

# HE1002 Macroeconomics I – Revision Notes

Quantitative Research Society @NTU

Academic Year 2025-2026

## Abstract

Comprehensive revision notes for HE1002 Macroeconomics I integrating all theoretical concepts, mathematical derivations, worked examples from 190 tutorial questions across 11 problem sheets, and policy applications.

## Course Overview & Topic Map

Topic Area	Tutorial	Key Concepts	Questions
GDP & National Accounts	T01	Expenditure/Income/Value-Added, Nominal vs Real, GDP Deflator	17
Inflation & CPI	T02	CPI Calculation, Real Values, Core vs Headline Inflation	13
Unemployment & Labor	T03	Labor Force Stats, Frictional/Structural/Cyclical, Natural Rate	10
Economic Growth	T04	Growth Accounting, Rule of 70, Convergence, TFP	12
Aggregate Expenditure	T05	Consumption Function, MPC, Multiplier, Output Gaps	16
AD-AS Framework	T06	SRAS vs LRAS, Demand/Supply Shocks, Short/Long Run Adjustment	20
Fiscal Policy	T07	Spending/Tax Multipliers, Deficits, Debt, Automatic Stabilizers	18
Financial Markets	T08	Loanable Funds, Interest Rates, Crowding Out, Adverse Selection	21
Money & Monetary Policy	T09	M1/M2, Money Multiplier, Fed Tools, Transmission Mechanism	20
Inflation Theory	T10	Quantity Theory, Phillips Curve, NAIRU, Expectations	22
Open Economy	T12	NX, NCO, Exchange Rates, PPP, Fixed vs Floating, Policy Effectiveness	21
<b>TOTAL</b>		<b>Complete Intermediate Macroeconomics Coverage</b>	<b>190</b>

# Contents

<b>How to Use These Notes</b>	<b>6</b>
<b>I Foundations: Measurement and Growth</b>	<b>7</b>
<b>1 GDP and National Income Accounting</b>	<b>7</b>
1.1 Introduction and Conceptual Foundation . . . . .	7
1.2 Three Approaches to Measuring GDP . . . . .	7
1.2.1 1. Expenditure Approach . . . . .	7
1.2.2 2. Income Approach . . . . .	9
1.2.3 3. Value-Added Approach . . . . .	9
1.3 Nominal vs. Real GDP . . . . .	10
1.4 GDP Per Capita and Growth Rates . . . . .	11
1.5 Limitations and Extensions of GDP . . . . .	12
1.6 Summary of Key Formulas . . . . .	12
1.7 Exam Focus . . . . .	12
<b>2 Inflation and the Consumer Price Index</b>	<b>14</b>
2.1 Introduction to Inflation . . . . .	14
2.2 The Consumer Price Index (CPI) . . . . .	14
2.2.1 CPI Calculation . . . . .	14
2.3 Core vs. Headline Inflation . . . . .	15
2.4 Real vs. Nominal Values . . . . .	15
<b>3 Unemployment and Labor Markets</b>	<b>15</b>
3.1 Introduction to Unemployment . . . . .	16
3.2 Labor Force Classifications . . . . .	16
3.3 Types of Unemployment . . . . .	18
3.3.1 1. Frictional Unemployment . . . . .	18
3.3.2 2. Structural Unemployment . . . . .	18
3.3.3 3. Cyclical Unemployment . . . . .	18
3.4 Natural Rate of Unemployment . . . . .	19
3.5 Labor Market Models . . . . .	19
3.5.1 Supply and Demand Framework . . . . .	19
3.5.2 Minimum Wage Effects . . . . .	20
3.6 Factors Affecting Unemployment . . . . .	21
3.6.1 Labor Market Rigidities . . . . .	21
3.7 Summary: Key Formulas and Concepts . . . . .	22
<b>4 Economic Growth and Productivity</b>	<b>23</b>
4.1 Introduction: Why Growth Matters . . . . .	23
4.2 Measuring Economic Growth . . . . .	23
4.3 Rule of 70 . . . . .	24
4.4 Sources of Economic Growth . . . . .	24
4.4.1 Production Function Framework . . . . .	24
4.4.2 Four Components of Productivity . . . . .	25
4.5 Growth Accounting Equation . . . . .	25

4.6	Convergence Theory . . . . .	26
4.7	Policies to Promote Growth . . . . .	28
4.8	Summary: Key Growth Formulas . . . . .	28
<b>II</b>	<b>Macroeconomic Models: Short-Run and Long-Run</b>	<b>30</b>
<b>5</b>	<b>The Aggregate Expenditure Model</b>	<b>30</b>
5.1	Introduction: Keynes and the Consumption-Based Framework . . . . .	30
5.2	Components of Aggregate Expenditure . . . . .	30
5.2.1	The Consumption Function . . . . .	30
5.3	The Expenditure Multiplier . . . . .	31
5.4	Output Gaps and Policy . . . . .	31
5.5	Common Mistakes . . . . .	32
5.6	Exam Focus . . . . .	32
<b>6</b>	<b>The Aggregate Demand and Aggregate Supply Model</b>	<b>33</b>
6.1	Introduction: Integrating the Price Level . . . . .	33
6.2	Aggregate Demand Curve . . . . .	33
6.3	Aggregate Supply: Short-Run vs. Long-Run . . . . .	33
6.3.1	Short-Run Aggregate Supply (SRAS) . . . . .	33
6.3.2	Long-Run Aggregate Supply (LRAS) . . . . .	33
6.4	Short-Run and Long-Run Equilibrium . . . . .	34
6.5	Shocks and Adjustment . . . . .	34
6.5.1	Demand Shocks . . . . .	34
6.5.2	Supply Shocks . . . . .	34
6.6	Exam Focus . . . . .	34
<b>III</b>	<b>Policy and Financial Markets</b>	<b>35</b>
<b>7</b>	<b>Fiscal Policy</b>	<b>35</b>
7.1	Introduction: Government as Economic Actor . . . . .	35
7.2	Government Spending Multiplier . . . . .	35
7.2.1	Fiscal Policy Lags . . . . .	35
7.3	Tax Multiplier . . . . .	35
7.4	Automatic Stabilizers . . . . .	36
7.5	Government Budget Deficits and Debt . . . . .	36
7.6	Fiscal Policy Concerns . . . . .	37
<b>8</b>	<b>Financial Markets and Loanable Funds</b>	<b>38</b>
8.1	Introduction: Financial Markets' Role . . . . .	38
8.2	The Loanable Funds Market . . . . .	38
8.3	Crowding Out . . . . .	38
8.4	Financial Instruments and Risk . . . . .	39
8.5	Banking Functions and Information Problems . . . . .	39
<b>IV</b>	<b>Monetary Economics: Money, Inflation, and Policy</b>	<b>40</b>

<b>9 Money and Monetary Policy</b>	<b>40</b>
9.1 Introduction: What is Money? . . . . .	40
9.2 Functions of Money . . . . .	40
9.3 Money Supply: M1 and M2 . . . . .	40
9.4 The Money Multiplier . . . . .	41
9.5 Federal Reserve Tools . . . . .	42
9.6 Transmission Mechanism . . . . .	42
9.7 Effective Lower Bound . . . . .	42
<b>10 Inflation Theory and the Phillips Curve</b>	<b>43</b>
10.1 Introduction: Quantity Theory of Money . . . . .	43
10.2 The Quantity Equation . . . . .	43
10.3 Money Neutrality . . . . .	44
10.4 The Phillips Curve . . . . .	44
10.4.1 Short-Run Phillips Curve . . . . .	44
10.4.2 Short-Run Phillips Curve . . . . .	44
10.4.3 Long-Run Phillips Curve . . . . .	45
10.5 Stagflation . . . . .	45
10.6 Expectations . . . . .	45
<b>V Open Economy Macroeconomics</b>	<b>46</b>
<b>11 Open Economy Macroeconomics</b>	<b>46</b>
11.1 Introduction: Opening the Economy . . . . .	46
11.2 Balance of Trade . . . . .	46
11.3 Net Capital Outflow . . . . .	46
11.4 Balance-of-Payments Identity . . . . .	46
11.5 Exchange Rates . . . . .	47
11.6 Real Exchange Rate and PPP . . . . .	47
11.7 Fixed vs. Floating Exchange Rates . . . . .	48
11.8 Policy Effectiveness . . . . .	48
11.9 Arbitrage . . . . .	48
11.10 Summary: Open Economy . . . . .	49
<b>A Complete Formula &amp; Facts Reference</b>	<b>50</b>
A.1 Chapter 1: GDP . . . . .	50
A.2 Chapter 2: Inflation . . . . .	50
A.3 Chapter 3: Unemployment . . . . .	50
A.4 Chapter 4: Growth . . . . .	50
A.5 Chapter 5: AE Model . . . . .	50
A.6 Chapter 6: AD-AS . . . . .	50
A.7 Chapter 7: Fiscal Policy . . . . .	50
A.8 Chapter 8: Financial Markets . . . . .	50
A.9 Chapter 9: Money . . . . .	50
A.10 Chapter 10: Inflation . . . . .	50
A.11 Chapter 11: Open Economy . . . . .	50

<b>B Examination Preparation Guide</b>	<b>51</b>
B.1 Overview of Practice Resources . . . . .	51
B.2 Examination Structure . . . . .	51
B.3 Resource Categorization . . . . .	51
B.3.1 Tutorial-Based Examinations (Direct Questions) . . . . .	51
B.3.2 Adapted Examinations (Modified Questions) . . . . .	52
B.4 Tutorial Coverage Analysis . . . . .	52
B.5 Difficulty Progression . . . . .	53
B.6 Diagram Mastery Guide . . . . .	53
<b>C Chapter Connections and Dependencies</b>	<b>54</b>
C.1 Conceptual Flow . . . . .	54
<b>D Quick Reference: All Key Formulas</b>	<b>55</b>

# How to Use These Notes

## Document Structure and Learning System

These comprehensive notes integrate five distinct learning components into each chapter:

1. **Theoretical Foundations:** Core concepts explained from first principles with formal definitions and theorems
2. **Mathematical Framework:** All key formulas, identities, derivations, and algebraic manipulations
3. **Worked Examples:** 35+ tutorial questions with complete step-by-step solutions
4. **Policy Applications:** Real-world contexts, debates, historical examples, and current economic issues
5. **Exam Preparation:** Common mistakes, strategic tips, time management, and frequently tested patterns

## Visual Learning System

Five color-coded environments guide your study:

Color	Environment	Purpose
Blue	Key Formula	Essential equations to memorize
Green	Worked Example	Tutorial solutions with step-by-step work
Red	Common Mistake	Frequent errors and misconceptions to avoid
Yellow	Policy Application	Real-world economic contexts and debates
Purple	Exam Focus	Strategic guidance and high-yield topics

## Tutorial Question Citation System

Examples reference source questions using format: *[Adapted from T03-Q05]*

- **T##:** Tutorial/Problem Sheet number (T01–T12)
- **Q##:** Question number within that tutorial
- **Database ID:** HE1002-T03-Q05 (full unique identifier)

Each example includes difficulty rating (1–10 scale):

- **Easy (1–3):** Direct application, fundamental concepts
- **Medium (4–6):** Multi-step problems, conceptual integration
- **Hard (7–10):** Complex analysis, policy evaluation, advanced applications

## Complete Curriculum Coverage

Ch	Topic	Tutorial	Questions	Avg Diff
1	GDP and National Income Accounting	T01	17	5.35
2	Inflation and Consumer Price Index	T02	13	4.92
3	Unemployment and Labor Markets	T03	10	5.50
4	Economic Growth and Productivity	T04	12	5.15
5	Aggregate Expenditure Model	T05	16	5.19
6	Aggregate Demand-Supply	T06	20	5.40
7	Fiscal Policy	T07	18	5.28
8	Financial Markets	T08	21	5.24
9	Money and Monetary Policy	T09	20	4.75
10	Inflation Theory & Phillips Curve	T10	22	5.45
11	Open Economy Macroeconomics	T12	21	5.81
<b>TOTAL</b>		<b>PS1–12</b>	<b>190</b>	<b>5.28</b>

## Part I

# Foundations: Measurement and Growth

## 1 GDP and National Income Accounting

*Tutorial Coverage: T01 (17 questions) — Difficulty: 3–8/10 — Avg: 5.35/10*

### 1.1 Introduction and Conceptual Foundation

**Gross Domestic Product (GDP)** is the foundational measure of aggregate economic activity. It quantifies the total market value of all final goods and services produced within a country's borders during a specific period (typically quarterly or annually).

