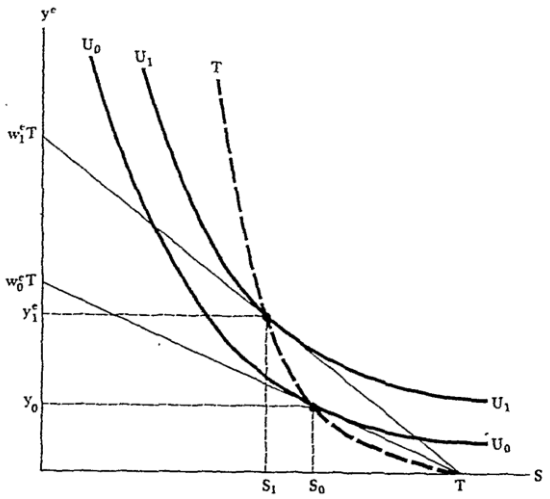


Figure 10.1: The Work-Leisure decision.

Each indifference curve shows the combination of y^e and S that yield the same level of utility. Points on U_1 represent higher level of utility than those on U_0. The entire y^e, S space are filled with such curves, non-crossing any other. The worker-consumer wants to reach the highest indifference curve possible. The limits of his or her ability to move towards the northeast depend on the number of hours available and the real wage.

Therefore, if the worker has T hours available and choose to have no income at all, then he/she will have T hours of leisure.

At the expected real wage W_0^e, if he/she chooses not to have any leisure then his/her income will be $W_0^e.T$ and leisure can be traded for income along the budget line connecting these two points. All point above the budget line are unattainable while those on or below the budget line are attainable or feasible.

The worker will hence maximize utility at the point of tangency between the budget line and indifference curve. Connecting the points of tangency between the budget line and indifference curve for various real wage rates with T fixed, we obtain the labor supply curve TT as shown in the Figure 10.1

The Aggregate Labor Supply Curve

We saw that the number of working hours is given by T – S. Let T – S = n so that we can draw the relationship between the expected real wage W_e and the amount of labor n_i offered by the individual as shown in Figure 10.2.

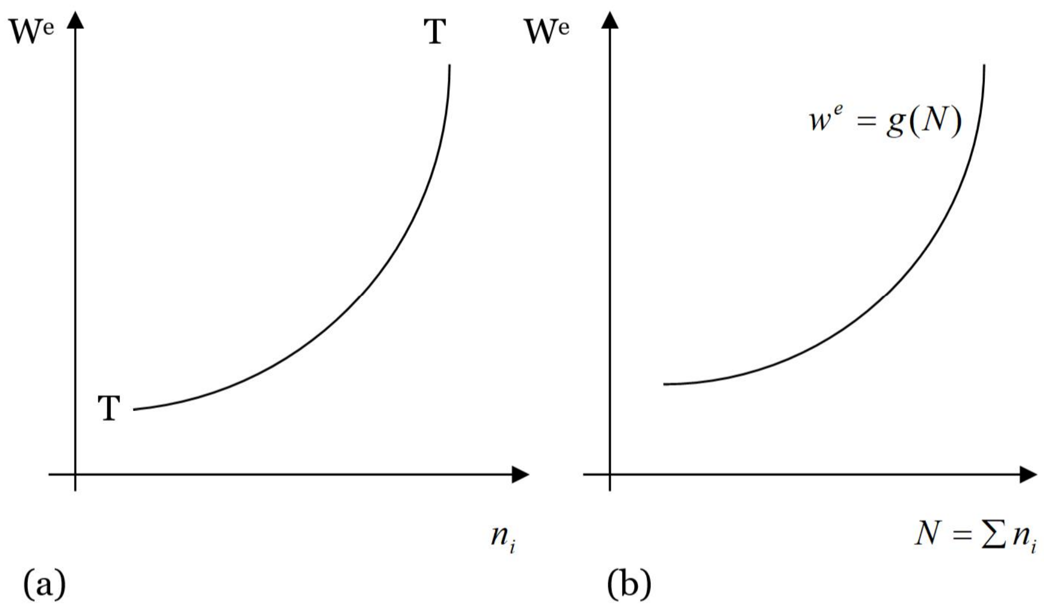


Figure 10.2: Labor supply curves.

Figure (a) shows an individual labor supply curve bending backwards showing that once wage rates reached a certain high level, further wage increase makes the worker to increase leisure than working time. If we assume a homogeneous labor force with a single wage rate, we can sum the entire individual's labor supply curve for the entire economy as shown in Figure (b).

