

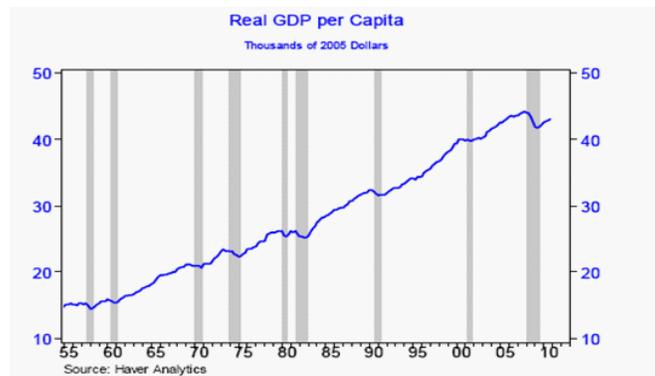
# SECTION 1: The Policy and Practice of Macroeconomics

## 1.1. The Purpose: Interpreting Macro Data

Macroeconomics focuses on 3 main indicators:

1. *Real GDP*
2. *The Unemployment Rate*
3. *Inflation*

Real GDP: measures the output of goods and services produced in an economy over some specific period of time

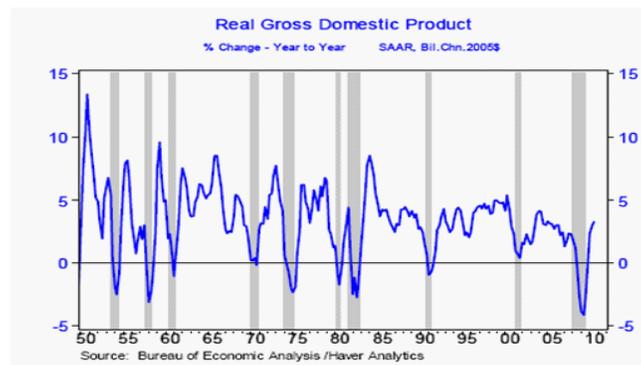


What do we mean by Real GDP per capita?

What is the trend? And what do we mean by business cycle? What is a stabilization policy?

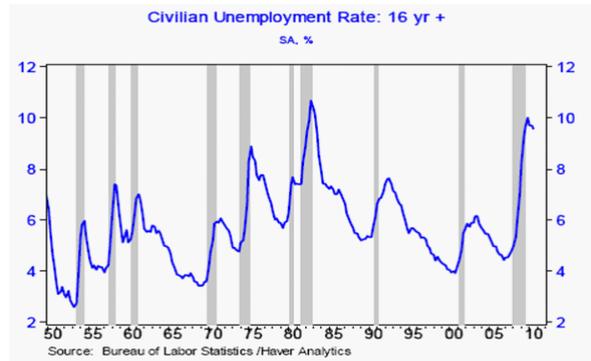
Why are there shaded areas in the figure?

What is the difference between a recession and a depression?



What do we mean by year to year percentage change in Real GDP? How is it calculated?

The Unemployment Rate: measures the percentage of the labor force who are actively looking for work but do not have jobs during a specified period of time

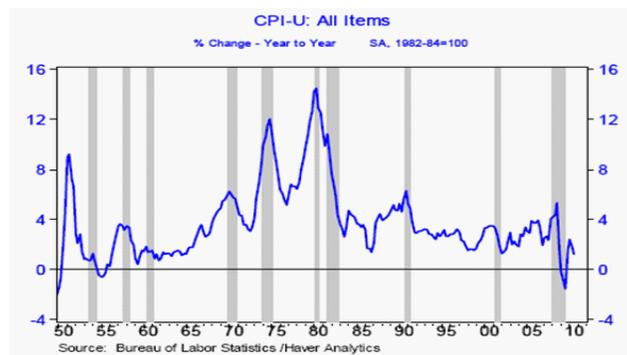


What is the civilian unemployment rate?

What does SA (Seasonally adjusted mean)?

What can we say about the unemployment rate in the US in the last couple years?

Inflation rate: measures how rapidly the overall price level is rising



Inflation vs. Deflation?

What is the CPI? Do you know of other price indexes?

## 1.2. Macroeconomic policy

Macroeconomic policies use economic models to determine how to produce better macroeconomic outcomes.

- Fiscal policy is the government's decisions about spending and taxes
- Monetary policy is the central bank's decisions about the level of short term interest rates or the growth of the money supply

They are important as they affect:

1. savings and consumption decisions
2. financial markets
3. trade imbalances

## Exercises

1. A simple macroeconomic model might explain how an increase in the demand for new housing would lead to a decrease in the rate of unemployment. In such a model, which of these variables is most likely to be exogenous?
  - (a) The demand for concrete.
  - (b) The wage rate for unskilled workers.
  - (c) The quantity sold of home furnishings.
  - (d) The degree of unionization of the construction industry.
  
2. If a large number of people were to leave their civilian jobs in order to join the military, which of the following would increase?
  - (a) The civilian labor force.
  - (b) The civilian employment ratio.
  - (c) The civilian unemployment rate.
  - (d) The civilian labor-force participation rate.

## Section 1 – Handout

### Macroeconomics vs. Microeconomics

**Macroeconomists** study aggregated indicators such as GDP, unemployment rates, and price indices to understand how the whole economy functions. Macroeconomists develop models that explain the relationship between such factors as national income, output, consumption, unemployment, inflation, savings, investment, international trade and international finance.

While macroeconomics is a broad field of study, there are two areas of research that are emblematic of the discipline: the attempt to understand the causes and consequences of short-run fluctuations in national income (the business cycle), and the attempt to understand the determinants of long-run economic growth (increases in national income).