**Definition 1.1** (Gross Domestic Product). *GDP is the market value of all final goods and services produced within a country during a specific time period.*

**Key Components of the Definition:**

- **Market value:** Measured in monetary units (prices × quantities)
- **Final goods:** Excludes intermediate goods to avoid double-counting
- **Goods and services:** Both tangible and intangible production
- **Produced:** New production only, not resale of existing goods
- **Within a country:** Geographic boundary (domestic), not citizenship
- **During a specific period:** Flow variable (per year), not stock variable

### 1.2 Three Approaches to Measuring GDP

GDP can be measured using three theoretically equivalent approaches. In practice, statistical agencies use all three to cross-validate and reconcile their estimates.

#### 1.2.1 1. Expenditure Approach

The expenditure approach sums all spending on domestically-produced final goods and services.

##### Key Formula

**GDP Identity (Expenditure Approach):**

$$Y = C + I + G + NX \quad (1)$$

where:

- $Y$  = GDP (output/income)
- $C$  = Personal consumption expenditures
- $I$  = Gross private domestic investment
- $G$  = Government consumption and gross investment
- $NX$  = Net exports ( $X - M$ )

##### Component Definitions:

1. **Consumption ( $C$ ):** Household expenditure on:

- Durable goods (cars, appliances)

- Nondurable goods (food, clothing)
- Services (healthcare, education, entertainment)

**2. Investment ( $I$ ):** Business sector expenditure on:

- Business fixed investment (equipment, structures)
- Residential investment (new housing construction)
- Change in business inventories (unplanned + planned)

*Note:* Financial “investment” (buying stocks/bonds) is NOT included.

**3. Government Purchases ( $G$ ):** Government expenditure on:

- Consumption (salaries, supplies)
- Investment (infrastructure, equipment)

*Excluded:* Transfer payments (Social Security, unemployment benefits) – these are redistributions, not purchases of goods/services.

**4. Net Exports ( $NX$ ):**

$$NX = X - M = \text{Exports} - \text{Imports} \quad (2)$$

- Exports ( $X$ ): Foreign purchases of domestic production
- Imports ( $M$ ): Domestic purchases of foreign production (subtracted)

### Worked Example

#### Worked Example 1: Basic GDP Calculation [Adapted from T01-Q04 — Difficulty: 5/10]

An economy has the following data (in billions of dollars):

- Consumption: \$8,000
- Investment: \$2,000
- Government purchases: \$1,500
- Exports: \$1,000
- Imports: \$1,200
- Transfer payments: \$500
- Interest on government bonds: \$300

**Question:** Calculate GDP.

**Solution:**

Step 1: Calculate  $NX = X - M = 1,000 - 1,200 = -200$

Step 2: Apply GDP identity

$$\begin{aligned} Y &= C + I + G + NX \\ &= 8,000 + 2,000 + 1,500 + (-200) \\ &= \$11,300 \text{ billion} \end{aligned}$$

### Important Notes:

- Transfer payments (\$500B) are NOT included in GDP
- Government bond interest (\$300B) is also NOT included (transfer)
- Net exports are negative (trade deficit)

### Common Mistake

#### Mistake #1: Including transfer payments in $G$

Transfer payments (Social Security, unemployment insurance, welfare) redistribute income but do not represent government purchases of goods/services. They should be *excluded* from GDP.

**Mistake #2:** Confusing investment ( $I$ ) with financial investment

In macroeconomics, “investment” means business capital formation, NOT purchasing stocks/bonds. When you buy a stock, you’re transferring ownership of an existing asset – no new production occurs.

### 1.2.2 2. Income Approach

The income approach sums all factor payments earned from producing GDP.

#### Key Formula

**GDP (Income Approach):**

$$\text{GDP} = \text{Wages} + \text{Interest} + \text{Rent} + \text{Profits} + \text{Depreciation} + \text{Indirect Taxes} \quad (3)$$

Components:

- **Compensation of employees:** Wages, salaries, benefits
- **Corporate profits:** After-tax profits
- **Rental income:** Property rental payments
- **Net interest:** Interest payments less receipts
- **Proprietors' income:** Small business owner income
- **Depreciation:** Capital consumption allowance
- **Indirect business taxes:** Sales taxes, excise taxes

*Conceptual Note:* Every dollar spent (expenditure approach) becomes someone’s income (income approach). Hence the two approaches yield identical GDP.

### 1.2.3 3. Value-Added Approach

The value-added approach sums the incremental value created at each production stage, avoiding double-counting of intermediate goods.

**Definition 1.2** (Value Added). *Value added at each production stage equals the difference between a firm’s revenues and its cost of purchased inputs:*

$$\text{Value Added}_i = \text{Revenue}_i - \text{Cost of Inputs}_i \quad (4)$$

#### Key Formula

**GDP (Value-Added Approach):**

$$\text{GDP} = \sum_{i=1}^n \text{Value Added}_i \quad (5)$$

where  $n$  is the number of production stages.

**Equivalence:**

$$\text{Sum of value added} = \text{Value of final good} = \text{GDP}$$

#### Worked Example

**Worked Example 2: Value-Added Calculation** [Adapted from T01-Q01 — Difficulty: 3/10]

A gold nugget moves through the following supply chain:

1. Gold miner finds nugget → sells to mining company for \$500
2. Mining company processes gold → sells to jewelry maker for \$1,000

3. Jewelry maker creates necklace → sells to department store for \$1,500
4. Department store → sells necklace to customer for \$2,000

**Question:** How much has GDP increased?

**Solution Method 1 (Final Goods Approach):**

$$\begin{aligned}\text{GDP increase} &= \text{Value of final sale to end consumer} \\ &= \$2,000\end{aligned}$$

**Solution Method 2 (Value-Added Approach):**

$$\begin{aligned}\text{Miner's VA: } 500 - 0 &= \$500 \\ \text{Mining Co.'s VA: } 1,000 - 500 &= \$500 \\ \text{Jeweler's VA: } 1,500 - 1,000 &= \$500 \\ \text{Retailer's VA: } 2,000 - 1,500 &= \$500 \\ \text{Total GDP increase: } 500 + 500 + 500 + 500 &= \$2,000\end{aligned}$$

**Verification:** Both methods yield \$2,000, confirming equivalence.

### Common Mistake

**Mistake #3:** Adding all transaction values

**Incorrect calculation:**

$$500 + 1,000 + 1,500 + 2,000 = \$5,000$$

**Why this is wrong:** This counts intermediate goods multiple times (double-counting error). The gold nugget's value is counted at each stage, artificially inflating GDP.

**Correct approaches:**

- Count only final sale: \$2,000
- Or sum value added:  $500 + 500 + 500 + 500 = \$2,000$

## 1.3 Nominal vs. Real GDP

A critical distinction in macroeconomics is between **nominal** (current-dollar) and **real** (constant-dollar) GDP.

**Definition 1.3** (Nominal GDP). *Nominal GDP measures the value of production using current year prices. It reflects both quantity changes and price level changes:*

$$\text{Nominal GDP}_t = \sum_i P_{i,t} \times Q_{i,t}$$

where  $P_{i,t}$  and  $Q_{i,t}$  are price and quantity of good  $i$  in year  $t$ .

**Definition 1.4** (Real GDP). *Real GDP measures the value of production using base year (constant) prices. It reflects only quantity changes:*

$$\text{Real GDP}_t = \sum_i P_{i,\text{base}} \times Q_{i,t}$$

**Key Formula****Converting Nominal to Real GDP:**

$$\text{Real GDP}_t = \frac{\text{Nominal GDP}_t}{\text{GDP Deflator}_t} \times 100 \quad (6)$$

**GDP Deflator:**

$$\text{GDP Deflator}_t = \frac{\text{Nominal GDP}_t}{\text{Real GDP}_t} \times 100 \quad (7)$$

The GDP deflator is a **price index** measuring the overall price level.

**Interpretation:**

- GDP deflator > 100: Prices higher than base year
- GDP deflator < 100: Prices lower than base year
- GDP deflator = 100: Current year IS base year

## 1.4 GDP Per Capita and Growth Rates

To compare living standards across time or countries, we use **real GDP per capita**.

**Key Formula****Real GDP Per Capita:**

$$\text{Real GDP per capita}_t = \frac{\text{Real GDP}_t}{\text{Population}_t} \quad (8)$$

**Growth Rate Decomposition:**

$$g_{\text{Real GDP/cap}} \approx g_{\text{Nom GDP}} - g_{\text{Price}} - g_{\text{Pop}} \quad (9)$$

where  $g$  denotes growth rate (percentage change).

**Worked Example****Worked Example 3: GDP Per Capita Growth** [Adapted from T01-Q14 — Difficulty: 7/10]

Country A has:

- Nominal GDP growth: 8%
- Inflation rate (GDP deflator growth): 3%
- Population growth: 1.5%

**Question:** Calculate the real GDP per capita growth rate.

**Solution:**

$$\begin{aligned} g_{\text{Real GDP}} &\approx g_{\text{Nom GDP}} - g_{\text{Price}} \\ &= 8\% - 3\% = 5\% \end{aligned}$$

$$\begin{aligned} g_{\text{Real GDP/cap}} &\approx g_{\text{Real GDP}} - g_{\text{Pop}} \\ &= 5\% - 1.5\% \\ &= 3.5\% \end{aligned}$$

**Interpretation:** The average person's real income (living standard) increased by 3.5% this year.

## 1.5 Limitations and Extensions of GDP

While GDP is the most widely used measure of economic activity, it has significant limitations:

1. **Non-market production:** Household work, child care, volunteer services not counted
2. **Underground economy:** Illegal activities, unreported income excluded (but still production)
3. **Quality improvements:** Difficult to measure accurately (e.g., computers, smartphones)
4. **Negative externalities:** Environmental damage, pollution costs not subtracted
5. **Leisure time:** Increased leisure has value, but GDP only counts work hours
6. **Income distribution:** GDP is aggregate – doesn't show inequality or who benefits
7. **Depreciation:** Gross GDP doesn't subtract capital wear-out

### Policy Application

#### Alternative Measures of Economic Welfare:

- **GDP Plus:** Adds home production, subtracts environmental costs
- **GNP (Gross National Product):** Production by country's citizens (not geography)
- **NDP (Net Domestic Product):** GDP minus depreciation
- **HDI (Human Development Index):** Combines GDP/cap, education, life expectancy
- **Gini Coefficient:** Measures income inequality directly

Policymakers increasingly look beyond GDP to assess economic welfare holistically.

## 1.6 Summary of Key Formulas

### Key Formula

#### GDP Measurement – Essential Identities:

$$Y = C + I + G + NX \quad (\text{Expenditure})$$

$$Y = \text{Wages} + \text{Interest} + \text{Rent} + \text{Profits} \quad (\text{Income})$$

$$Y = \sum \text{Value Added} \quad (\text{Production})$$

$$\text{Real GDP} = \frac{\text{Nominal GDP}}{\text{GDP Deflator}} \times 100 \quad (10)$$

$$\text{Real GDP/capita} = \frac{\text{Real GDP}}{\text{Population}} \quad (11)$$

$$g_{\text{Real GDP/cap}} \approx g_{\text{Nom}} - g_{\text{Inflation}} - g_{\text{Pop}} \quad (12)$$

## 1.7 Exam Focus

### Exam Focus

#### High-Yield Topics (from 17 tutorial questions, avg difficulty 5.35/10):

##### 1. GDP Component Calculations (Medium, 4–6/10):

- Given  $C, I, G, X, M \rightarrow$  calculate GDP
- Identify what counts in each component
- Handle transfer payments correctly

**2. Value-Added Method** (Easy–Medium, 3–5/10):

- Multi-stage production chains
- Calculate value added at each stage
- Verify equivalence with final goods method

**3. Nominal vs. Real Conversion** (Medium–Hard, 6–7/10):

- Given nominal GDP and deflator → find real GDP
- Calculate inflation rate from deflators
- Interpret changes in deflator

**4. GDP Per Capita Growth Decomposition** (Hard, 7/10):

- Given growth rates → decompose into components
- Calculate real per capita growth
- Compare living standard changes across countries

**Typical Mistakes to Avoid:**

- Including transfers in  $G$
- Counting intermediate goods
- Mixing up investment with financial investment
- Forgetting to subtract imports

**Time Management:**

- Simple GDP calculation: 10–12 minutes
- Value-added multi-stage: 15–20 minutes
- Growth decomposition: 15–20 minutes

## 2 Inflation and the Consumer Price Index

*Tutorial Coverage: T02 (13 questions), T10 (22 questions) — Difficulty: 4–7/10*

### 2.1 Introduction to Inflation

**Definition 2.1** (Inflation). *Inflation is a sustained increase in the overall price level of goods and services in an economy over time. It reduces the purchasing power of money.*

**Definition 2.2** (Deflation). *Deflation is a sustained decrease in the overall price level (negative inflation rate). Prices are falling over time.*

**Key Distinction:**

- **Inflation:** Price level  $\uparrow$ , inflation rate  $> 0$
- **Deflation:** Price level  $\downarrow$ , inflation rate  $< 0$
- **Disinflation:** Inflation rate  $\downarrow$  but still  $> 0$  (slowing inflation)

### 2.2 The Consumer Price Index (CPI)

The CPI is the most widely used measure of inflation for consumers.