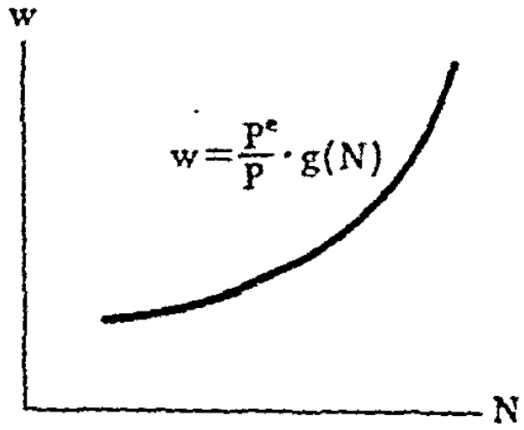
For a given value of p^e, the aggregate labour supply curve can be represented as:

$$N = N(W^e)$$

Or $$w^e = \frac{W}{p^e} = g(N); g' > 0 \quad \text{...(10.3)}$$

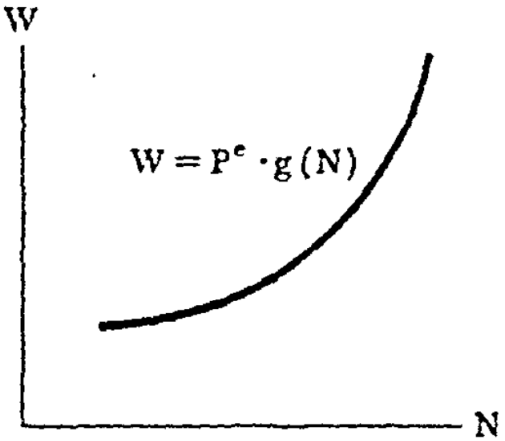
Or $$W = p^e.g(N) \quad \text{...(10.4)}$$

Equation (10.4) is used to derive a labor supply curve in the W, N space of Figure 10.3:



(a)

Figure 10.3 (a): Aggregate labor supply.



(b)

Figure 10.3 (b): Aggregate labor supply.

10.2.2 Equilibrium in the Labor Market

We have derived equations both demand and supply of labor as:

Demand: $W = p.f(N)$ …….. (10.5)

Supply: $W = p^e.g(N)$ ……..…. (10.6)

Equating demand to supply gives the labor market equilibrium condition:

$p.f(N) = p^e.g(N)$

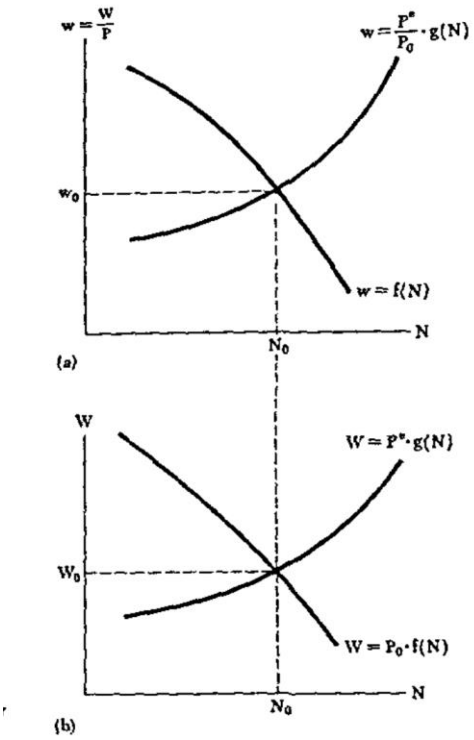


Figure 10.4: Equilibrium in the labor market.

The graphical solution of the labor market equilibrium is represented by the intersection of the two curves as shown in Figure 10.4. The actual equilibrium value of the price level is p_0 while the expected price level is p^e. Equilibrium employment is N_0 while nominal wage is W_0 and the real wage is w_0. We will explore the supply for labor function further on e-tivity 10.2.1.

E-tivity 10.2.1

Numbering, pacing and sequencing	**10.2.1**
Title	The Supply for Labor Function.
Purpose	To enable you analyze the supply for labor function.
Brief summary of overall task	Watch this video on the labor supply function.

Spark	
Individual task	With reference to the video above: ✎ Discuss and illustrate the income and substitution effect in the context of labor supply All your answers should be posted on the Discussion Forum 10.
Interaction begins	Provide constructive feedback on your class mates views and ideas on Discussion Forum 10.
E-moderator interventions	1. Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity
Schedule and time	This task should take two hours
Next	Expectations And Aggregate Supply

10.3 Summary

In this lecture, we have discussed the following:

- The labor supply function has a positive slope because at higher wages, workers are willing to supply more labor
- Equilibrium in the labor market is obtained when labor demand is equal to labor supply

10.4 Further Activity

	**(i)** Derive individual's labor supply curve using individual's work – leisure decision model. **(ii)** Explain how workers' expectation about the price are formed in relation to labor supply.