In contrast, **microeconomics** is primarily focused on the actions of individual agents, such as firms and consumers, and how their behavior determines prices and quantities in specific markets.

### Real Gross Domestic Product (GDP)

Economists use many different methods to measure how fast the economy is growing. The most common way to measure the economy is real gross domestic product, or real GDP. GDP is the total value of everything—goods and services—produced in our economy. The word "real" means that the total has been adjusted to remove the effects of inflation.

There are at least three different ways to measure growth of real GDP. It is important to know which is being used, and to understand the differences among them. The three most common ways to measure real GDP are:

- Quarterly growth at an annual rate
- The four-quarter or "year-over-year" growth rate
- The annual average growth rate

**Quarterly growth at an annual rate** shows the change in real GDP from one quarter to the next, compounded into an annual rate. (This process is often called "annualizing.") For example, in the second quarter of 2001, the economy grew 0.1 per cent from the first quarter. If the economy had grown at that pace for an entire year, the annual growth would be 0.4 per cent. So the quarterly growth at an annual rate was reported at 0.4 per cent.

This measure is often used by the media. It does a good job of showing recent economic developments. But it also tends to be volatile. This is because the effects of any one-time-only factors during the quarter become compounded when the rate is annualized.

**The four-quarter, or "year-over-year" growth rate**, compares the level of GDP in one quarter to the level of GDP in the same quarter of the previous year. For example, in the second quarter of 2001, GDP was 2.1 per cent above that in the second quarter of 2000. This measure is popular among businesses, who generally present their own quarterly earnings results on that basis to avoid seasonal variations.

The year-over-year growth rate tends to be somewhat less volatile than quarterly growth at an annual rate. That is because the effect of any special factors does not get compounded. But it is also less timely, since it looks at what happened to the economy over the entire previous year, not just the past three months.

Finally, the **annual average growth rate** is the average of year-over-year percentage changes reported during a year.

### **Recession vs. Depression**

A **recession** is a business cycle contraction, a general slowdown in economic activity. Governments usually respond to recessions by adopting expansionary macroeconomic policies, such as increasing money supply, increasing government spending and decreasing taxation.

In the United States, the Business Cycle Dating Committee of the National Bureau of Economic Research (NBER) is generally seen as the authority for dating US recessions. The NBER defines an economic recession as: "a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales."

A **depression** is a sustained, long-term downturn in economic activity in one or more economies. It is a more severe downturn than a recession, which is seen by some economists as part of the modern business cycle.

In the United States the National Bureau of Economic Research determines contractions and expansions in the business cycle, but does not declare depressions. Generally, periods labeled depressions are marked by a substantial and sustained shortfall of the ability to purchase goods relative to the amount that could be produced using current resources and technology (potential output). Another proposed definition of *depression* includes two general rules: (1) a decline in real GDP exceeding 10%, or (2) a recession lasting 2 or more years.

⇒ Still there is some controversy over what is what: **2008–2012 global RECESSION**

### **Exogenous vs. Endogenous Variables**

**Exogenous variables:** independent variable that affects a model without being affected by it, and whose qualitative characteristics and method of generation are not specified by the model builder. An exogenous variable is used for setting arbitrary external conditions, and not in achieving a more realistic model behavior.

**Endogenous variables:** dependent variable generated within a model and, therefore, a variable whose value is changed (determined) by one of the functional relationships in that model.

Rule of thumb:

- endogenous: variable we are trying to explain.
- exogenous: variable not explained by the model, this value is given.

### **Civilian unemployment rate**

The number of unemployed people divided by the total size of the labor force, expressed as a percentage. The Unemployment Rate is the percentage of the civilian labor force who are:

1. Willing and able to work
2. Actively looking for work

### 3. Who do not have jobs

The labor force is defined as people who are either employed or unemployed.

Doesn't include discouraged workers. In the United States, a discouraged worker is defined as a person not in the labor force who wants and is available for a job and who has looked for work sometime in the past 12 months (or since the end of his or her last job if a job was held within the past 12 months), but who is not currently looking because of real or perceived poor employment prospects.

#### **Different measures of inflation**

CPI (Consumer Price Index)