**Definition 2.3** (Consumer Price Index). *The CPI measures the average change over time in prices paid by urban consumers for a market basket of consumer goods and services.*

#### 2.2.1 CPI Calculation

##### Key Formula

###### CPI Formula:

$$\text{CPI}_t = \frac{\text{Cost of basket in year } t}{\text{Cost of basket in base year}} \times 100 \quad (13)$$

###### Inflation Rate (using CPI):

$$\pi_t = \frac{\text{CPI}_t - \text{CPI}_{t-1}}{\text{CPI}_{t-1}} \times 100\% \quad (14)$$

##### CPI Calculation Steps:

1. Fix the market basket (base year quantities)
2. Find prices in each year
3. Compute basket cost each year
4. Choose base year (set CPI = 100)
5. Calculate index for other years

##### Worked Example

###### Worked Example 4: CPI Calculation [Adapted from T02-Q01 — Difficulty: 4/10]

A simplified market basket contains:

- 10 apples
- 5 loaves of bread

Prices:

Item	2020 Price	2025 Price
Apple	\$1.00	\$1.20
Bread	\$2.50	\$3.00

Base year: 2020. Calculate CPI for 2025 and inflation rate.

**Solution:**

*Step 1: Calculate basket costs*

$$\text{Cost}_{2020} = (10 \times \$1.00) + (5 \times \$2.50) = \$22.50$$

$$\text{Cost}_{2025} = (10 \times \$1.20) + (5 \times \$3.00) = \$27.00$$

*Step 2: Calculate CPI*

$$\text{CPI}_{2020} = \frac{22.50}{22.50} \times 100 = 100 \quad (\text{base year})$$

$$\text{CPI}_{2025} = \frac{27.00}{22.50} \times 100 = 120$$

*Step 3: Calculate inflation rate (2020–2025)*

$$\pi = \frac{120 - 100}{100} \times 100\% = 20\%$$

**Interpretation:** Prices increased 20% over 5 years.

## 2.3 Core vs. Headline Inflation

**Definition 2.4** (Headline Inflation). *Measured using all items in the CPI basket, including volatile food and energy prices.*

**Definition 2.5** (Core Inflation). *Excludes food and energy prices, which are highly volatile. Better indicator of underlying inflation trend.*

Central banks often target core inflation for policy decisions because it's more stable.

## 2.4 Real vs. Nominal Values

Inflation erodes purchasing power. We adjust nominal values to obtain real values.

### Key Formula

**Real Value Formula:**

$$\text{Real Value}_t = \text{Nominal Value}_t \times \frac{\text{CPI}_{\text{base}}}{\text{CPI}_t} \quad (15)$$

**Real Interest Rate:**

$$r \approx i - \pi \quad (16)$$

where:

- $r$  = real interest rate
- $i$  = nominal interest rate
- $\pi$  = inflation rate

## 3 Unemployment and Labor Markets

*Tutorial Coverage: T03 (10 questions) — Difficulty: 3–7/10 — Avg: 5.50/10*

### 3.1 Introduction to Unemployment

Unemployment represents a critical macroeconomic challenge, affecting both economic efficiency and individual welfare. Understanding unemployment requires precise measurement and classification of labor market participants.

**Definition 3.1** (Labor Force). *The labor force consists of all persons aged 16 and older who are either employed or actively seeking employment.*

$$\text{Labor Force} = \text{Employed} + \text{Unemployed} \quad (17)$$

**Definition 3.2** (Unemployment Rate). *The unemployment rate is the percentage of the labor force that is unemployed:*

$$\text{Unemployment Rate} = \frac{\text{Unemployed}}{\text{Labor Force}} \times 100\% \quad (18)$$

### 3.2 Labor Force Classifications

The Bureau of Labor Statistics (BLS) classifies the working-age population into three categories:

1. **Employed:** Currently working (full-time or part-time, including self-employed)
2. **Unemployed:** Not working but actively seeking employment (job applications, interviews within past 4 weeks)
3. **Not in Labor Force:** Neither employed nor actively seeking work (retirees, full-time students, discouraged workers)

#### Key Formula

##### Labor Market Statistics:

$$\text{Labor Force} = \text{Employed} + \text{Unemployed} \quad (19)$$

$$\text{Unemployment Rate} = \frac{\text{Unemployed}}{\text{Labor Force}} \times 100\% \quad (20)$$

$$\text{Labor Force Participation Rate} = \frac{\text{Labor Force}}{\text{Working-Age Population}} \times 100\% \quad (21)$$

$$\text{Employment-Population Ratio} = \frac{\text{Employed}}{\text{Working-Age Population}} \times 100\% \quad (22)$$

#### Worked Example

##### Worked Example 5: Labor Force Status Classification [Adapted from T03-Q01 — Difficulty: 3/10]

For each situation, determine if Rick is classified as employed, unemployed, or not in labor force:

- (a) Rick is self-employed as a carpenter.
- (b) Rick moves to Florida and begins looking for work.
- (c) Rick feels discouraged and stops applying for jobs.
- (d) Rick starts looking for work again.
- (e) Rick starts work at a new job.

#### Solutions:

- (a) **Employed.** Self-employment counts as employment.
- (b) **Unemployed.** Rick no longer has a job but is actively seeking employment.
- (c) **Not in labor force.** Rick doesn't have a job and isn't looking, making him a *discouraged worker*.
- (d) **Unemployed.** Rick still doesn't have a job but is now actively searching again.
- (e) **Employed.** Rick has found new employment.

**Key Point:** Discouraged workers (part c) are *not* counted as unemployed, which can understate true labor market slack.

### Worked Example

**Worked Example 6: Calculating Labor Market Statistics** [Adapted from T03-Q03 — Difficulty: 6/10]

Table shows international labor market data (in thousands):

Country	WAP	LF	Employed
Japan	74,518	?	67,124
France	?	29,620	27,255
Germany	52,967	41,674	?

Additional info: Japan unemployment rate = 2.80%; France LF participation = 88.0%; Germany unemployment rate = 3.57%.

**Calculate:** Fill in all missing values.

**Solution:**

*Japan:*

$$\text{Unemployed} = \text{LF} - \text{Employed}$$

$$\text{But first need LF. Use: } u = \frac{\text{Unemp}}{\text{LF}}$$

Let  $U$  = unemployed,  $E$  = employed

$$0.028 = \frac{U}{U + E} = \frac{U}{U + 67,124}$$

$$0.028(U + 67,124) = U$$

$$0.028U + 1,879.5 = U$$

$$1,879.5 = 0.972U$$

$$U = 1,934 \text{ thousand}$$

$$\text{LF} = 67,124 + 1,934 = 69,058$$

$$\text{LF Participation} = \frac{69,058}{74,518} = 92.7\%$$

*France:*

$$\text{Unemployed} = 29,620 - 27,255 = 2,365$$

$$\text{Unemployment Rate} = \frac{2,365}{29,620} = 7.98\%$$

$$\text{WAP} = \frac{\text{LF}}{0.88} = \frac{29,620}{0.88} = 33,659$$

*Germany:*

$$0.0357 = \frac{U}{41,674}$$

$$U = 1,488$$

$$\text{Employed} = 41,674 - 1,488 = 40,186$$

$$\text{LF Participation} = \frac{41,674}{52,967} = 78.7\%$$

### 3.3 Types of Unemployment

Economists identify three distinct types of unemployment, each with different causes and policy implications:

#### 3.3.1 1. Frictional Unemployment

**Definition 3.3** (Frictional Unemployment). *Short-term unemployment arising from the normal process of workers changing jobs, locations, or careers. Results from imperfect information and search time.*

**Characteristics:**

- Short duration (weeks to months)
- Inevitable in dynamic economies
- Not necessarily harmful (indicates labor mobility)
- Can be reduced through better job matching technology

**Examples:** Recent graduate searching for first job, worker relocating to new city, employee transitioning between careers.

#### 3.3.2 2. Structural Unemployment

**Definition 3.4** (Structural Unemployment). *Long-term unemployment caused by fundamental mismatch between workers' skills and job requirements. Results from technological change, globalization, or industry decline.*

**Characteristics:**

- Long duration (months to years)
- Requires retraining or relocation
- More costly to economy and individuals
- Addressed through education and training programs

**Examples:** Factory worker displaced by automation, coal miner as industry declines, lack of coding skills in tech-driven economy.

#### 3.3.3 3. Cyclical Unemployment

**Definition 3.5** (Cyclical Unemployment). *Unemployment fluctuating with the business cycle. Rises during recessions when aggregate demand falls, declines during expansions.*

**Characteristics:**

- Varies with economic conditions
- Affects all industries simultaneously
- Can be addressed through fiscal/monetary policy
- Represents inefficient use of resources

**Examples:** Construction workers during 2008-09 financial crisis, retail workers during recession, Wall Street analysts during market crash.

### Worked Example

**Worked Example 7: Classifying Unemployment Types** [Adapted from T03-Q07 — Difficulty: 4/10]

Classify each scenario as frictional, structural, or cyclical unemployment:

- (a) Maria has started looking for work after taking time off to have a baby.
- (b) Juan left high school without graduating and can't find any jobs he's qualified for.
- (c) Rohit lost his Wall Street job during the 2008 financial crisis.
- (d) Adam just arrived in a new city and is looking for work.
- (e) Max wants to work as an air steward, but airline unionization limits available jobs.
- (f) Jada lost her web startup job during economic downturn.

**Solutions:**

- (a) **Frictional** – Temporarily searching while re-entering labor force
- (b) **Structural** – Skills mismatch (lack of education/qualifications)
- (c) **Cyclical** – Job loss due to recession/economic downturn
- (d) **Frictional** – Normal search process after relocation
- (e) **Structural** – Industry-specific barriers limiting job availability
- (f) **Cyclical** – Job loss due to business cycle downturn

## 3.4 Natural Rate of Unemployment

**Definition 3.6** (Natural Rate of Unemployment). *The unemployment rate that exists when the economy is at full employment. Equals frictional plus structural unemployment (excludes cyclical):*

$$u_n = u_{\text{frictional}} + u_{\text{structural}} \quad (23)$$

Also called the Non-Accelerating Inflation Rate of Unemployment (NAIRU).

**Key Points:**

- Natural rate  $\neq$  zero unemployment
- Full employment occurs at  $u_n$  (typically 4-5% in U.S.)
- Actual unemployment fluctuates around  $u_n$  due to business cycle
- Cannot be reduced through aggregate demand policies

## 3.5 Labor Market Models

### 3.5.1 Supply and Demand Framework

**Key Formula****Labor Market Equilibrium:**

$$L^d = L^d(w) \quad (\text{Labor demand: decreasing in wage}) \quad (24)$$

$$L^s = L^s(w) \quad (\text{Labor supply: increasing in wage}) \quad (25)$$

$$L^d(w^*) = L^s(w^*) \quad (\text{Equilibrium condition}) \quad (26)$$

At equilibrium wage  $w^*$ , quantity demanded equals quantity supplied: no unemployment.

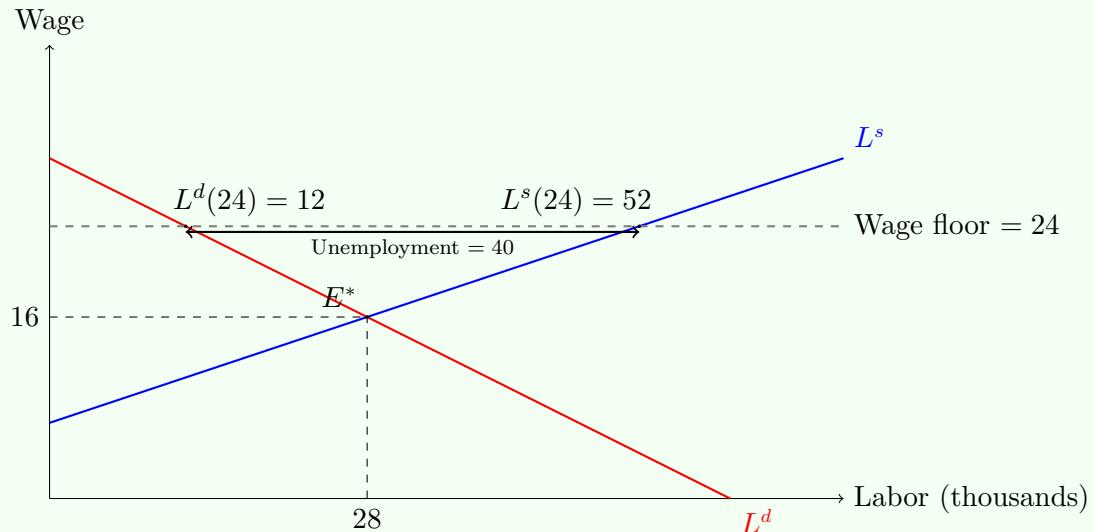
**3.5.2 Minimum Wage Effects****Worked Example****Worked Example 8: Labor Market with Wage Floor** [Adapted from T03-Q06 — Difficulty: 7/10]

Labor demand:  $L^d = 60 - 2w$

Labor supply:  $L^s = -20 + 3w$

where  $w$  = wage (dollars/hour),  $L$  = workers (thousands)

- (a) Find equilibrium wage and employment.
- (b) Workers strike and negotiate 50% wage increase. Calculate resulting unemployment.