10.5 Further Reading

1. Krugman, P. & Robin, W. (2021). *Macroeconomics* (6th ed.). Macmillan Higher Education. ISBN: 9781319320164, 2020942110. http://library.lol/main/DFA1CA10088EA05602291872423C5A50
2. Mankiw, N. Gregory (2021). *Principles of Economics* (9th ed.). Cengage Learning. ISBN: 2019941033, 9780357038314, 9780357133705. http://library.lol/main/E4F408FE98ABD6329394D2C9C9DE877F
3. Romer, D. (2018). *Advanced Macroeconomics* (5th ed.). The McGraw Hill. ISBN: 1260185214, 9781260185218. http://library.lol/main/3B9AF2793837DF6767E985633BE2CC37
4. The CORE Team (2022). The Economy: Economics for a Changing World. Core Economics Education. ISBN: 1838165665, 9781838165666. http://library.lol/main/5E3DD6586AFE840C3BDEE3BE9CD8CE3F

LECTURE XI: EXPECTATIONS AND AGGREGATE SUPPLY

11.1Introduction

In our previous lesson we discussed expectations on the supply side of the labor market. The functional relationship between the expected price level P^e and the actual price level P was explained. In this lesson we will specify that relationship a little more precisely in order to derive the aggregate supply curve and see exactly how it is affected by the expectations assumption.

The relationship of $P^e$to P can be written $P^e = p(P); 0 \leq P' \leq 1$.

When:

1. $P' = 0$: The case of no adjustment of the expected price level as the actual price changes. This case is one of complete ***money illusion***. Also known as the ***extreme Keynesian case*.**

2. $P' = 1$: The case of full adjustment of expectations over the period under consideration/ ***perfect foresight/ extreme classical case.***
3. $0 < P' < 1$ *The general Keynesian model with some degree of money illusion.* This is the model in which expectations adjust to changes in the actual price level, but not fully. ***Imperfect foresight model.***

11.2 Lesson Learning Outcomes

By the end of this lesson, you will be able to:

11.2.1 Derive aggregate supply curve in the extreme Keynesian case.

11.2.2 Derive aggregate supply curve in the extreme Classical case.

11.2.3 Derive aggregate supply curve under the general Keynesian Case.

11.2.1 Aggregate supply curve in the extreme Keynesian case

$P' = 0$: This is the case of no adjustment of the expected price level as the actual price changes. This case is one of complete ***money illusion***. Also known as the ***extreme Keynesian case.***

We begin the derivation of the aggregate supply curve in the extreme Keynesian case with the labor market equilibrium condition written as:

$$P.f(N) = P^e.g(N) \quad \text{..... (11.1)}$$

Equation (11.1) is illustrated in Figure 11.1. With P^e given and not responsive to changes in actual P ($p' = 0$), this labor market equilibrium condition gives us equilibrium employment N depending on the price level P.

By varying the (so far) exogenously determined price level, we can see how equilibrium employment will vary. Then, using the production function, we can determine the variation in equilibrium output supplied as the price level changes. This gives us the aggregate supply curve.

Figure 11.1 illustrates the effect on equilibrium employment in the labor market as the price level rises from P_0 to P_1 to P_2. Since this shifts the labor demand curve, but not the supply curve with P^e fixed, employment rises from N_0 to N_1 to N_2. Figure 11.1 shows the changes in equilibrium output on the supply side as employment changes. As N rises in Figure 11.1, equilibrium output, in turn, rises from y_0 to y_1 to y_2. This gives the aggregate supply curve in Figure 11.2.

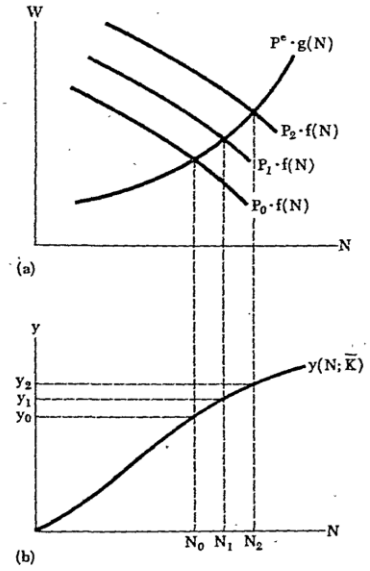


Figure 11.1: Derivation of the Aggregate Supply curve, extreme Keynesian case.

The important thing to observe from Figure 11.2 is that the positive slope of the aggregate supply curve comes from the fact that as P increases, shifting the labor demand up in Figure 11.1, labor market equilibrium employment N moves up along the given labor supply curve.

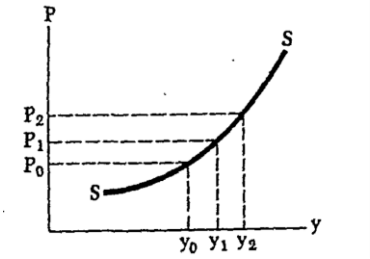


Figure 11.2: The Aggregate Supply curve, extreme Keynesian case.