GDP Deflator

The Personal Consumption Expenditure (PCE) Deflator

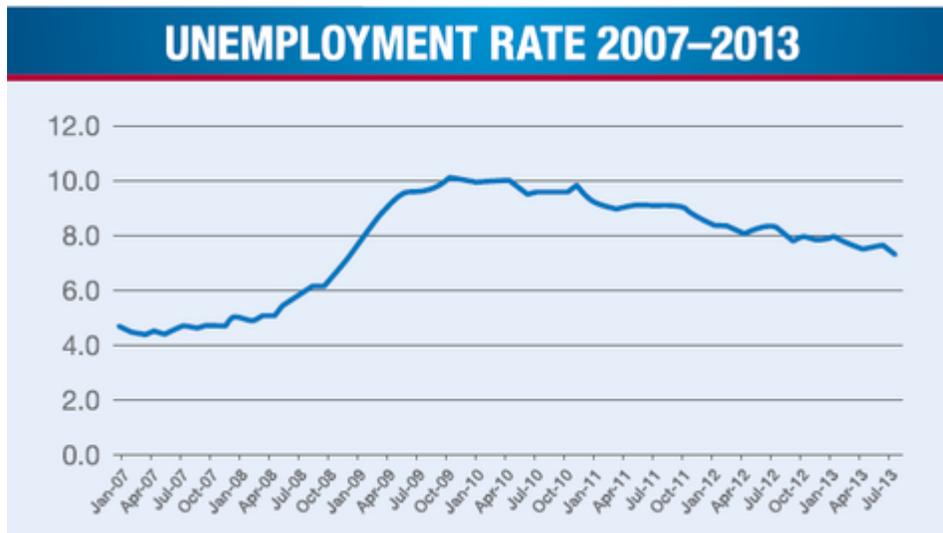


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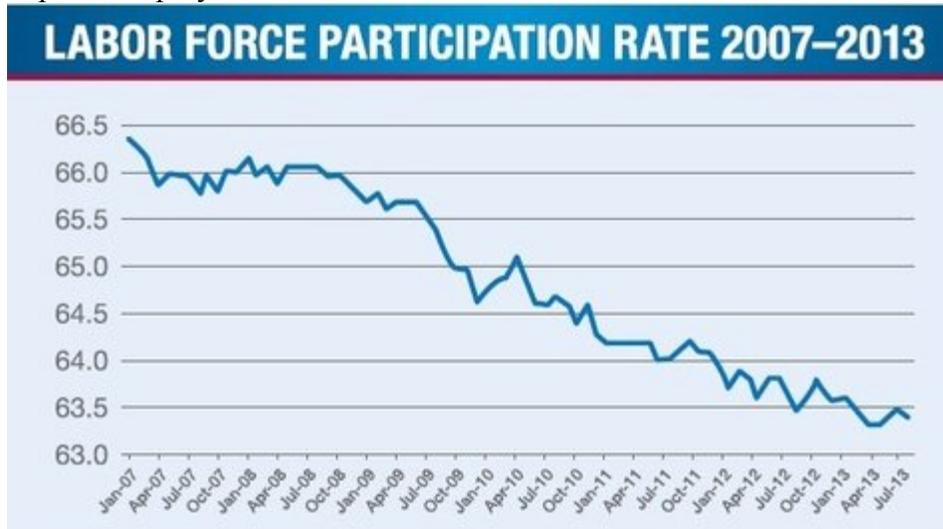
## ‘The Great Shift’: Americans Not Working

By [DAVID LEONHARDT](#)

Looking at these two charts together is a quick way to become demoralized about the American economy:



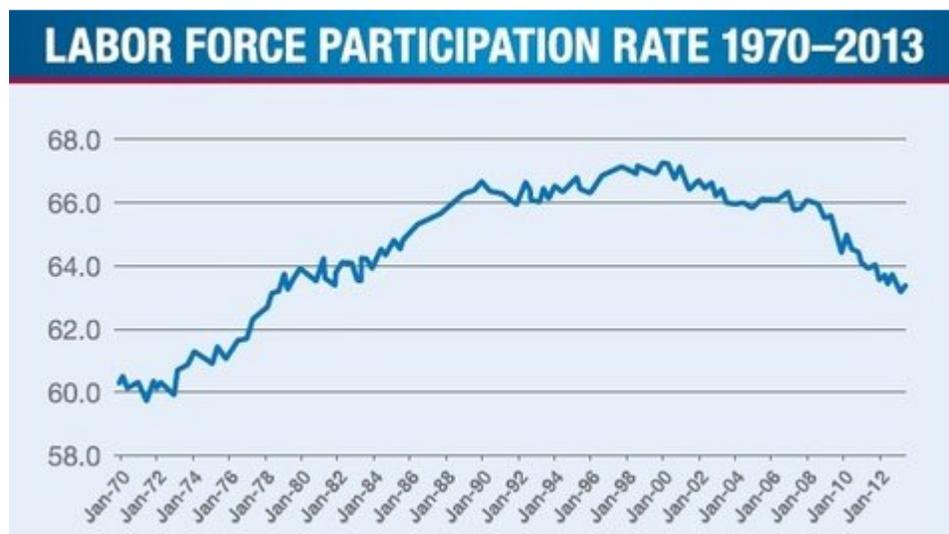
Express Employment Professionals Source: Bureau of Labor Statistics



Express Employment Professionals Source: Bureau of Labor Statistics

Yes, the unemployment rate has fallen. But almost the entire reason it has fallen is the drop in the number of people in the labor force — either working or actively looking. As Binyamin Appelbaum [has noted](#), the share of adult Americans with jobs is essentially unchanged over the last three years.

In a brief new report from [Express Employment Professionals](#), a staffing firm, the company's chief executive, Bob Funk, refers to the problem as “the great shift.” This shift long predates the recent financial crisis, too. The labor force participation rate peaked more than a decade ago.



Express Employment Professionals Source: Bureau of Labor Statistics

If the decline stemmed largely from an aging work force, it would be much less worrisome. But the initial wave of baby-boomer retirements plays [only a small role](#) in the drop; the labor force participation rate has fallen almost as sharply for people aged 25 to 54 as it has for the overall adult population.

As the report notes, economists are not entirely sure what has caused the shift. One factor seems to be the so-called skills gap — the [slow growth](#) in educational attainment in recent decades, even as the economy has become more technologically advanced.

A second factor is most likely the weak economic growth of the past 13 years: the 2000-1 dot-com bust, the mediocre expansion that followed, the financial crisis that began in 2007 and the disappointing recovery of the last few years.

Another cause may be the rise in the number of workers on disability. The report cites a [study by the Federal Reserve Bank of San Francisco](#) to argue that disability is helping cause the decline in work. That's [probably right](#), although it is worth remembering that the growth of the ranks of the disabled may be more of an effect of the jobs slump than a cause.