**Solution**

Part (a): Equilibrium

$$60 - 2w = -20 + 3w$$

$$80 = 5w$$

$$w^* = 16$$

$$L^* = 28$$

Part (b): Wage Increase of 50%

$$\begin{aligned}
 w_{\text{new}} &= 24 \\
 L^d(24) &= 12 \\
 L^s(24) &= 52 \\
 \text{Unemployment} &= 52 - 12 = 40
 \end{aligned}$$

**Result:** A wage floor above equilibrium reduces labor demanded and increases labor supplied, creating unemployment.

## 3.6 Factors Affecting Unemployment

### 3.6.1 Labor Market Rigidities

Several factors prevent wages from adjusting to clear labor markets:

1. **Minimum Wage Laws:** Legal wage floors create unemployment if set above equilibrium
2. **Labor Unions:** Collective bargaining raises wages above market-clearing level for members
3. **Efficiency Wages:** Firms voluntarily pay above-equilibrium wages to:
  - Reduce turnover costs
  - Increase worker productivity
  - Attract higher-quality workers
  - Reduce monitoring/shirking
4. **Unemployment Insurance:** Generous benefits reduce search intensity, extending unemployment duration

### Policy Application

#### Unemployment Insurance Trade-offs *[Adapted from T03-Q09, Q10]*

##### Benefits:

- Provides income security during job search
- Allows workers to find better job matches
- Acts as automatic stabilizer during recessions
- Maintains consumer spending

##### Costs:

- Reduces incentive to search actively (moral hazard)
- Extends average unemployment duration
- Creates fiscal burden on government
- May keep wages artificially high

##### Policy Design Considerations:

- Benefit duration (26 weeks typical in U.S.)
- Replacement rate (percentage of previous wage)
- Job search requirements
- Alternative: lump-sum payment instead of weekly checks (T03-Q10)

**Evidence:** Studies show unemployment spikes in 26th week of benefits, suggesting workers respond to expiration incentives.

### 3.7 Summary: Key Formulas and Concepts

#### Key Formula

##### Essential Unemployment Formulas:

$$\text{Unemployment Rate} = \frac{\text{Unemployed}}{\text{Labor Force}} \times 100\% \quad (27)$$

$$\text{LF Participation Rate} = \frac{\text{Labor Force}}{\text{Working-Age Pop}} \times 100\% \quad (28)$$

$$\text{Natural Rate} = u_{\text{frictional}} + u_{\text{structural}} \quad (29)$$

$$\text{Cyclical Unemployment} = u_{\text{actual}} - u_n \quad (30)$$

#### Exam Focus

**High-Yield Topics** (from 10 tutorial questions, avg difficulty 5.50/10):

1. **Labor Force Classifications** (Easy, 3/10):

- Distinguish employed, unemployed, not in labor force
- Identify discouraged workers correctly
- Understand self-employment counts as employed

2. **Calculating Unemployment Statistics** (Medium–Hard, 6/10):

- Use  $u = U/(E + U)$  formula correctly
- Solve for missing labor market variables
- International comparisons require careful calculation

3. **Types of Unemployment** (Medium, 4–5/10):

- Distinguish frictional, structural, cyclical
- Apply definitions to real-world scenarios
- Understand policy implications for each type

4. **Labor Market Equilibrium** (Hard, 7/10):

- Solve supply-demand equations
- Calculate unemployment from wage changes
- Interpret surplus/shortage graphically

#### Common Mistakes:

- Counting discouraged workers as unemployed
- Using working-age population instead of labor force in denominator
- Confusing unemployment types
- Forgetting that equilibrium  $\Rightarrow$  zero cyclical unemployment

## 4 Economic Growth and Productivity

*Tutorial Coverage: T04 (12 questions) — Difficulty: 3–7/10 — Avg: 5.15/10*

### 4.1 Introduction: Why Growth Matters

Economic growth—sustained increases in real GDP per capita—is the most important determinant of long-run living standards. Small differences in growth rates compound dramatically over time.

**Principle 4.1** (Power of Compounding). *Even modest growth rate differences create vast income disparities across countries after several decades. A country growing at 3% per year doubles income every 23 years; at 1% growth, doubling takes 70 years.*

### 4.2 Measuring Economic Growth

#### Key Formula

**Real GDP Per Capita Growth Rate:**

$$g_{\text{GDP/cap}} \approx g_{\text{Nominal GDP}} - g_{\text{Inflation}} - g_{\text{Population}} \quad (31)$$

**Exact Formula** (for precision):

$$g_{\text{GDP/cap}} = \frac{\text{GDP/cap}_t - \text{GDP/cap}_{t-1}}{\text{GDP/cap}_{t-1}} \times 100\% \quad (32)$$

#### Worked Example

**Worked Example 9: Growth Rate Decomposition** [Adapted from T04-Q01, Q02 — Difficulty: 6/10]

Country has the following annual growth rates:

- Nominal GDP growth: 7%
- Inflation (GDP deflator): 2%
- Population growth: 1%

**Calculate:**

- (a) Real GDP growth rate
- (b) Real GDP per capita growth rate

**Solution:**

*Part (a): Real GDP Growth*

$$\begin{aligned} g_{\text{Real GDP}} &\approx g_{\text{Nominal}} - g_{\text{Inflation}} \\ &= 7\% - 2\% = 5\% \end{aligned}$$

*Part (b): Real GDP Per Capita Growth*

$$\begin{aligned} g_{\text{GDP/cap}} &\approx g_{\text{Real GDP}} - g_{\text{Population}} \\ &= 5\% - 1\% = 4\% \end{aligned}$$

**Interpretation:** While nominal GDP grew 7%, the true increase in average living standards (real GDP per capita) was only 4% after accounting for inflation and population growth.

### 4.3 Rule of 70

#### Key Formula

##### Rule of 70:

$$\text{Years to Double} \approx \frac{70}{\text{Growth Rate (\%)}} \quad (33)$$

Quick approximation for doubling time at constant growth rates.

#### Worked Example

##### Worked Example 10: Rule of 70 Applications [Adapted from T04-Q03 — Difficulty: 3/10]

Calculate doubling times for:

- (a) 4% annual growth
- (b) 7% annual growth
- (c) 2.5% annual growth

##### Solutions:

$$\begin{aligned} \text{(a) } 4\% : \quad & \frac{70}{4} = 17.5 \text{ years} \\ \text{(b) } 7\% : \quad & \frac{70}{7} = 10 \text{ years} \\ \text{(c) } 2.5\% : \quad & \frac{70}{2.5} = 28 \text{ years} \end{aligned}$$

**Insight:** Doubling China's growth rate from 3.5% to 7% cuts doubling time from 20 years to 10 years—explaining rapid development.

### 4.4 Sources of Economic Growth

Economic growth arises from increases in inputs (capital, labor) and improvements in technology (total factor productivity).

#### 4.4.1 Production Function Framework

**Definition 4.2** (Aggregate Production Function). *Relates output to inputs:*

$$Y = A \cdot F(K, L, N) \quad (34)$$

where:

- $Y$  = Real GDP (output)
- $A$  = Total factor productivity (technology)
- $K$  = Physical capital stock
- $L$  = Human capital (education, skills)
- $N$  = Natural resources

**Common Specification** (Cobb-Douglas):

$$Y = A \cdot K^\alpha \cdot L^{1-\alpha} \quad (35)$$

where  $\alpha$  is capital's share of income (typically 0.3–0.4).

#### 4.4.2 Four Components of Productivity

1. **Physical Capital ( $K$ ):**

- Equipment, structures, machinery
- Increases worker productivity
- Requires investment (saving)
- Subject to diminishing returns

2. **Human Capital ( $L$ ):**

- Education, training, experience
- Skills and knowledge
- Health and nutrition
- Most important for long-run growth

3. **Natural Resources ( $N$ ):**

- Land, minerals, energy
- Less important than often thought
- Many resource-poor countries are wealthy (Japan, Singapore)
- Resource curse: abundant resources may hinder growth

4. **Technological Knowledge ( $A$ ):**

- Innovations, inventions, techniques
- Non-rival (one person's use doesn't reduce another's)
- Key driver of sustained growth
- R&D, patents, knowledge spillovers

#### 4.5 Growth Accounting Equation

**Key Formula**

**Growth Accounting Identity:**

$$g_Y = g_A + \alpha \cdot g_K + (1 - \alpha) \cdot g_L \quad (36)$$

where:

- $g_Y$  = Output growth rate
- $g_A$  = Technology growth rate (TFP growth, Solow residual)
- $g_K$  = Capital growth rate
- $g_L$  = Labor growth rate
- $\alpha$  = Capital's share of income  $\approx 0.3\text{--}0.4$

**Solving for Technology Growth:**

$$g_A = g_Y - \alpha \cdot g_K - (1 - \alpha) \cdot g_L \quad (37)$$

**Worked Example**

**Worked Example 11: Growth Accounting** [Adapted from T04-Q09 — Difficulty: 7/10]

An economy has:

- Output growth:  $g_Y = 4.2\%$
- Capital growth:  $g_K = 4\%$
- Labor growth:  $g_L = 1\%$
- Capital share:  $\alpha = 0.4$

**Calculate:** Technology (TFP) growth rate.

**Solution:**

$$\begin{aligned} g_A &= g_Y - \alpha \cdot g_K - (1 - \alpha) \cdot g_L \\ &= 4.2 - 0.4(4) - 0.6(1) \\ &= 4.2 - 1.6 - 0.6 \\ &= 2.0\% \end{aligned}$$

**Interpretation:** Of the 4.2% output growth:

- 1.6 percentage points from capital accumulation (38%)
- 0.6 percentage points from labor force growth (14%)
- 2.0 percentage points from technology/productivity improvements (48%)

Technology is the largest contributor to growth.

## 4.6 Convergence Theory

**Principle 4.3** (Convergence Hypothesis). *Poor countries should grow faster than rich countries, eventually converging to similar income levels. Based on diminishing returns to capital: additional capital has larger impact in capital-scarce (poor) countries.*

**Two Types of Convergence:**

1. **Absolute Convergence:** All countries converge to same income level
  - Not observed in reality
  - Requires identical institutions, policies, savings rates
2. **Conditional Convergence:** Countries converge to their own steady-state income
  - Supported by data
  - Steady state depends on savings, population growth, technology
  - Poor countries with good institutions grow faster

### Worked Example

**Worked Example 12: Convergence Analysis** [Adapted from T04-Q06, Q07 — Difficulty: 6/10]

Three countries with different starting incomes and growth rates:

Country	Income/capita	Growth Rate
Ansonia	\$5,000	7.0%
Trumbull	\$7,500	4.5%
Shelton	\$10,000	2.0%

**Question:** Will these countries converge?

**Analysis:**

Pattern shows convergence characteristics:

- Poorest (Ansonia): Highest growth (7%)
- Middle (Trumbull): Medium growth (4.5%)
- Richest (Shelton): Lowest growth (2%)

**Long-run projections** (using Rule of 70):

Ansonia doubles in:  $\frac{70}{7} = 10$  years  $\rightarrow \$10,000$

Trumbull doubles in:  $\frac{70}{4.5} \approx 16$  years  $\rightarrow \$15,000$

Shelton doubles in:  $\frac{70}{2} = 35$  years  $\rightarrow \$20,000$

**Conclusion:** Yes, convergence is occurring. The poorest country (Ansonia) is growing fast enough to catch up, while the richest (Shelton) is slowing down. Income gaps will narrow over time, consistent with convergence theory.