The money-illusion assumption that $p' = 0$ holds the labor supply curve constant as P rises, generating the increase in employment and output in Figure 11.2.

11.2.2 Aggregate Supply Curve in the Extreme Classical Case

To derive the aggregate supply in the classical case of perfect foresight with $p' = 1$ we can focus on the labor market equilibrium condition written as:

$f(N) = \frac{P^e}{P} . g(N)$..... (11.2)

Equation (11.2) is illustrated in Figure 11.3. Equilibrium in W, N space, is shown in Figure 11.3. Again, we can derive the aggregate supply curve in this classical case by asking what happens to equilibrium employment as the price level moves exogenously.

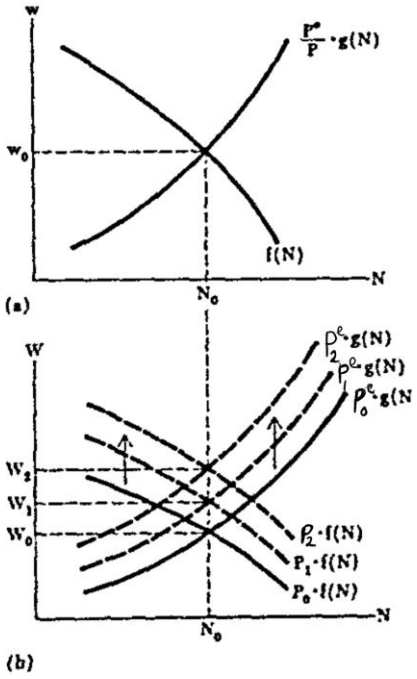


Figure 11.3: Derivation of the Aggregate Supply curve, extreme Classical case.

With P^e moving along with P, Figure 11.3 (a) shows no effect on equilibrium employment as P rises. The mechanism holding employment constant is seen clearly in Figure 11.3 (b). The exogenous increase in actual P_0 to P_1 to P_2 shifts the labor demand curve up. With $p' = 1$, P^e moves by equal amounts from P_0^e to P_1^e to P_2^e. Thus, the labor supply curve shifts up proportionately to the demand curve shifts, holding equilibrium employment at N_0. The nominal wage rate rises proportionately to the originating increase in the price level P, holding the real wage constant at w_0 in Figure 11.3 (a). The result is no movement in employment and output as the price level rises in the classical case with $p' = 1$.

The resulting aggregate supply curve in the classical case is shown in Figure 11.4. With employment fixed at N_0, output is fixed at $y_0 = y(N_0, \bar{K})$ as P rises from P_0 to P_1 to P_2.

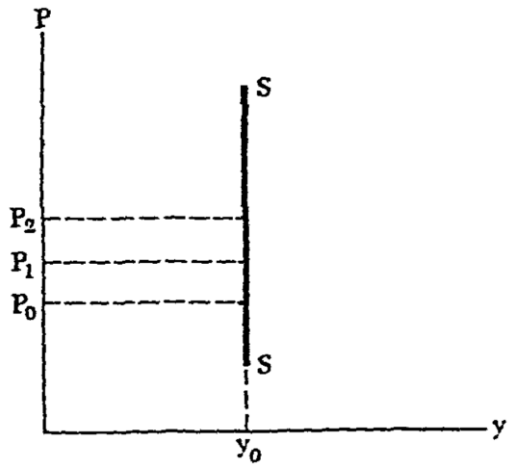


Figure 11.4: Aggregate Supply curve, extreme Classical case.

So in this classical case, the aggregate supply curve is vertical; on the supply side, equilibrium output and employment are insensitive to movement in the price level under the assumption of perfect foresight.

11.2.3: Aggregate Supply Curve Under the General Keynesian Case

In the general Keynesian model, $0 < p' < 1$. This is the model in which expectations adjust to changes in the actual price level, but not fully. It could be labeled the *imperfect foresight* model. This is illustrated in Figure 11.5.

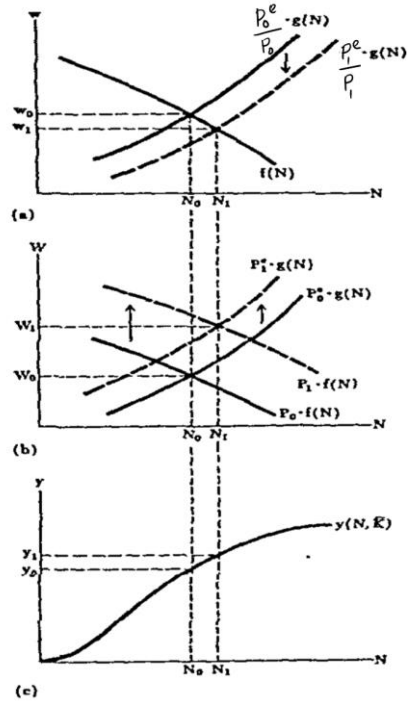


Figure 11.5: Derivation of the Aggregate Supply curve, general Keynesian case.