Either way, the decline in labor force participation almost certainly receives too little attention. Each month, small changes in the unemployment rate receive great scrutiny. We often overlook just how flawed a measure of the job market that rate has become over the last 13 years.

## SECTION 2: Measuring Macroeconomic Data

### 2.1. National Income Accounting

#### Introduction

Three different approaches:

1. *Product approach*: the dollar amount of output produced.
2. *Expenditure approach*: the dollar amount spent by purchasers.
3. *Income approach*: the dollar incomes earned by production.

Fundamental identity of national income accounting:

Total production = Total expenditure = Total income (at least in theory!)

#### Product approach

- the *current market value*
  - a. underground economy and household work such as cooking at home and cleaning are not included
  - b. imputed value: e.g. house owners, services provided by the government (national defense, police, firefighting, education).
- of all *final goods and services*: goods and services that are not completely used up in the production process. Include capital used to produce other goods and inventory investment.
- *newly produced*: a bike produced last year doesn't contribute to this year's GDP
- in the *domestic economy*: a computer produced in Japan doesn't contribute to the U.S. GDP
- *during a specified period of time*: usually a quarter or a year

#### Expenditure approach

- *total spending*:  $C + I + G + NX$ , where:
  - a.  $C$  = Consumption: spending by domestic households on final goods and services (durable goods, nondurable goods, services).
  - b.  $I$  = Investment: business (or non-residential) fixed investment plus residential fixed investments plus inventory investment.
  - c.  $G$  = Government purchases of goods and services (federal government purchases and state and local government purchases). Government transfer payments are not included!
  - d.  $NX$  = Net Exports: Exports-Imports
- on all *final goods and services* produced
- within the *domestic economy*: a computer produced in Japan and sold in the U.S. doesn't contribute to the U.S. GDP
- *during a specified period of time*

### Income approach:

- National Income = Compensation of employees + Other income + Corporate profits
- GNP (Gross National Product) = National Income + Depreciation
- GDP (Gross Domestic Product) = GNP + Net factor payments (equivalently: GNP - Net factor income)
- Private disposable income = GDP + Net factor income + Transfer payments from the government + Interest payments on government debt - Taxes
- Net government income = Taxes - Government transfer payments - Interest payments on government debt

## 2.2. Real versus Nominal GDP

- *Nominal variables* are measured in current dollar terms.
- *Real variables* are adjusted for changes in prices to reflect only quantity terms. They are considered a more accurate measure of economic activity
- *Price level*: the average level of prices in the economy

Real GDP is GDP evaluated at the market prices of some base year. For example, if 1990 were chosen as the base year, then real GDP for 1995 is calculated by taking the quantities of all goods and services purchased in 1995 and multiplying them by their 1990 prices.

## 2.3. Measuring Inflation

- Nominal GDP = Price Level  $\times$  Real GDP
- Three major price indexes to measure the price level and inflation (percentage change in the price level), and to “transform” real GDP into nominal GDP
  1. The GDP Deflator:  $P = 100 \times \frac{\text{nominal } GDP}{\text{real } GDP}$ , where  $P = 100$  in the base year
  2. The Personal Consumption Expenditure (PCE) Deflator:  $P = 100 \times \frac{\text{nominal } PCE}{\text{real } PCE}$ , where  $P = 100$  in the base year
  3. The Consumer Price Index (CPI): average prices of a specified *basket of goods and services* bought by consumers
- Inflation rate:  $\pi_t = (P_t - P_{t-1})/P_{t-1}$

## 2.4. Measuring Unemployment

The Unemployment Rate is the percentage of the civilian labor force who are:

1. Willing and able to work
2. Actively looking for work
3. Who do not have jobs

Definitions:

- Unemployment Rate = Unemployed/Labor Force
- Participation Rate = Labor Force/Population
- Employment Ratio = Employed/Population

where Labor Force = Employed + Unemployed

## 2.5. Measuring interest rates

An interest rate measures:

- the cost of borrowing
- the return to savings and lending

The Fisher Equation is the relationship between nominal and (ex-ante) real interest rates:

$$i = r + \pi^e$$

The real interest rate, which reflects the real cost of borrowing, is likely to be a better indicator of the incentives to borrow, invest and lend than the nominal interest rate.

## Exercises

1. Exercise 5 pag. 43, Mishkin

Mario and Lucia are discussing current economic data printed in the morning newspaper. Mario is quite happy about the fact that nominal GDP has increased at a steady rate for the last two years and asserts that this is very good news, since it means that they are better off than a few years ago. Lucia warns Mario about his conclusions and suggests that she has observed a steady increase in many prices during the same period, which might undermine Mario's conclusions. Based on this information:

- (a) Who do you think is right? Explain why.
- (b) Is it possible that Mario and Lucia could be worse off than two years ago?

2. Exercise 6 pag. 44, Mishkin

Based on surveys conducted by the BLS, the CPI basket assigns a weight of approximately 15% to transportation spending. Suppose you walk to your workplace every day and you do not use any other means of transportation.

- (a) With everything else the same, if the price of transportation services increase by 10%, by how much would the CPI increase?
- (b) Is the CPI measuring the true change in your cost of living?

3. Exercise 8 pag. 44, Mishkin

Use the accompanying table to calculate the following statistics for Brazil: a) labor force b) labor force participation rate c) unemployment rate

- Adult population (millions): 140
- Unemployed (millions): 7
- Employed (millions): 88

4. Which of the following goods is not included in the GDP under the product approach:

- (a) home-made spaghetti
- (b) local retailer's bicycles
- (c) national defense
- (d) digital cameras produced in the US and sold in Germany.