## 4.7 Policies to Promote Growth

### Policy Application

#### Growth-Promoting Policies:

##### 1. Encourage Saving and Investment:

- Tax incentives for saving (401k, IRA)
- Reduce corporate taxes on investment
- Stable macroeconomic environment

##### 2. Invest in Human Capital:

- Public education funding
- Vocational training programs
- Health care access
- On-the-job training incentives

##### 3. Foster Technological Progress:

- R&D tax credits
- Patent protection (but not excessive)
- Basic research funding
- University-industry partnerships

##### 4. Maintain Institutional Quality:

- Property rights protection
- Rule of law and contract enforcement
- Low corruption
- Political stability
- Effective government

##### 5. Promote Free Trade:

- Access to larger markets
- Technology transfer
- Competitive pressure for efficiency
- Specialization gains

#### Trade-offs:

- Growth vs. environment (pollution, resource depletion)
- Growth vs. inequality (who benefits?)
- Current consumption vs. investment
- Budget constraints limit simultaneous pursuit of all policies

## 4.8 Summary: Key Growth Formulas

### Key Formula

#### Essential Growth Equations:

$$g_{\text{GDP/cap}} \approx g_{\text{Nom GDP}} - g_{\text{Inflation}} - g_{\text{Pop}} \quad (38)$$

$$\text{Doubling Time} \approx \frac{70}{g} \quad (\text{Rule of 70}) \quad (39)$$

$$g_Y = g_A + \alpha \cdot g_K + (1 - \alpha) \cdot g_L \quad (\text{Growth Accounting}) \quad (40)$$

$$g_A = g_Y - \alpha \cdot g_K - (1 - \alpha) \cdot g_L \quad (\text{TFP Growth}) \quad (41)$$

**Exam Focus****High-Yield Topics** (from 12 tutorial questions, avg difficulty 5.15/10):**1. Growth Rate Calculations** (Medium, 5–6/10):

- Decompose nominal into real per capita
- Use approximation formula correctly
- Verify with exact calculation when needed

**2. Rule of 70** (Easy, 3/10):

- Quick mental math: divide 70 by growth rate
- Compare doubling times across scenarios
- Understand compounding power

**3. Growth Accounting** (Hard, 7/10):

- Identify  $\alpha$  correctly (capital share  $\approx 0.3\text{--}0.4$ )
- Solve for TFP growth as residual
- Interpret contributions of K, L, A

**4. Convergence** (Medium, 5–6/10):

- Recognize convergence patterns
- Use Rule of 70 for long-run projections
- Understand conditional vs. absolute convergence

**Common Mistakes:**

- Forgetting to subtract population growth
- Using wrong  $\alpha$  value in growth accounting
- Confusing levels vs. growth rates
- Assuming all countries converge to same income

**Time Management:**

- Growth decomposition: 12–15 minutes
- Rule of 70: 5–8 minutes
- Growth accounting: 15–20 minutes
- Convergence analysis: 15 minutes

# Part II

# Macroeconomic Models: Short-Run and Long-Run

## 5 The Aggregate Expenditure Model

*Tutorial Coverage: T05 (16 questions) — Difficulty: 4.7/10 — Avg: 5.19/10*

### 5.1 Introduction: Keynes and the Consumption-Based Framework

The Aggregate Expenditure (AE) Model, developed by John Maynard Keynes, explains how total spending determines output. It emphasizes that aggregate demand, not productive capacity alone, determines output and employment in the short run.

**Principle 5.1** (Keynesian Principle). *In the short run, the economy is demand-determined. Output is limited by how much businesses and consumers want to spend, not by production capacity.*

### 5.2 Components of Aggregate Expenditure

#### Key Formula

**Aggregate Expenditure Identity:**

$$AE = C + I + G + NX \quad (42)$$

where  $C$  = consumption,  $I$  = planned investment,  $G$  = government purchases,  $NX$  = net exports.

#### 5.2.1 The Consumption Function

**Definition 5.2** (Consumption Function). *Relationship between consumption and disposable income:*

$$C = C_0 + MPC \cdot (Y - T) \quad (43)$$

Key concepts:

- $C_0$ : Autonomous consumption (consumption even if income = 0)
- **MPC**: Marginal Propensity to Consume ( $0 < MPC < 1$ )
- $(Y - T)$ : Disposable income
- **MPS**: Marginal Propensity to Save =  $1 - MPC$

#### Worked Example

**Worked Example 13: Equilibrium Output Determination** [T05-Q12 — Difficulty: 6/10]

Given:  $C_0 = 150$ ,  $MPC = 0.75$ ,  $T = 200$ ,  $I = 200$ ,  $G = 300$ ,  $NX = 50$ .  
**Find:** Equilibrium output.

**Solution:**

$$\begin{aligned}
 Y &= C + I + G + NX \\
 Y &= [150 + 0.75(Y - 200)] + 200 + 300 + 50 \\
 Y &= 150 + 0.75Y - 150 + 550 \\
 0.25Y &= 550 \\
 Y^* &= 2,200
 \end{aligned}$$

Equilibrium consumption:  $C = 150 + 0.75(2,000) = 1,650$ .

Check:  $AE = 1,650 + 200 + 300 + 50 = 2,200 = Y$

### 5.3 The Expenditure Multiplier

**Definition 5.3** (Expenditure Multiplier). *How much equilibrium output changes from a one-dollar change in autonomous spending.*

#### Key Formula

**Multiplier Formula:**

$$m = \frac{1}{1 - MPC} = \frac{1}{MPS} \quad (44)$$

**Output Change:**

$$\Delta Y = m \times \Delta A \quad (45)$$

where  $\Delta A$  = change in autonomous spending.

**Economic Mechanism:** Spending  $\rightarrow$  Income  $\rightarrow$  Consumption  $\rightarrow$  More Income  $\rightarrow$  Cycle repeats with diminishing increments.

#### Worked Example

**Worked Example 14: Multiplier Effects** [T05-Q15 — Difficulty: 6/10]

From above, if  $G$  increases from 300 to 325 (increase of 25), find new equilibrium output.

**Solution:**

$$\begin{aligned}
 m &= \frac{1}{1 - 0.75} = 4 \\
 \Delta Y &= 4 \times 25 = 100 \\
 Y_{\text{new}} &= 2,200 + 100 = 2,300
 \end{aligned}$$

A \$25B government spending increase creates \$100B output increase through multiplier effect.

### 5.4 Output Gaps and Policy

#### Key Formula

**Output Gap:**

$$\text{Gap} = Y_{\text{potential}} - Y_{\text{actual}} \quad (46)$$

To close gap using policy:

$$\Delta A = \frac{\text{Output Gap}}{m} \quad (47)$$

## 5.5 Common Mistakes

### Common Mistake

**Mistake:** Confusing MPC with multiplier. If  $MPC = 0.75$ , this is NOT the multiplier; the multiplier is  $1/(1-0.75) = 4$ .

**Mistake:** Forgetting taxes when calculating consumption. Must use  $(Y - T)$ , not just  $Y$ .

## 5.6 Exam Focus

### Exam Focus

#### High-Yield:

- Equilibrium output calculation
- Multiplier effect derivation
- Policy to close output gaps

**Time:** Simple equilibrium 10–12 min, multiplier 10 min, complex 20–25 min.

## 6 The Aggregate Demand and Aggregate Supply Model

*Tutorial Coverage: T06 (20 questions) — Difficulty: 3–8/10 — Avg: 5.40/10*

### 6.1 Introduction: Integrating the Price Level

While the AE model treats prices as fixed, the AD-AS model allows prices to vary, connecting short-run fluctuations to long-run equilibrium.

**Principle 6.1** (AD-AS Framework). *Output and prices are jointly determined by Aggregate Demand and Aggregate Supply curves, which differ markedly between short run (sticky prices) and long run (flexible prices).*

### 6.2 Aggregate Demand Curve

**Definition 6.2** (Aggregate Demand). *Total quantity of goods and services demanded at each price level. Inverse relationship: higher prices → lower quantity demanded.*

#### Key Formula

**Why AD slopes downward:**

1. **Wealth Effect:** Higher prices reduce real purchasing power → lower consumption.
2. **Interest Rate Effect:** Higher prices increase money demand → higher interest rates → lower investment.
3. **Net Export Effect:** Higher domestic prices → exports less competitive, imports more attractive → lower NX.

AD shifts with changes in autonomous spending: increases in  $C_0$ ,  $I$ , or  $G$  shift AD right.

### 6.3 Aggregate Supply: Short-Run vs. Long-Run

#### 6.3.1 Short-Run Aggregate Supply (SRAS)

**Definition 6.3** (SRAS). *Many prices and wages are sticky (rigid) in short run. Firms respond to price changes by adjusting quantity.*

#### Key Formula

**SRAS Function:**

$$Y = Y_p + \alpha(P - P^e) \quad (48)$$

where upward slope reflects price stickiness; if  $P > P^e$ , output exceeds potential.

#### 6.3.2 Long-Run Aggregate Supply (LRAS)

**Definition 6.4** (LRAS). *All prices and wages fully adjust. Economy reaches potential output regardless of price level.*

#### Key Formula

**LRAS:**

$$Y = Y_p \quad (\text{vertical line at potential output}) \quad (49)$$

Determined by factor supplies and technology; shifts only with productivity improvements.

## 6.4 Short-Run and Long-Run Equilibrium

**Short-run equilibrium** occurs where the **AD curve intersects the SRAS curve**:

Short-run equilibrium:  $AD \cap SRAS$

**Long-run equilibrium** occurs where the **AD curve intersects the LRAS curve**, meaning the economy is producing at potential output:

Long-run equilibrium:  $AD \cap LRAS$

## 6.5 Shocks and Adjustment

### 6.5.1 Demand Shocks

Decrease in AD (recession):

1. Short-run: Output falls, prices fall  $\rightarrow$  recessionary gap
2. Long-run: Wages fall  $\rightarrow$  SRAS shifts right  $\rightarrow$  equilibrium restored at original price level
3. Slow process with prolonged unemployment

**Policy Option:** Increase  $G$  or cut  $T$  to shift AD back immediately, avoiding long wait.

### 6.5.2 Supply Shocks

Negative supply shock (e.g., oil spike):

- SRAS shifts left
- Output falls, prices rise (stagflation)
- Policy dilemma: Can't have both lower prices AND higher output

Positive supply shock (e.g., technology):

- SRAS shifts right
- Output rises, prices fall (ideal scenario)

### Policy Application

#### Stagflation Policy Dilemma [T06-Q19 — Difficulty: 8/10]

After negative supply shock, policymakers face:

**Option A:** Stimulate AD to restore output

- Pro: Returns to full employment
- Con: Drives prices higher  $\rightarrow$  more inflation

**Option B:** Restrict AD to contain prices

- Pro: Controls inflation
- Con: Deepens recession, increases unemployment

**No Perfect Solution:** Must accept either inflation or unemployment; trade-off is unavoidable.

## 6.6 Exam Focus

### Exam Focus

**High-Yield:**

- Identify shock type (demand vs. supply)
- Predict output and price effects
- Graph short-run vs. long-run adjustment

- Policy analysis and trade-offs

**Typical Questions:** Shock identification and graphing, equilibrium calculation, policy comparison.

**Time:** Graphical analysis 10–15 min, full calculation with policy 15–20 min.

## Part III

# Policy and Financial Markets

## 7 Fiscal Policy

*Tutorial Coverage: T07 (18 questions) — Difficulty: 3–7/10 — Avg: 5.28/10*

### 7.1 Introduction: Government as Economic Actor

Fiscal policy uses government spending and taxation to influence aggregate demand and economic outcomes. Unlike monetary policy (central bank interest rates), fiscal policy directly affects output through the expenditure multiplier developed in Chapter 5.

**Principle 7.1** (Fiscal Policy Framework). *Government purchases and taxes operate through the AE model. Increases in government spending shift AD right, reducing unemployment in recessions. Taxes reduce disposable income, dampening consumption and AD.*

### 7.2 Government Spending Multiplier

From Chapter 5, recall that autonomous spending increases have multiplied effects on output.

#### Key Formula

**Government Spending Multiplier:**

$$m_G = \frac{1}{1 - MPC} \quad (50)$$

Example: If  $MPC = 0.75$ , then  $m_G = 4$ . A \$1 billion government spending increase creates \$4 billion output increase.

#### 7.2.1 Fiscal Policy Lags

Three types of delays limit fiscal policy effectiveness:

1. **Recognition Lag:** Time to realize economy is in recession (data availability)
2. **Implementation Lag:** Time to pass legislation and begin spending (political delays)
3. **Formulation Lag:** Time for spending to work through economy (multiplier rounds)

### 7.3 Tax Multiplier

Taxation affects output indirectly through consumption rather than directly as spending does.

**Key Formula****Tax Multiplier:**

$$m_T = -\frac{MPC}{1 - MPC} \quad (51)$$

Example: If  $MPC = 0.75$ , then  $m_T = -3$ . A \$1 billion tax cut increases output by \$3 billion (smaller than spending multiplier).

**Worked Example****Worked Example 18: Comparing Policy Tools [T07-Q07, Q10 — Difficulty: 5/10]**

Economy has  $MPC = 0.80$  and \$200 billion recessionary gap. Compare policies.