In Figure 11.5, adjustment of the labor market equilibrium to an exogenous increase in the price level P_0 to P_1 is shown.

P^e adjusts by an amount less than the exogenous change in P.

In Figure 11.5 (a), the increase in P reduces the ratio of expected to actual price level from P_0^e/P_0 to P_1^e/P_1 since $p' < 1$. This shifts the labor supply curve down in w, N space, reducing the real wage and increasing employment from N_0 to N_1.

The same movement is also shown in the w, N space of Figure 11.5 (b). There we see the increase in P shifting the demand curve up while the rise in P^e shifts the supply curve up, but less than the movement in the demand curve, since $p' < 1$. The excess demand for labor at W_0 pulls up the nominal wage to W_1, an increase less than proportionate to the P increase since $dP^e < dP$. Thus employment rises to N_1.

The movement in employment is translated to the change in output in Figure 11.5 (c), using the production function.

So, in the *imperfect foresight model*, with $p' < 1$, the exogenous increase in the price level from P_0 to P_1 increases equilibrium output supplied from y_0 to y_1 in Figure 11.5 (c). This relationship is traced in the aggregate supply curve in Figure 11.6. This yields a positively sloped aggregate supply curve.

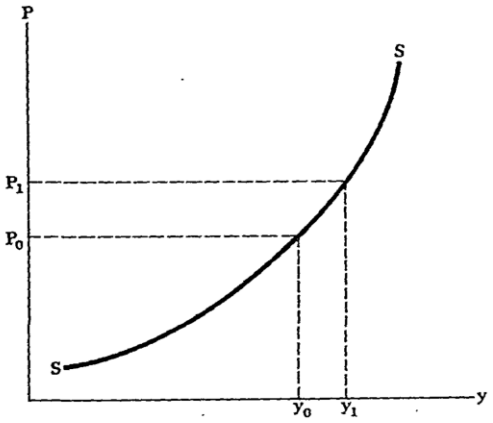
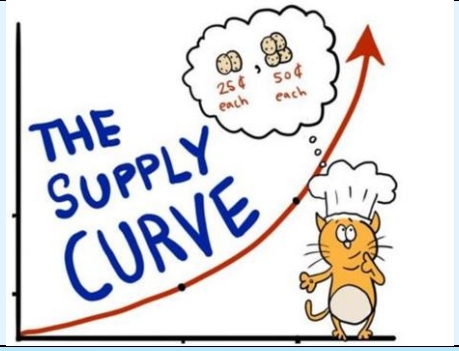


Figure 11.6: The Aggregate Supply curve, general Keynesian case.

E-tivity 11.2.1 discusses the causes of the shifts in labor supply and labor demand.

E-tivity 11.2.1

Numbering, pacing and sequencing	**11.2.1**
Title	Shift in Labor Supply and Labor Demand functions
Purpose	To enable you analyze what causes a shift in Labor Supply and Labor Demand functions.
Brief summary of overall task	Watch this video on the causes of a shift in Labor Supply and Labor Demand functions.
Spark	
Individual task	With reference to the video above: ✎ Illustrate and explain the causes of the shift in labor demand and labor supply functions. All your answers should be posted on the Discussion Forum 11.
Interaction begins	Provide constructive feedback on your class mates views and ideas on Discussion Forum 11.
E-moderator interventions	1. Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity
Schedule and time	This task should take two hours
Next	Equilibrium in the Static Model

11.3 Summary

In this lecture we have learnt the following:

➔ The aggregate supply curve in the extreme Keynesian case is positively sloped.

➔ The aggregate supply curve in the extreme Classical case is vertical.

➔ The aggregate supply curve under the general Keynesian Case is positively sloped.

11.4 Further Activity

	**(i)** Derive and show that the economy's supply curve under imperfect foresight model has a positive slope. **(ii)** Describe the differences in derivation of aggregate supply under extreme Keynesian and general Keynesian case.

11.5 Further Reading

1. Krugman, P. & Robin, W. (2021). *Macroeconomics* (6th ed.). Macmillan Higher Education. ISBN: 9781319320164, 2020942110.
   http://library.lol/main/DFA1CA10088EA05602291872423C5A50
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LECTURE TWELVE: EQUILIBRIUM IN THE STATIC MODEL

12.1 Introduction

We have developed the demand side, labor market equilibrium and derived the economy's supply curve taking price as exogenous. In this lesson, we combine demand and supply to determine equilibrium values for the price level P, and output y, and employment N, and the interest rate r.