5. Which of the following categories is not included in the GDP under the expenditure approach?

- (a) household consumption of fruits and vegetables
- (b) government payment of unemployment insurance benefits
- (c) firms' purchase of new machinery
- (d) goods produced abroad and consumed domestically

6. Under the expenditure approach, which of the following is considered consumption?

- (a) purchase of houses
- (b) change in inventories held by firms
- (c) government purchase of offices
- (d) education

7. Under the income approach, which of the following variables is not included in the GDP?

- (a) corporate profits

- (b) dividends paid to shareholders
  - (c) income of the self-employed
  - (d) wages earned abroad by domestic residents
8. Which of the following does not increase private disposable income?
- (a) Positive net factor income
  - (b) Interest payments on government debt
  - (c) Transfer payments from the government
  - (d) Depreciation
9. Assume you take 2011 as your base year and that your economy produces only two goods (hamburgers and cupcakes). Assume that in 2011 10,000 hamburgers and 50,000 thousands cupcakes are produced, at a price of \$10 and \$4 respectively. In 2012 the same quantities are produced, but prices went up to \$15 and \$6 respectively.
- (a) What is the change in real GDP? And in nominal GDP?
  - (b) What about the GDP Deflator in 2012? By how much did prices increase between 2011 and 2012?
10. Assume your measure of inflation is the GDP Deflator. Nominal GDP in 2011 (these are real data) in the US was \$15 trillion, and it was \$14.4 trillion in 2010. If you assumed that quantities produced didn't changed over time and took 2010 as the base year, what would be the inflation rate between 2010 and 2011?
11. Which of these variables does the Fisher equation allow you to compute?
- (a) the natural rate of unemployment
  - (b) the ex-ante real interest rate
  - (c) actual inflation
  - (d) GDP growth rate

## SECTION 3: Aggregate Production and Productivity

### 3.1. Aggregate Production and Underlying Assumptions

- *Production function*  $Y = AF(K, L)$ , in which:
  - the factors of production are:
    1. *Labor* ( $L$ ): the total number of worker hours
    2. *Capital* ( $K$ ): the stock of productive assets (real value of physical capital)
  - *technology (or total factor productivity)* ( $A$ ): is a measure of the productivity of the factors of production. It takes into account how productive labor and capital are together.

Example: Cobb-Douglas production function:  $Y = AK^\alpha L^{1-\alpha}$

- Assumptions we are making while studying the equilibrium in the labor and capital markets:
  1. The labor market is competitive
  2. Workers are homogeneous
  3. Supply of capital is fixed
  4. Firms maximize profits
  5. Individuals maximize utility

### 3.2. Equilibrium in Capital and Labor Markets

#### Output and Capital and the Equilibrium in the Capital Market

- The production function between output and capital shows how economic output,  $Y$ , depends on the size of the capital stock,  $K$ , for a given labor force,  $L_0$ , and for a given level of technology,  $A_0$ .
- Equilibrium in the capital market:
  - The demand for capital depends on the marginal product of capital  $MPK = \frac{\Delta Y}{\Delta K}$ , which:
    1. equals the slope of the production function
    2. is always positive
    3. declines as the amount of capital increases (diminishing marginal product)

Factors that shift the demand for capital curve:

1. Changes in the labor force,  $\Delta L$ .
  2. Supply (or technology) shocks,  $\Delta A$ .
- The supply of capital is fixed:  $K_s = \bar{K}$
  - In equilibrium, capital demand equals capital supply, and:
    - \* the real cost of capital,  $r_c$ , equals the marginal product of capital
    - \* capital demanded equals capital supplied

## Output and Labor and the Equilibrium in the Labor Market

- Symmetric to what we just did for Output and Capital. Instead of focusing on capital we are now focusing on labor.
- The production function between output and labor shows how economic output,  $Y$ , depends on the size of the labor force,  $L$ , for a given capital stock,  $K_0$ , and for a given level of technology,  $A_0$ .
- Equilibrium in the labor market:
  - The demand for labor depends on the marginal product of labor  $MPL = \frac{\Delta Y}{\Delta L}$ 
    1. Equals the slope of this production function.
    2. Is always positive.
    3. Declines as the amount of labor increases.
  - Factors that shift the demand for labor curve:
    1. Changes in the capital stock,  $\Delta K$ .
    2. Supply (or technology) shocks,  $\Delta A$ .
  - The supply of labor doesn't depend on wages (in this sense it is fixed  $L_s = \bar{L}$ ), but there are some factors that could shift the labor supply curve:
    1. Changes in wealth
    2. Changes in expected future real wage
    3. Changes in the working-age population
    4. Changes in the labor force participation rate
  - In equilibrium, labor demand equals labor supply, and:
    - \* the real cost of labor (real wage),  $w$ , equals the marginal product of labor
    - \* labor demanded equals labor supplied

### 3.3. Full-Employment Output

- Full-employment, or potential, output is the level of output when the labor market is in (long-run) equilibrium.

$$Y^P = AF(K, \bar{L})$$

- Factors that change full-employment output:
  1. Shifts in the demand for labor and/or supply of labor.
  2. Shifts in the production function (supply shocks or changes in capital)

### 3.4. Supply shocks

- *Supply (or productivity) shocks* occur if there is a change in the amount of output that can be produced with a given amount of capital and labor. They can occur because of:
  1. Technology shocks
  2. Natural environmental shocks
  3. Energy price shocks
- Supply shocks involve *changes in A* and *rotate* the production function.
  - A positive supply shock causes:
    1. The production function to rotate higher,
    2. The marginal product of capital to increase,
    3. The real (rental) cost of capital to increase,
    4. The marginal product of labor to increase, and
    5. The real wage to increase.
  - A negative supply shock has opposite effects.