**Solution:**

Government spending increase needed:

$$\begin{aligned} m_G &= \frac{1}{1 - 0.80} = 5 \\ \Delta G &= \frac{200}{5} = 40 \text{ billion} \end{aligned}$$

Tax cut needed:

$$\begin{aligned} m_T &= -\frac{0.80}{1 - 0.80} = -4 \\ \Delta T &= \frac{200}{4} = 50 \text{ billion} \end{aligned}$$

Government is more efficient: cut taxes by more than spending increase to achieve same output effect.

## 7.4 Automatic Stabilizers

**Definition 7.2** (Automatic Stabilizers). *Tax and spending programs that automatically reduce aggregate demand in booms and increase it in recessions, without requiring legislative action.*

Examples: Progressive taxes, unemployment benefits, welfare programs.

**Benefit:** Reduce business cycle severity without political delays.

## 7.5 Government Budget Deficits and Debt

**Key Formula****Budget and Debt Definitions:**

$$\text{Deficit}_t = G_t - T_t \quad (\text{flow in year } t) \quad (52)$$

$$\text{Debt}_t = \text{Debt}_{t-1} + \text{Deficit}_t \quad (\text{cumulative stock}) \quad (53)$$

Debt is the running total of all past deficits. Debt stabilizes only if government eventually runs surpluses.

**Public and Private Saving:**

$$\text{Private Saving} = Y - T - C$$

$$\text{Public Saving} = T - G$$

$$\text{National Saving} = \text{Private Saving} + \text{Public Saving}$$

Note: Public saving is the negative of the government deficit:

$$\text{Public Saving} = -\text{Deficit.}$$

### Worked Example

#### Worked Example 19: Government Debt Tracking [T07-Q13 — Difficulty: 5/10]

Starting debt (2019): \$2,000B. Year-by-year deficits: 100, 60, 0, 20.

**Calculate debt at end of 2023:**

$$\text{Debt}_{2020} = 2,000 + 100 = 2,100$$

$$\text{Debt}_{2021} = 2,100 + 60 = 2,160$$

$$\text{Debt}_{2022} = 2,160 + 0 = 2,160$$

$$\text{Debt}_{2023} = 2,160 + 20 = 2,180$$

Only when government has surpluses does debt decline.

## 7.6 Fiscal Policy Concerns

1. **Crowding Out:** Government borrowing raises interest rates, reducing private investment
2. **Ricardian Equivalence:** Consumers may save (not spend) tax cuts if they anticipate future taxes
3. **Debt Sustainability:** Large persistent deficits lead to unsustainable debt
4. **Political:** Deficits popular, surpluses unpopular; debt tends to grow

### Exam Focus

**Key Topics:** Spending vs. tax multipliers, deficit/debt calculations, automatic stabilizers, policy lags.

**Time:** Multiplier 10 min, deficit tracking 12–15 min, policy comparison 15 min.

## 8 Financial Markets and Loanable Funds

*Tutorial Coverage: T08 (21 questions) — Difficulty: 3–7/10 — Avg: 5.24/10*

### 8.1 Introduction: Financial Markets' Role

Financial markets connect savers (who lend) with borrowers (who invest). Interest rates equalize supply and demand for loanable funds, determining investment levels and capital accumulation.

**Principle 8.1** (Loanable Funds Market). *The interest rate adjusts to equate savings with investment. Changes in saving or investment shift equilibrium, affecting interest rates and output.*

### 8.2 The Loanable Funds Market

#### Key Formula

##### Loanable Funds Equilibrium:

$$S_{\text{total}} = S_{\text{private}} + S_{\text{gov}} + S_{\text{foreign}} \quad (54)$$

$$S(r^*) = I(r^*) \quad (\text{equilibrium}) \quad (55)$$

Supply includes: household saving, government saving (negative if deficit), foreign capital.  
Demand: business investment, government borrowing, foreign borrowing needs.

#### Worked Example

##### Worked Example 20: Loanable Funds Equilibrium [T08-Q06 — Difficulty: 6/10]

Supply:  $S = 500 + 50r$ ; Demand:  $I = 800 - 40r$  (closed economy, balanced budget).

**Find equilibrium:**

$$500 + 50r = 800 - 40r$$

$$90r = 300$$

$$r^* = 3.33\%$$

Equilibrium:  $S^* = I^* = 666.5$ . Interest rate is 3.33%.

### 8.3 Crowding Out

**Definition 8.2** (Crowding Out). *Higher government deficits raise interest rates, reducing private investment. Government borrowing “crowds out” private borrowing.*

#### Worked Example

##### Worked Example 21: Crowding Out from Fiscal Deficit [T08-Q20 — Difficulty: 7/10]

From Example 20, government now runs \$100B deficit:  $S_g = -100$ .

New supply:  $S = 400 + 50r$

**New equilibrium:**

$$400 + 50r = 800 - 40r$$

$$r^* = 4.44\%$$

Investment falls to:  $I^* = 800 - 40(4.44) = 622.4$

**Crowding out:** \$44.1B of private investment displaced by fiscal deficit (from 666.5 to 622.4).

Fiscal stimulus increases AD but raises interest rates, partially offsetting the effect through lower investment.

## 8.4 Financial Instruments and Risk

Financial instruments differ by liquidity, risk, and return:

1. **Loans:** Illiquid, higher risk, variable return
2. **Bonds:** More liquid than loans, moderate risk, fixed return
3. **Stocks:** Most liquid, high risk/return potential

### Key Formula

#### Risk-Return Trade-off:

$$\text{Expected Return} = \text{Risk-Free Rate} + \text{Risk Premium} \quad (56)$$

Higher risk demands higher expected return. Risk premiums increase during recessions (investors become risk-averse).

## 8.5 Banking Functions and Information Problems

#### Three Banking Functions:

1. Credit intermediation (accept deposits, make loans)
2. Diversification (hold portfolios reducing risk)
3. Liquidity provision (deposits withdrawable, loans long-term)

#### Two Information Problems:

1. **Adverse Selection:** Can't distinguish good from bad borrowers before lending
2. **Moral Hazard:** Can't monitor borrowers after lending

Solutions: Credit rationing, collateral requirements, covenants, monitoring.

### Common Mistake

**Mistake:** Confusing savings (not consuming) with investment (capital formation). Buying stocks is asset transfer, not macroeconomic investment.

### Exam Focus

**Key Topics:** Loanable funds equilibrium, crowding out, risk-return, information problems.  
**Time:** Equilibrium 12–15 min, crowding out 15 min, conceptual 10 min.

# Part IV

# Monetary Economics: Money, Inflation, and Policy

## 9 Money and Monetary Policy

*Tutorial Coverage: T09 (20 questions) — Difficulty: 3-7/10 — Avg: 4.75/10*

### 9.1 Introduction: What is Money?

Money is a medium of exchange that facilitates transactions by avoiding the double-coincidence-of-wants problem inherent in barter. Beyond facilitating exchange, money serves as a unit of account and store of value.

**Definition 9.1** (Money). *An asset widely accepted in payment for goods and services. Must serve three functions: medium of exchange, unit of account, and store of value.*

### 9.2 Functions of Money

1. **Medium of Exchange:** Accepted in transactions, eliminating barter inefficiency
2. **Unit of Account:** Prices and debts quoted in money terms
3. **Store of Value:** Holds purchasing power over time (though inflation erodes it)

#### Worked Example

##### Worked Example 23: Functions of Money [T09-Q02 — Difficulty: 3/10]

Identify function(s) of money for:

- (a) You pay \$5 for coffee
- (b) Mortgage quoted at 5% annually
- (c) Money in savings earning interest
- (d) Store prices goods in dollars

**Solutions:**

- (a) **Medium of exchange**
- (b) **Unit of account**
- (c) **Store of value**
- (d) **Unit of account**

### 9.3 Money Supply: M1 and M2

**Definition 9.2** (M1 Money Supply). *Most liquid: currency in circulation plus checking accounts (instantly spendable).*

$$M1 = \text{Currency} + \text{Checking Deposits} \quad (57)$$

**Definition 9.3** (M2 Money Supply). *Broader measure including less liquid savings accounts:*

$$M2 = M1 + \text{Savings Deposits} + \text{Money Market Accounts} \quad (58)$$

### Worked Example

#### Worked Example 24: M1 and M2 Classification [T09-Q05 — Difficulty: 3/10]

Classify each as M1, M2, or neither:

- (a) \$200 checking account
- (b) \$500 savings account
- (c) \$1,000 stock portfolio
- (d) \$100 cash
- (e) \$2,000 CD (6-month)

**Solutions:**

- (a) **M1**
- (b) **M2 (not M1)**
- (c) **Neither**
- (d) **M1**
- (e) **M2 (not M1)**

## 9.4 The Money Multiplier

### Key Formula

#### Money Multiplier:

$$m_{\text{money}} = \frac{1}{\text{Reserve Ratio}} \quad (59)$$

Reserve ratio = 0.10 (10%) → multiplier = 10. Each \$1 reserve creates \$10 total money.

### Worked Example

#### Worked Example 25: Money Multiplier [T09-Q07, Q08 — Difficulty: 5/10]

Reserve ratio 0.20; initial deposit \$1,000.

**Find:** Total money supply created.

**Solution:**

$$m = \frac{1}{0.20} = 5$$

Total =  $5 \times 1,000 = 5,000$

\$5,000 total money created through multiplier process.

## 9.5 Federal Reserve Tools

Three mechanisms control money supply:

1. **Open Market Operations:** Buy/sell bonds; injects/removes reserves
2. **Discount Rate:** Interest on Fed loans to banks; lower rate expands money supply
3. **Interest on Reserves (IORB):** Higher rate encourages banks to hold reserves, reducing lending

## 9.6 Transmission Mechanism

Fed controls reserves → interest rates → investment/consumption → AD → output/prices.

## 9.7 Effective Lower Bound

At zero interest rates, conventional policy cannot further expand money supply. Solutions: quantitative easing, forward guidance, fiscal coordination.

### Exam Focus

**Key Topics:** M1 vs. M2, money multiplier, Fed tools, transmission, ELB.

**Time:** Classification 5–8 min, multiplier 10 min, transmission 15 min.

## 10 Inflation Theory and the Phillips Curve

*Tutorial Coverage: T10 (22 questions) — Difficulty: 4–7/10 — Avg: 5.45/10*

### 10.1 Introduction: Quantity Theory of Money

The Quantity Theory links money supply to prices in long run.

**Principle 10.1** (Quantity Theory of Money). *Money supply growth directly causes inflation in long run. Excessive money creation causes inflation.*

### 10.2 The Quantity Equation

#### Key Formula

##### Quantity Theory of Money

$$MV = PY \quad (60)$$

- $M$ : Money supply (amount of money in the economy)
- $V$ : Velocity of money (how many times a dollar is spent per year)
- $P$ : Price level
- $Y$ : Real output (real GDP)

This identity states that the total spending in the economy ( $MV$ ) must equal the total value of output ( $PY$ ).

#### Growth Form

$$g_M + g_V = g_P + g_Y$$

- $g_M$ : Growth rate of the money supply
- $g_V$ : Growth in velocity (often assumed to be 0 in the long run)
- $g_P$ : Inflation rate
- $g_Y$ : Real GDP growth

*Interpretation:* Money growth + velocity growth = inflation + real output growth. If velocity is stable, increases in the money supply translate into higher inflation unless matched by output growth.

#### Worked Example

##### Worked Example 26: Quantity Theory [T10-Q16 — Difficulty: 6/10]

Money growth 8%; output growth 3%; velocity constant.

**Find:** Inflation rate.

**Solution:**

$$\begin{aligned} g_M + g_V &= g_P + g_Y \\ 8\% + 0 &= g_P + 3\% \\ g_P &= 5\% \end{aligned}$$

Excess money growth ( $8\% - 3\% = 5\%$ ) creates 5% inflation.

## 10.3 Money Neutrality

Long-run: money affects only nominal variables (prices, wages). Real variables (output, unemployment) unaffected.

Short-run: sticky prices allow money to affect real output.

## 10.4 The Phillips Curve

Historical relationship between inflation and unemployment.

### 10.4.1 Short-Run Phillips Curve

#### Key Formula

**Short-Run Phillips Curve:**

$$\pi = \pi^e - \beta(u - u_n) + \epsilon \quad (61)$$

Downward sloping: lower unemployment  $\rightarrow$  higher inflation (wage pressure).