12.2 Lesson Learning Outcomes

By the end of this lesson, you will be able to:

12.2.1 Determine Equilibrium y, N, r and P in an Economy.

12.2.2 Explain Reaction to Demand Disturbances Under the Three Assumptions.

12.2.1 Determination of Equilibrium y, N, r and P in an Economy

To get the equilibrium values of y, N, r and P we are going to combine the equilibrium conditions for demand side i.e. product and money markets with supply side conditions i.e. production function and labour markets. We look at graphical solutions of the complete system in the general Keynesian model($P' < 1$). Combining the aggregate demand and the aggregate supply curves, we obtain the equilibrium price and quantity a shown in Figure 12.1.

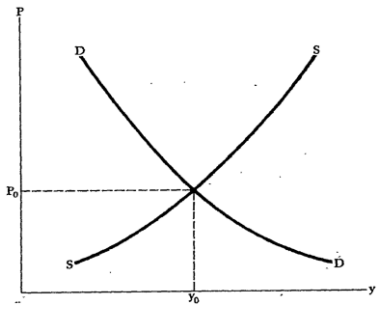

Figure 12.1: Aggregate demand and supply in the general model.

The intersection of the supply and demand curves gives us the equilibrium price (P_0) and output (y_0). We can take those equilibrium values back to the IS or LM curves on the demand side to find equilibrium r_0, and to the labor market equation or production function on the supply side to find equilibrium N_0.

On the demand side, we derived the following conditions:

Product Market: $y = c\{y - t(y)\} + i(r) + g$: **IS Curve**……..…….. (12.1)

Money Market: $\frac{\bar{M}}{P} = l(r) + k(y)$: **LM Curve**…….. (12.2)

From the two equilibrium conditions above, the aggregate demand function in Figure 12.1 was derived.

On the supply side, we added the production function and the labor market equilibrium condition as follows:

Production Function: $y = y(N, \bar{K})$…… (12.3)

Labor Market: $P.f(N) = P^e.g(N) = p(P).g(N)$…… (12.4)

In the general Keynesian Model where $0 < p' < 1$, the production function and the labor market equilibrium conditions were combined to give a positively sloped aggregate supply curve in P, y space as presented in Figure 12.1. In the extreme *classical case* where $p' = 1$, the supply curve is vertical and equilibrium employment and output are determined by supply conditions only.

We solve equations (12.1), (12.2), (12.3) and (12.4) simultaneously for the equilibrium values of $y, N, r \; and \; P$. Substituting N for y from the production function 12.3, we can see that the product market equilibrium condition includes the variables N and r and the money market includes N, P and r. On the supply side, the labor market equilibrium condition includes N and P. When we use the extreme classical assumption that $p' = 1$, we begin with a full equilibrium where P and P^e are indexed to 1, so $P^e = P = 1$, then the classical assumption that $p' = 1$, makes $P^e = P$ throughout the analysis.

If we substitute $P^e = P$ into equation (12.4), we have the classical condition;

$f(N) = g(N)$…… (12.5)

Equation (12.5) is one equation with one unknown, N. Using (12.5) we can solve the value of N_0. We then find the equilibrium output using equation (12.3) which gives us an aggregate supply curve that is vertical at $y = y_0$ as discussed in lecture 11.

Combining the aggregate demand and the vertical aggregate supply curve we obtain the equilibrium price and output (P_0, y_0) as shown in Figure 12.2. With (P_0, y_0) fixed, we can go back to the IS curve or LM curve to find the equilibrium interest rate r_0.

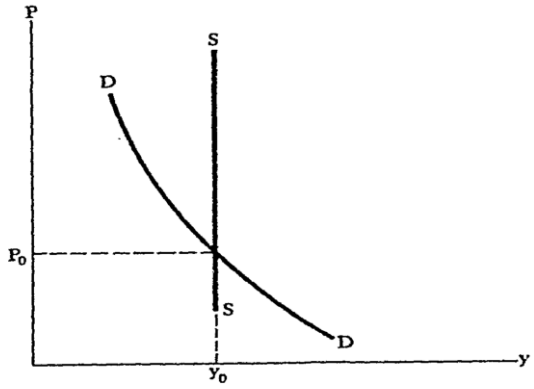

Figure 12.2: Aggregate demand and supply: The classical case.