## Exercises

1. An adverse supply shock would:
  - (a) Shift the production function up and decrease marginal products at every level of employment.
  - (b) Shift the production function down and decrease marginal products at every level of employment.
  - (c) Shift the production function down and increase marginal products at every level of employment.
  - (d) Shift the production function up and increase marginal products at every level of employment.
2. Which of the following events would lead to an increase in the marginal product of labor for every quantity of labor?
  - (a) An increase in the real wage.
  - (b) A decrease in the real wage.
  - (c) A favorable supply shock such as a fall in the price of oil.
  - (d) An adverse supply shock such as a reduced supply of raw materials.
3. A tremendous flood along the Mississippi River destroys thousands of factories, reducing the nation's capital stock by 5%. What happens to current employment and the real wage rate if labor supply is positively related to the real wage?
  - (a) Both employment and the real wage rate would increase.
  - (b) Both employment and the real wage rate would decrease.
  - (c) Employment would increase and the real wage rate would decrease.
  - (d) Employment would decrease and the real wage rate would increase.
4. Which of the following is (are) likely to cause the marginal product of labor to decrease?
  - (a) A decrease in the real wage.
  - (b) An increase in total factor productivity.
  - (c) A decrease in the amount of labor used in production.
  - (d) All of the above.
  - (e) None of the above.
5. Europe has been experiencing an unusually harsh winter with well above average snowfalls and well below average temperatures. This has significantly disrupted transportation throughout Europe. As a result:
  - (a) Both the real wage and the real rental cost of capital would increase.
  - (b) Both the real wage and the real rental cost of capital would decrease.
  - (c) The real wage would increase but the real rental cost of capital would decrease.
  - (d) The real wage would decrease but the real rental cost of capital would increase.

• Analytical question #1. *Production Functions and Labor Markets.*

Suppose that Haiti's labor supply function can be described as a positive function of the real wage. Assume that in 2008, Haiti was at its full-employment level of output.

1. Use diagrams of the production function and labor market to clearly and accurately show Haiti's initial 2008 level of employment, output and the real wage. These diagrams should be drawn in BLACK.
2. In 2009 an earthquake in Port-au-Prince, Haiti destroyed thousands of factories, reducing the nation's capital stock by 25%. Based only on this information, clearly and accurately show this effect of the earthquake on Haiti's economic output, employment, and the real wage. These changes should be drawn in RED.

3. Also as a result of the earthquake, up to 200,000 people were killed, reducing the labor force by 15%. Based only on this information, clearly and accurately show this effect of the earthquake on Haiti's economic output, employment, and the real wage. These changes should be drawn in BLUE.
  4. Provide a brief economic explanation of each of the changes you have shown in your diagrams above. Be sure to discuss what happens to economic output, employment, and the real wage rate at each step and to explain why these changes take place.
- Analytical Question #2 (Spring 2012). *Production Functions, Labor Markets, and Capital Markets.*

Suppose that an economy is initially at its full-employment level of output, that labor supply is a positive function of the real wage, and that the capital stock is fixed.

1. Based only on this information, use a Production Function diagram (on the left) and a Labor Market diagram (on the right) to clearly and accurately show the economy's initial levels of economic output, employment, and the real wage rate. These diagrams should be drawn in BLACK.
2. Provide an economic explanation of what you have shown in your diagrams above.
3. Now use a Production Function diagram (on the left) and a Capital Market diagram (on the right) to clearly and accurately show the economy's initial levels of economic output, the capital stock, and the real (rental) cost of capital. These diagrams should be drawn in BLACK.
4. Provide an economic explanation of what you have shown in your diagrams above.
5. Now suppose that the economy experiences a massive earthquake that destroys a significant portion of the capital stock but, fortunately, does not kill anyone. Incorporating only this additional information, clearly and accurately show in your diagrams above what effects this would have on economic output, employment, the real wage, the capital stock, and the real (rental) cost of capital. These effects should be drawn in RED.
6. Provide an economic explanation of what you have shown in your diagrams above. Discuss what happens to economic output, employment, the real wage rate, the capital stock, and the real (rental) cost of capital. Be sure to explain why this takes place.
7. Now suppose that the capital stock that was destroyed was heavily embedded with new technologies. Incorporating only this additional information, clearly and accurately show in your diagrams above what effects this would have on economic output, employment, the real wage, the capital stock, and the real (rental) cost of capital. These effects should be drawn in BLUE.
8. Provide an economic explanation of what you have shown in your diagrams above. Discuss what happens to economic output, employment, the real wage rate, the capital stock, and the real (rental) cost of capital. Be sure to explain why this takes place.

## SECTION 4: Saving and Investment in Closed and Open Economies, Part 1

### 4.1. Saving and Wealth

#### 4.1.1 Saving: flow variable

- National saving:  $S = S_P + S_G$ , where:

Private saving:  $S_P = Y - T - C$

Government saving:  $S_G = T - G_c \cong T - G$  (= budget surplus if  $T - G > 0$   
budget deficit if  $T - G < 0$ )

It follows that  $S = Y - T - C + T - G = Y - C - G$

- National saving rate (not equal to private saving rate+government saving rate!):  $\frac{S}{Y} * 100$

Private saving rate:  $\frac{S_P}{(Y-T)} * 100$

Government saving rate:  $\frac{S_G}{Y} * 100$

- Combining the saving identity:  $S = Y - C - G$  and the national income identity:  $Y = C + I + G + NX$  we get:

$$\begin{aligned} S &= I + NX \\ S - I &= NX \end{aligned}$$

1. National saving is used to:

- (a) finance domestic investment ( $I$ )
- (b) finance net export surpluses ( $NX$ )