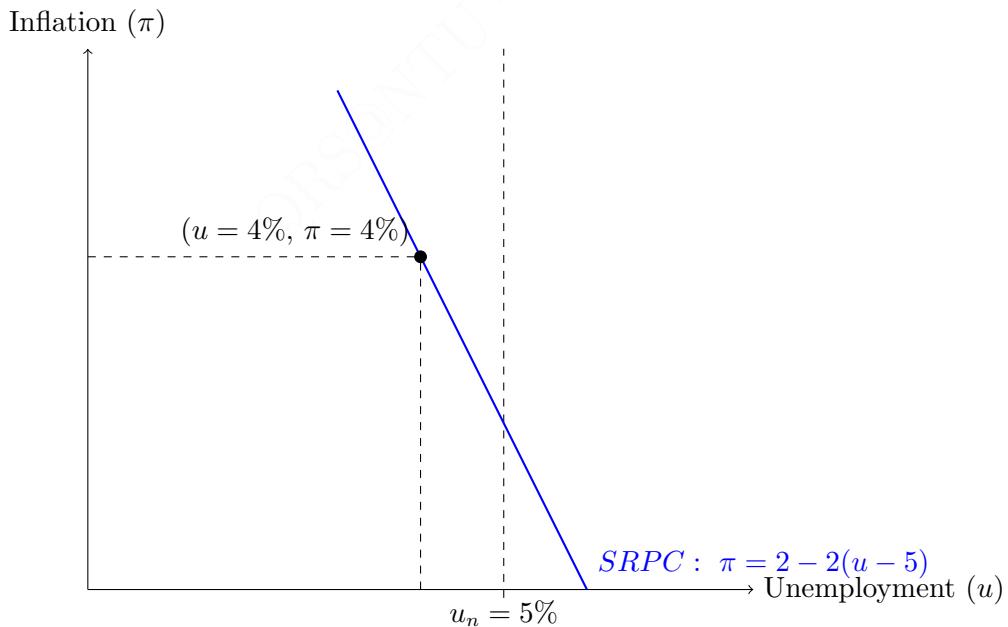
### 10.4.2 Short-Run Phillips Curve

#### Key Formula

**Short-Run Phillips Curve:**

$$\pi = \pi^e - \beta(u - u_n) + \epsilon \quad (62)$$

Downward sloping: lower unemployment  $\rightarrow$  higher inflation (wage pressure).



#### Worked Example

**Worked Example 27: Phillips Curve Trade-off** [T10-Q21 — Difficulty: 6/10]

Phillips curve:  $U = -I + 15$ ; NAIRU = 8%; inflation changes to 14%.

**Solution:**

**Short-run unemployment:**

$$U_{SR} = -14 + 15 = 1\%$$

**Long-run unemployment: 8% (returns to NAIRU)**

The economy initially experiences lower unemployment as inflation rises (Phillips curve tradeoff), but in the long run, unemployment returns to the natural rate as expectations adjust.

### 10.4.3 Long-Run Phillips Curve

The **Long-Run Phillips Curve (LRPC)** is **vertical** at the natural rate of unemployment:

$u_n$  (also called the **NAIRU**: Non-Accelerating Inflation Rate of Unemployment).

**Interpretation:** In the long run, there is *no permanent trade-off* between inflation and unemployment. The economy always returns to  $u_n$  regardless of the inflation rate.

**Why is it vertical?** Because expectations adjust over time. Workers and firms eventually learn the actual inflation rate and incorporate it into:

- wage negotiations,
- price-setting,
- contracts.

As expected inflation rises, the Short-Run Phillips Curve shifts upward, bringing unemployment back to  $u_n$  in the long run—eliminating any sustained inflation–unemployment trade-off.

## 10.5 Stagflation

Negative supply shock (oil embargo) shifts Phillips curve upward.

### Policy Application

#### Stagflation Problem

Supply shock shifts Phillips up by 5%:

$$\pi = 7\% - 2(u - 5\%)$$

#### Policy dilemma:

- Accept 7% inflation at  $u = 5\%$
- OR raise unemployment to reduce inflation
- No win-win solution

## 10.6 Expectations

**Adaptive:** Based on past inflation (slow adjustment)

**Rational:** Based on all info and correct model (quick adjustment)

Implication: Credible disinflation with rational expectations has low unemployment cost.

### Exam Focus

**Key Topics:** Quantity theory, Phillips curve trade-off, expectations, stagflation, money neutrality.

**Time:** Quantity theory 12 min, Phillips 15 min, stagflation 20 min.

# Part V

# Open Economy Macroeconomics

## 11 Open Economy Macroeconomics

*Tutorial Coverage: T12 (21 questions) — Difficulty: 3-7/10 — Avg: 5.81/10*

### 11.1 Introduction: Opening the Economy

Previous chapters analyzed closed economies. Real economies are open, engaging in international trade and financial transactions.

**Definition 11.1** (Open Economy). *An economy that interacts freely with others through international trade in goods/services and capital flows.*

### 11.2 Balance of Trade

**Definition 11.2** (Net Exports).

$$NX = X - M = \text{Exports} - \text{Imports} \quad (63)$$

*Types: Trade Surplus ( $NX > 0$ ), Deficit ( $NX < 0$ ), Balanced ( $NX = 0$ ).*

#### Worked Example

**Example 28: Balance of Trade** [T12-Q01 — Diff: 3/10]

U.S. exports \$123.1B, imports \$192.2B. Find balance of trade.

**Solution:**  $NX = 123.1 - 192.2 = -69.1$  billion (trade deficit).

### 11.3 Net Capital Outflow

**Definition 11.3** (Net Capital Outflow).

$$NCO = \text{Domestic purchase of foreign assets} - \text{Foreign purchase of domestic assets} \quad (64)$$

*Types: FDI (direct, controlling) vs. Portfolio (stocks/bonds, passive).*

#### Worked Example

**Example 29: NCO Calculation** [T12-Q03 — Diff: 4/10]

U.S. invests \$200B abroad; foreigners invest \$200B in U.S.

**Solution:**  $NCO = 200 - 200 = 0$ .

### 11.4 Balance-of-Payments Identity

#### Key Formula

**Fundamental Identity:**

$$NCO = NX \quad (65)$$

Always true by accounting. Net capital outflow equals net exports.

**Extended Form:**

$$S = I + NCO = I + NX \quad (66)$$

**Worked Example****Example 30: Open Economy Accounts [T12-Q02 — Diff: 6/10]**

$Y = 10$ ,  $C = 8$ ,  $I = 3$ ,  $G = 2$ ,  $T = 1.6$  (trillions).

Find: NX, public/private saving, NCO.

**Solution:**

$$\begin{aligned}NX &= Y - C - I - G = 10 - 8 - 3 - 2 = -3 \\S_{\text{public}} &= T - G = 1.6 - 2 = -0.4 \\S_{\text{private}} &= Y - C - T = 10 - 8 - 1.6 = 0.4 \\NCO &= NX = -3 \text{ (identity)}\end{aligned}$$

## 11.5 Exchange Rates

**Definition 11.4** (Nominal Exchange Rate). *Price of one currency in terms of another. Example: \$1 = 0.94 euros.*

**Definition 11.5** (Appreciation/Depreciation). *Appreciation: Currency increases in value.*

*Depreciation: Currency decreases in value.*

Effects:

- Appreciation → imports cheaper, exports expensive → NX falls
- Depreciation → imports expensive, exports cheaper → NX rises

**Worked Example****Example 31: Exchange Rate Shifts [T12-Q07 — Diff: 5/10]**

Russian drought increases U.S. wheat exports.

**Analysis:**

- Demand for dollars increases (Russia needs dollars)
- Dollar appreciates
- NX effect: exports ↑ direct but appreciation makes other exports expensive
- Net effect ambiguous

## 11.6 Real Exchange Rate and PPP

**Key Formula****Real Exchange Rate (RER)**

$$\text{Real ER} = \text{Nominal ER} \times \frac{P_{\text{domestic}}}{P_{\text{foreign}}}$$

**Purchasing Power Parity (PPP)**

$$ER_{PPP} = \frac{P_{\text{domestic}}}{P_{\text{foreign}}}$$

**Notation:** Most macro textbooks use **ER** for exchange rate, but **NTU HE1002 explicitly uses “XR”** in lectures, tutorials, and exams. When reading HE1002 materials, interpret:

$$XR \equiv ER$$

i.e., they represent the same exchange rate variable.

**Worked Example****Example 32: PPP Test [T12-Q18 — Diff: 5/10]**

Big Mac: Canada C\$4.17, U.S. \$3.56. Actual rate: \$0.70/C.

Check PPP: Canadian Big Mac in US\$ =  $4.17 \times 0.70 = \$2.92 \neq \$3.56$ . PPP fails.

PPP rate:  $3.56/4.17 = \$0.854 /C$ .

## 11.7 Fixed vs. Floating Exchange Rates

**Definition 11.6** (Floating). *Market determines exchange rate. Central bank doesn't intervene.*

**Definition 11.7** (Fixed). *Government sets rate. Central bank must intervene to maintain peg.*

## 11.8 Policy Effectiveness

**Principle 11.8** (Monetary Policy). **Floating:** Effective (can control interest rates and money supply)  
**Fixed:** Ineffective (must maintain peg; cannot control money supply independently)

**Worked Example****Example 33: Monetary Policy, Floating Rate [T12-Q15 — Diff: 7/10]**

Fed cuts rates under floating regime.

Effects: Investment  $\uparrow$ , capital outflow  $\uparrow$ , exchange rate  $\downarrow$ , NX  $\uparrow$ , AD  $\uparrow$ .

**Conclusion:** Effective through both  $I$  and  $NX$  channels.

**Worked Example****Example 34: Monetary Policy, Fixed Rate [T12-Q16 — Diff: 7/10]**

Fed cuts rates under fixed regime.

Initial: rates fall, capital outflows, pressure to depreciate.

But: Central bank must defend peg, buys domestic currency, reduces money supply, rates rise back.

**Conclusion:** Neutralized. Cannot control both money supply and exchange rate.

**Policy Application****Crisis Management [T12-Q21 — Diff: 7/10]**

Capital flight scenario: investors withdraw funds.

**Fixed Rate:** Must sell reserves to defend peg. Reserves deplete. Currency crisis. Cannot stimulate economy.

**Floating Rate:** Currency depreciates naturally. Exports cheaper, stimulates production. Can cut rates. Flexible response.

**Recommendation:** Floating preferable during crises.

## 11.9 Arbitrage

**Worked Example****Example 35: Currency Arbitrage [T12-Q13 — Diff: 7/10]**

Hiro has \$10,000 to invest in the foreign exchange market trading USD, EUR, and JPY. Determine the arbitrage profit/loss for each scenario.

Exchange rate	USD	EUR	JPY
USD	1.00000	0.78230	81.200
EUR	1.27830	1.00000	103.796
JPY	0.01232	0.00963	1.000

- (a) USD → EUR → JPY → USD.

**Solution:**

$$\$10,000 \rightarrow 7,823 \text{ EUR} \rightarrow 811,996 \text{ JPY} \rightarrow \$10,004$$

**Arbitrage gain:** \$4 (less than \$10 threshold, so no significant arbitrage opportunity)

- (b) USD → JPY → EUR → USD.

**Solution:**

$$\$10,000 \rightarrow 812,000 \text{ JPY} \rightarrow 7,820 \text{ EUR} \rightarrow \$9,996$$

**Arbitrage loss:** \$4 (less than \$10 threshold, so no significant arbitrage opportunity)

## 11.10 Summary: Open Economy

### Key Formula

#### Key Open Economy Identities:

$$NX = X - M \quad (67)$$

$$NCO = NX \quad (68)$$

$$S = I + NCO \quad (69)$$

$$\text{Real ER} = \text{Nominal ER} \times \frac{P_d}{P_f} \quad (70)$$

### Exam Focus

**High-Yield:** National accounts with NCO, exchange rate effects, policy effectiveness under different regimes, PPP calculations.