12.2.2 Reaction to demand disturbance under the three assumptions

a) General Keynesian Model

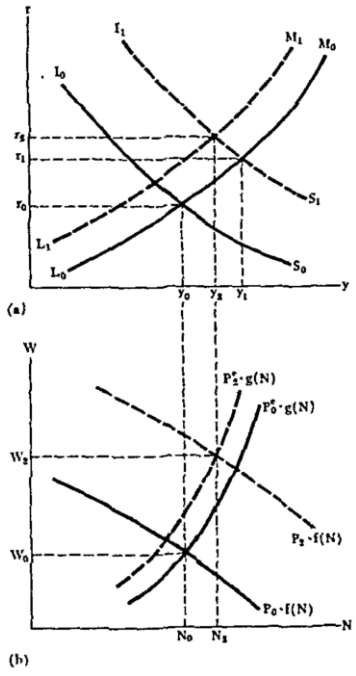

Figure 12.3: Adjustment in the general Keynesian model

In the general Keynesian model $p' < 1$, Figure 12.3 (a) shows the product and money market equilibrium while Figure 12.3 (b) shows the labor market equilibrium.The initial equilibrium level of output y_0 corresponds to equilibrium employment N_0.

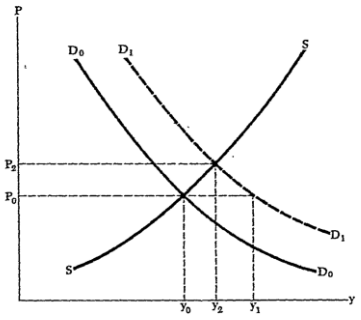

Figure 12.4: Adjustment in the general Keynesian model

Adjustment in the general Keynesian Model (explanation)

To see how equilibrium is reached, we will now assume that there is a sudden exogenous increase in the level of investment demand in the economy, due, perhaps, to an increase in expected returns from investment. This will lead to an outward shift of the IS curve from I_0S_0 to I_1S_1 changing equilibrium output on the demand side of the economy to y_1 as shown in figure 12.3 (a). Equilibrium output supplied remains at y_0 and this corresponds to the employment level N_0 on the supply side at the initial price level P_0.

In Figure 12.4, the increase in investment demand shifts the demand curve up to D_1D_1.

At the initial price level P_0, this shows a new equilibrium output demanded of y_1, the same as the new demand-side equilibrium y_1 in Figure 12.3 (a). Thus the shift in investment demand $i(r)$ creates an excess demand for goods and services which would be magnified by the multiplier process to give excess demand at the initial price level of $y_1 - y_0$. The excess demand leads to a rise in prices. This reduces the real money supply $m = \frac{\bar{M}}{P}$ shifting the LM curve to the left towards L_1M_1 in Figure 12.3

(a). This reduction in equilibrium output demanded in the economy as the price level rises is represented in Figure 12.4 by the movement up along the new demand curve D_1D_1 from y_1 towards y_2.

In the labor market, the rise in prices stimulates employers to expand production by hiring more labor which is represented in Figure 12.3 (b) by shifting the labor demand curve to the right. At the same time, the expected price level P^e rises, shifting the labor supply curve to the left. However, since in the short-run p' nears zero, the shift in labor supply will be small compared to the shift in labor demand. Thus in the short-run, employment would rise towards N_2 in Figure 12.3 (b).

In Figure 12.4, this increase in y is represented by moving up the original supply curve from y_0 towards y_2. Once the equilibrium has been achieved, the price rises stop and on the labor market, the wage increases will also stop. The excess demand for money at y_1 has also been eliminated by the increase in interest rates to r_2 after which the interest rates stop to rise.

In summary:

- The increase in demand has tightened money market and credit market conditions both by raising y at the initial price level, pulling r up to r_1 in Figure 12.3 (a) and by raising prices, accounting for a further increase in r to r_2.
- On the supply side, the price increase tends to increase equilibrium output. With $p' < 1$, the price increase increases employment by increasing labor demand; the money wage rises less than the price level so the real wage rate falls.

b) The Classical Model

In the classical case, with $p' = 1$, the exogenous increase in the level of investment demand in the economy, will lead to an outward shift of the IS curve from I_0S_0 to I_1S_1. At the initial price $P_{0,}$

equilibrium output demanded rises to y_1. This is shown as a shift in the aggregate demand curve in Figure 12.6, where the increase from y_0 to y_1 on the demand side is the same as in Figure 12.5 (a).

The shift of the demand curve produces an excess demand gap of $y_1 - y_0$: so the price level begins to rise. This shifts the *LM* curve in Figure 12.5 (a) to the left raising the interest rate further and reducing investment demand. In Figure 12.5 (c), the price increase shifts labor demand up as firms bid for more employees to increase output. However, with $p' = 1$, the labor supply curve shifts as much as demand so that while an excess demand gap appears on the labor market, pulling up the money wage, there is no movement in employment or output which remain fixed at (N_0, y_0).

This is seen explicitly in Figure 12.5 (b) where the ratio $\frac{P^e}{P}$ remains unchanged, leaving $N = N_0$. The price level rises until demand is reduced to the original level y_0, as seen in Figure 12.6. At that point demand is again equal to the fixed supply, so excess demand is eliminated.