2. Implications:

- (a) if  $S - I > 0$ , then  $NX > 0 \Rightarrow$  Net capital outflows and trade surplus (or current account surplus)
- (b) if  $S - I < 0$ , then  $NX < 0 \Rightarrow$  Net capital inflows and trade deficit (or current account deficit)

3. We also get:  $S_P = I + (-S_G) + NX$ . In other words private saving is used to:

- (a) finance domestic investment ( $I$ )
- (b) finance government budget deficit ( $-S_G$ )
- (c) finance net export surpluses ( $NX$ )

#### 4.1.2. Wealth: stock variable

- Wealth = Assets - Liabilities, where:

1. Assets include: productive assets, financial assets and nonproductive assets
2. Liabilities are the debts owed

- A country's wealth is the value of its:

1. Domestic physical assets plus
2. Net foreign assets

- Changes in a country's wealth due to:

- a. national saving: through increase in  $I$  or  $NX$
- b. changes in the value of existing net assets

## 4.2. Saving and Investment

- The national income identity is:

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

let's look at little more closely at the determinants of consumption, saving, and investment

- Consumption:

$$C = \bar{C} + C(Y - T, r)$$

(+)                      (-)

where  $\bar{C}$  is autonomous consumption and changes with:

1. changes in wealth
2. changes in expected future income
3. changes in consumer confidence ("animal spirits")

Assume that:

- fiscal policy is exogenous ( $G = \bar{G}, T = \bar{T}$ ) and that
- $L = \bar{L}$  and  $K = \bar{K}$  are exogenously determined and correspond to the long run levels of labor and capital, so that  $Y = AF(\bar{K}, \bar{L}) = \bar{Y}$ .

Then the national saving can be written as:

$$\begin{aligned} S &= Y - C - G \\ &= \bar{Y} - \bar{C} - C(\bar{Y} - \bar{T}, r) - \bar{G} \end{aligned}$$

(+)                      (-)

National saving  $S$  is a positive function of the real interest rate  $r$ .

- Investment:

$$I = \bar{I} + I(r)$$

(-)

where  $\bar{I}$  is autonomous investment and changes with:

1. changes in expected future marginal product of capital
2. changes in the effective corporate tax rate
3. business confidence/optimism
4. changes in technology

National investment  $I$  is a negative function of the real interest rate  $r$

- Graphically, in the saving-investment diagram:

1. saving function is upward sloping and describes:

- (a) desired saving
- (b) the supply of loanable funds

2. investment function is downward sloping and describes:

- (a) desired investment
- (b) the demand for loanable funds

## Exercises

- In goods market equilibrium in an open economy:
  - The desired amount of exports must equal the desired amount of imports.
  - The desired amount of exports must equal the desired amount of imports minus net exports.
  - The desired amount of national saving must equal the desired amount of domestic investment.
  - The desired amount of national saving must equal the desired amount of domestic investment plus net exports.
- Suppose the government has a balanced budget when private saving is \$100. If investment is \$150 then:
  - The country has a trade deficit of \$50.
  - The country has a trade surplus of \$50.
  - The country has a trade surplus of \$250.
  - Net exports cannot be determined.
- In the 1990s, the private saving rate fell dramatically in the U.S. However, the investment rate increased. This would be fully explained by:
  - An increase in the budget balance.
  - A decrease in the net export balance.
  - An increase in the net export balance.
  - a and b.
  - a and c.
- If the world real interest rate were to fall below the rate at which domestic saving and domestic investment would be equal then:
  - Saving would be greater than investment so the economy would be running a trade surplus.
  - Investment would be greater than saving so the economy would be running a trade surplus.
  - Saving would be greater than investment so the economy would be running a trade deficit.
  - Investment would be greater than saving so the economy would be running a trade deficit.
- If consumers (but not businesses) believe that a recession will occur next year, then what would happen to the real interest rate and investment this year?
  - Both the real interest rate and investment would increase.
  - Both the real interest rate and investment would decrease.
  - The real interest rate would increase but investment would decrease.
  - The real interest rate would decrease but investment would increase.
- Suppose there is a new invention that increases autonomous investment (in a closed economy). This would cause the desired investment curve to shift to the \_ \_ \_ \_ and would cause the real interest rate to \_ \_ \_ \_ .
  - Left; increase.
  - Left; decrease.
  - Right; increase.
  - Right; decrease.
  - Left; remain unchanged.
  - Right; remain unchanged.

## SECTION 5: Saving and Investment in Closed and Open Economies, Part 2

### 5.1. Saving and Investment in Closed Economies

- Closed economies are economies in which both imports ( $M$ ) and exports ( $X$ ) are zero. Therefore  $NX = 0$ .
- In a closed economy the goods market equilibrium is  $S = I$ 
  1. An increase in *desired saving* will:
    - (a) Reduce that country's real interest rate, and
    - (b) Increase that country's desired investment
  2. An increase in *desired investment* will:
    - (a) Increase that country's real interest rate, and
    - (b) Increase that country's desired saving