**Mistakes:** Forgetting NCO = NX, ignoring exchange rate feedback on NX, mixing up regime effects.

**Time:** National accounts 15 min, exchange analysis 10–12 min, policy regimes 20 min, PPP 12 min.

## A Complete Formula & Facts Reference

### A.1 Chapter 1: GDP

$$Y = C + I + G + NX$$

$$\text{Real GDP} = \frac{\text{Nominal GDP}}{\text{Deflator}} \times 100$$

$$\text{Value Added} = \text{Revenue} - \text{Cost of Inputs}$$

### A.2 Chapter 2: Inflation

$$\text{CPI}_t = \frac{\text{Cost}_t}{\text{Cost}_{\text{base}}} \times 100$$

$$\pi = \frac{\text{CPI}_t - \text{CPI}_{t-1}}{\text{CPI}_{t-1}} \times 100\%$$

$$r \approx i - \pi$$

### A.3 Chapter 3: Unemployment

$$u = \frac{\text{Unemployed}}{\text{LF}} \times 100\%$$

$$\text{LFPR} = \frac{\text{LF}}{\text{WAP}} \times 100\%$$

$$u_n = u_{\text{fric}} + u_{\text{struct}}$$

### A.4 Chapter 4: Growth

$$g_{\text{GDP/cap}} \approx g_{\text{nom}} - g_{\pi} - g_{\text{pop}}$$

$$\text{Doubling} \approx \frac{70}{g}$$

$$g_Y = g_A + \alpha g_K + (1 - \alpha) g_L$$

### A.5 Chapter 5: AE Model

$$AE = C + I + G + NX$$

$$C = C_0 + MPC(Y - T)$$

$$m = \frac{1}{1 - MPC}$$

$$\Delta Y = m \times \Delta A$$

### A.6 Chapter 6: AD-AS

$$\text{SRAS} : Y = Y_p + \alpha(P - P^e)$$

$$\text{LRAS} : Y = Y_p$$

### A.7 Chapter 7: Fiscal Policy

$$m_G = \frac{1}{1 - MPC}$$

$$m_T = -\frac{MPC}{1 - MPC}$$

$$\text{Deficit} = G - T$$

$$\text{Debt}_t = \text{Debt}_{t-1} + \text{Deficit}_t$$

$$\text{Private Saving} = Y - T - C$$

$$\text{Public Saving} = T - G$$

$$\text{National Saving} = \text{Private Saving} + \text{Public Saving}$$

### A.8 Chapter 8: Financial Markets

$$S_{\text{total}} = S_{\text{priv}} + S_{\text{gov}} + S_{\text{for}}$$

$$S(r^*) = I(r^*)$$

### A.9 Chapter 9: Money

$$M1 = \text{Currency} + \text{Checking}$$

$$M2 = M1 + \text{Savings}$$

$$m_{\text{money}} = \frac{1}{RR}$$

### A.10 Chapter 10: Inflation

$$MV = PY$$

$$g_M + g_V = g_P + g_Y$$

$$\pi = \pi^e - \beta(u - u_n) + \epsilon$$

### A.11 Chapter 11: Open Economy

$$NX = X - M$$

$$NCO = NX$$

$$S = I + NCO$$

$$\text{Real XR} = \text{Nom XR} \times \frac{P_d}{P_f}$$

## B Examination Preparation Guide

### B.1 Overview of Practice Resources

The Quantitative Research Society has compiled a comprehensive examination preparation package consisting of one tutorial-based mock examination and five full-length practice examinations. Together, these resources provide over 12 hours of realistic practice under examination conditions.

Resource	Questions	Marks	Time	Description
Final Mock Exam	20	60	90 min	Mini mock conducted during tutorial class with solutions compiled by QRS
Practice Exam 1	37	100	120 min	Foundation exam based on tutorial questions
Practice Exam 2	37	100	120 min	Advanced topics based on tutorial questions
Practice Exam 3	37	100	120 min	Comprehensive coverage based on tutorial questions
Practice Exam 4	37	100	120 min	Anti-memorization exam with adapted tutorial questions
Practice Exam 5	37	100	120 min	Sophisticated analysis with adapted tutorial questions
<b>TOTAL</b>	<b>205</b>	<b>560</b>	<b>750 min</b>	<b>12.5 hours practice</b>

### B.2 Examination Structure

#### Standard Format (Practice Exams 1–5):

All five practice examinations follow the identical structure expected in the actual final examination:

- **Question 1:** 15 calculation questions (2 marks each = 30 marks total)
- **Question 2:** 10 short-answer questions (3 marks each = 30 marks total)
- **Question 3:** 10 true/false questions with justification (3 marks each = 30 marks total)
- **Question 4:** 2 diagram-related questions (5 marks each = 10 marks total)
- **Total:** 100 marks, 120 minutes (2 hours)

#### Mock Examination Format:

The tutorial mock examination has a condensed format designed for in-class practice:

- 20 questions across multiple question types
- 60 marks total
- 90 minutes duration
- Solutions compiled by QRS based on tutorial discussions

### B.3 Resource Categorization

#### B.3.1 Tutorial-Based Examinations (Direct Questions)

Practice Exams 1–3 use questions *directly from* or with *minimal adaptations* from the 12 tutorial problem sheets (T01–T12):

- **Practice Exam 1 (Foundation):** 70% direct tutorial questions, 30% adapted
  - Focus: Core concepts and standard calculations
  - Difficulty: 5.0/10 (moderate baseline)
  - Best for: Initial practice and confidence building
  - Coverage: All 11 topics with standard difficulty

- **Practice Exam 2 (Advanced Topics):** 76% direct tutorial questions, 24% adapted
  - Focus: Challenging concepts (stagflation, TFP growth, balanced budget multiplier)
  - Difficulty: 5.1/10 (slightly elevated)
  - Best for: Mastering difficult material
  - Coverage: Emphasizes AD-AS shocks, growth accounting, policy trade-offs
- **Practice Exam 3 (Comprehensive):** 65% direct tutorial questions, 35% adapted
  - Focus: Real vs nominal analysis, Phillips curve with expectations
  - Difficulty: 5.0/10 (balanced)
  - Best for: Breadth of understanding across all topics
  - Coverage: Most balanced distribution across tutorials

**Key Feature:** These three examinations have **zero overlap**—all 111 questions are unique. Students can complete all three for maximum exposure to tutorial content without repetition.

### B.3.2 Adapted Examinations (Modified Questions)

Practice Exams 4–5 use questions *adapted from* tutorial sources with complete modifications (100% adaptation rate):

- **Practice Exam 4 (Anti-Memorization):** 100% adapted questions
  - Focus: Tests conceptual understanding vs rote memorization
  - Difficulty: 5.1/10
  - Adaptations: Reversed T/F logic, new numerical values, different contexts
  - Best for: Verification that concepts are truly understood
  - Strategy: Cannot rely on memorizing tutorial answers—must understand principles
- **Practice Exam 5 (Sophisticated Analysis):** 100% adapted questions
  - Focus: Advanced applications (sacrifice ratio, liquidity preference, J-curve)
  - Difficulty: 5.3/10 (highest of all five exams)
  - Adaptations: Mechanism explanations, derivations, comparative analysis
  - Best for: Final mastery assessment before exam
  - Challenge: Requires deeper understanding and synthesis across topics

**Key Feature:** Exams 4–5 reuse tutorial question *concepts* but present them differently, testing whether students can transfer knowledge to new contexts.

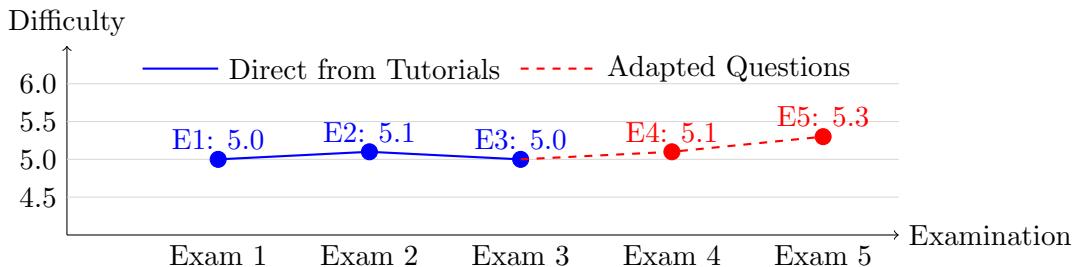
## B.4 Tutorial Coverage Analysis

Tutorial	Total Q's	E1	E2	E3	E4	E5	Coverage
T01	17	3	4	3	3	3	76%
T02	13	2	4	4	3	3	87%
T03	10	3	3	3	3	3	120%*
T04	12	3	4	3	3	3	108%*
T05	16	3	5	4	4	4	100%
T06	20	2	4	3	3	2	60%
T07	18	4	3	3	4	3	78%
T08	23	4	3	4	4	3	65%
T09	20	3	2	3	3	4	61%
T10	24	3	3	4	4	5	63%
T12	21	3	2	3	3	4	58%
<b>TOTAL</b>	<b>190</b>	<b>33</b>	<b>37</b>	<b>37</b>	<b>37</b>	<b>37</b>	<b>76%</b>

\*Over 100% indicates questions used in multiple exams with adaptations

**Analysis:** The five practice examinations collectively utilize 128 unique tutorial questions (67% of all 190 tutorial questions), with an additional 57 adapted reuses in Exams 4–5. This provides comprehensive coverage of tutorial content while maintaining examination diversity.

## B.5 Difficulty Progression



### Progression Strategy:

- **Exams 1–3** (blue): Foundation building with direct tutorial practice
- **Exams 4–5** (red): Sophistication and transfer with adapted questions
- **Overall:** Gradual difficulty increase from 5.0 to 5.3

## B.6 Diagram Mastery Guide

All five practice examinations include 2 diagram questions each (10 total diagrams across the bank). Mastering these diagrams is essential:

Exam	Diagram 1	Diagram 2	Difficulty
Exam 1	AD-AS Demand Shock	Loanable Funds (Crowding Out)	7/10
Exam 2	AD-AS Supply Shock (Stagflation)	Keynesian Cross	7/10
Exam 3	Phillips Curve (SR/LR)	Open Economy Loanable Funds	7/10
Exam 4	AD-AS (Positive Demand Shock)	Loanable Funds (Investment ↑)	7/10
Exam 5	Keynesian Cross (Multiplier)	Sacrifice Ratio (Phillips)	7.5/10

### Diagram Types Covered:

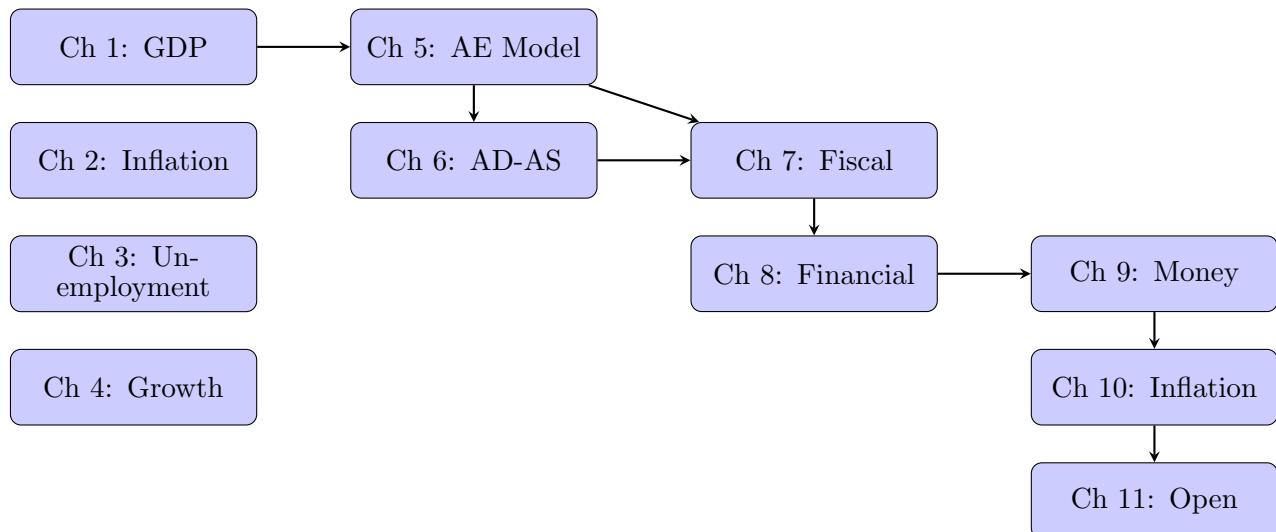
1. AD-AS Framework: Demand shocks (E1, E4), supply shocks (E2)
2. Loanable Funds: Government deficit crowding out (E1), investment increase (E4), open economy (E3)
3. Phillips Curve: SR/LR expectations (E3), sacrifice ratio (E5)
4. Keynesian Cross: Equilibrium (E2), multiplier process (E5)

### Diagram Practice Strategy:

1. Draw each diagram type from memory
2. Practice labeling axes, curves, and equilibrium points
3. Explain adjustment mechanisms verbally (as if teaching)
4. Compare related diagrams (e.g., all three loanable funds variations)
5. Time yourself: 15–20 minutes per diagram question

## C Chapter Connections and Dependencies

### C.1 Conceptual Flow



## D Quick Reference: All Key Formulas

**GDP & Growth:**

$$Y = C + I + G + NX$$

$$g_Y = g_A + \alpha g_K + (1 - \alpha) g_L$$

**Inflation:**

$$\pi = \frac{\Delta \text{CPI}}{\text{CPI}} \times 100\%$$

$$r \approx i - \pi$$

**Unemployment:**

$$u = \frac{U}{LF} \times 100\%$$

$$u_n = u_f + u_s$$

**Multipliers:**

$$m = \frac{1}{1 - MPC}$$

$$m_T = -\frac{MPC}{1 - MPC}$$

$$m_{\text{money}} = \frac{1}{RR}$$

**Loanable Funds:**

$$S(r^*) = I(r^*)$$

**Money:**

$$MV = PY$$

$$M2 = M1 + \text{Savings}$$

**Phillips:**

$$\pi = \pi^e - \beta(u - u_n)$$

**Open Economy:**

$$NCO = NX$$

$$S = I + NCO$$