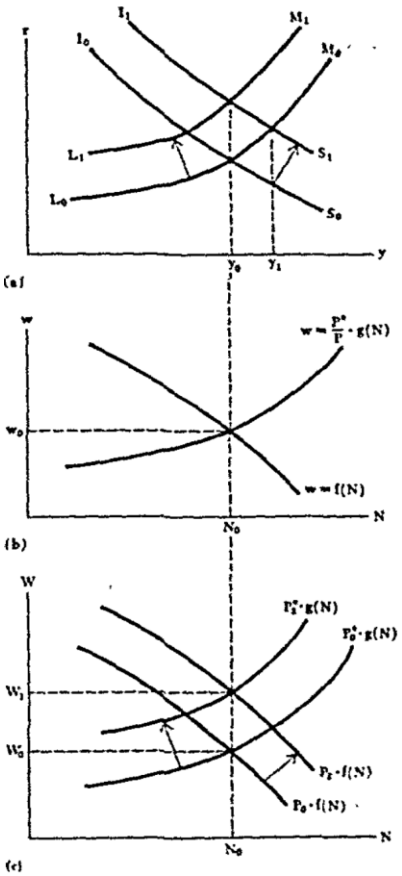

Figure 12.5: Adjustment in the Classical case

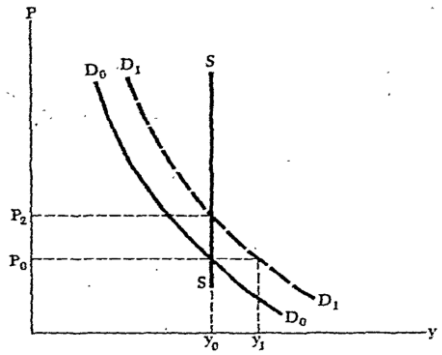

Figure 12.6: Aggregate demand and supply adjustment in the classical model

The LM curve shifts up until equilibrium output demanded is back to y_0. In Figure 12.5 (c) the money wage W rises as much as the price level so that in Figure 12.5 (b), the real wage is unchanged. If y remains unchanged at y_0 and there in no change in government expenditure, investment must return to its original value before the exogenous shift. The price increase to P_2 raises the interest rates just enough to reduce total investment back to the original value.

NB: While the classical model argues that the level of employment is not sensitive to changes in demand conditions in the economy, these fluctuations in the level of employment in reality have been related to demand conditions.

c) Keynesian Case: $p' = 0$

Using the information gained from lecture 11 and 12, Illustrate the effects of an increase in government spending in the economy in a static short run model with $P' = 0$
E-tivity 12.1.1 presents more discussion on equilibrium in the static model.

E-tivity 12.1.1

Numbering, pacing and sequencing	**12.1.1**
Title	Equilibrium in the Static Model.
Purpose	To enable you explore equilibrium in the Static Model.
Brief summary of overall task	Read this book on pages 123-145 on equilibrium in the Static Model.

Spark	
Individual task	With reference to the book above: ✎ Explain how an increase in government expenditure affect the equilibrium variables. All your answers should be posted on the Discussion Forum 12.
Interaction begins	Provide constructive feedback on your class mates views and ideas on Discussion Forum 12.
E-moderator interventions	1. Ensure that learners are focused on the contents and context of discussion. 2. Stimulate further learning and generation of new ideas. 3. Provide feedback on the learning progress. 4. Close the e-tivity
Schedule and time	This task should take two hours
Next	THE END

12.3 Summary

In this lecture we have been able to understand how the equilibrium in the static model is obtained. We have also discussed how equilibrium is restored following a disturbance in the model.

12.4 Further Activity

	a) Assuming that there is a sudden exogenous increase in the level of investment demand in the economy, explain how equilibrium is reached in the static short run model with $p^1 < 1$ and $p' = 1$. **b)** Assuming that there is an increase in government expenditure in the economy, explain how equilibrium is reached in the static short run

	model with $p^1 < 1$ and $p' = 1$.

12.5 Further Reading

1. Krugman, P. & Robin, W. (2021). *Macroeconomics* (6th ed.). Macmillan Higher Education. ISBN: 9781319320164, 2020942110.
   http://library.lol/main/DFA1CA10088EA05602291872423C5A50
2. Mankiw, N. Gregory (2021). *Principles of Economics* (9th ed.). Cengage Learning. ISBN: 2019941033, 9780357038314, 9780357133705.
   http://library.lol/main/E4F408FE98ABD6329394D2C9C9DE877F
3. Romer, D. (2018). *Advanced Macroeconomics* (5th ed.). The McGraw Hill. ISBN: 1260185214, 9781260185218.
   http://library.lol/main/3B9AF2793837DF6767E985633BE2CC37
4. The CORE Team (2022). The Economy: Economics for a Changing World. Core Economics Education. ISBN: 1838165665, 9781838165666.
   http://library.lol/main/5E3DD6586AFE840C3BDEE3BE9CD8CE3F

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