### 5.2. Saving and Investment in Open Economies

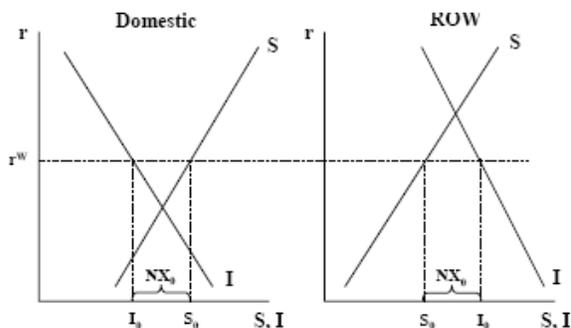
- Open economies are economies in which both imports ( $M$ ) and exports ( $X$ ) can be different from zero. Therefore  $NX \geq 0$  or  $NX \leq 0$ . When we talk about open economies we also assume *perfect capital mobility* (which implies that the domestic real interest rate  $r$  must be the same as the world interest rate  $r_w$ )
- In an open economy the goods market equilibrium is  $S = I + NX$

#### 5.2.1 Small Open Economies

- A small open economy:
  1. is open to international trade and capital flows
  2. is too "small" relative to the world economy to affect the world real interest rate
- An increase in *desired saving* will:
  - a. Not change that country's real interest rate.
  - b. Not change that country's desired investment.
  - c. Increase that country's net export balance.
  - d. Increase that country's net foreign lending (or reduce that country's net foreign borrowing)
- An increase in *desired investment* will:
  - a. Not change that country's real interest rate.
  - b. Not change that country's desired saving.
  - c. Reduce that country's net export balance.
  - d. Reduce that country's net foreign lending (or increase that country's net foreign borrowing)

## 5.2.2 Large Open Economies

- A large open economy:
  1. is open to international trade and capital flows.
  2. is “large” enough relative to the world economy to affect the world real interest rate.
- The world real interest rate,  $r_w$ , must adjust so that the *international lending* by one country is *exactly equal* to the *international borrowing* by the other country (and so that the *net export surplus* in one country is exactly equal in magnitude to the *net export deficit* in the other country)



- An increase in *desired saving* will:
  - a. Cause the world real interest rate to fall.
  - b. Increase that country’s investment.
  - c. Increase that country’s net export balance.
  - d. Increase that country’s net foreign lending (or reduce that country’s net foreign borrowing).
- An increase in *desired investment* will:
  - a. Cause the world real interest rate to rise.
  - b. Increase that country’s desired saving.
  - c. Reduce that country’s net export balance.
  - d. Reduce that country’s net foreign lending (or increase that country’s net foreign borrowing).

## Exercises

- Suppose there is an increase in personal income taxes in a small open economy. This would cause the desired saving curve to shift to the \_ \_ \_ \_ and would cause the real interest rate to \_ \_ \_ \_ .
  - Left; increase.
  - Left; decrease.
  - Right; increase.
  - Right; decrease.
  - Left; remain unchanged.
  - Right; remain unchanged.
- Assume that Costa Rica's government budget deficit is reduced by 10 million colon (the Costa Rican currency). Assuming Costa Rica is a small open economy, you would expect this government's action to:
  - Increase net foreign lending by exactly 10 million colon.
  - Increase net foreign lending by less than 10 million colon.
  - Increase net foreign lending by more than 10 million colon.
  - Increase net foreign borrowing by exactly 10 million colon.
  - Increase net foreign borrowing by more than 10 million colon.
  - Increase net foreign borrowing by less than 10 million colon.
- If corporate income taxes rise in a large open economy it would cause the net export balance to \_ \_ \_ \_ and national saving to \_ \_ \_ \_ .
  - Increase; increase.
  - Increase; decrease.
  - Increase; remain unchanged.
  - Decrease; decrease.
  - Decrease; increase.
  - Decrease; remain unchanged.
- When a beneficial supply shock hits a small open economy it causes the current account to \_ \_ \_ \_ and investment to \_ \_ \_ \_ .
  - Increase; decrease.
  - Decrease; decrease.
  - Increase; remain unchanged.
  - Decrease; remain unchanged.
- Suppose that a small open economy is currently experiencing large net capital outflows. If that country then imposes capital controls that prohibits domestic residents from engaging in foreign borrowing and lending activities, this would cause:
  - The net export balance to increase.
  - Desired national saving to decrease.
  - The real world interest rate to decrease.
  - The closed economy real interest rate to increase.
- The real domestic interest rate would decrease in a large open economy if:

- (a) There was a positive domestic supply shock.
  - (b) Foreigners decided to reduce their national saving rate.
  - (c) There was a negative supply shock abroad in a small open economy.
  - (d) The government imposed capital controls when there was a current account deficit.
- Analytical question #1 (Fall 2011). *Open Economy  $S^d - I^d$  Model.*

Suppose that the world economy is in equilibrium and composed of only two large, open-economy countries—the United States and the Euro-region—with the U.S. running a substantial net export deficit.

1. Based only on this information, use a 2-country Open Economy  $S^d - I^d$  diagram to clearly and accurately show the world interest rate and both countries' initial levels of desired saving, desired investment, and net export balance. These diagrams should be drawn in BLACK.
  2. Provide an economic explanation of what you have shown in your diagrams above.
  3. Now suppose that the U.S. government decreases the effective corporate tax rate and, as a result, there is a sharp increase in stock prices. Based only on this additional information, clearly and accurately show what effect this would have on the world interest rate and desired national saving, desired investment, and the net export balance in both countries. These changes should be drawn in RED.
  4. Provide an economic explanation of the changes you have shown in your diagram above. Be sure to discuss what happens to the world real interest rate and desired national saving, desired investment and the net export balance in both countries. Be sure to explain why these changes take place.
- Analytical question #2 (Fall 2011). *Production Function and Desired Saving-Desired Investment Models.*

Suppose that the Irish economy is a small open economy with perfect capital mobility.

1. In 2008, Ireland's economy was in equilibrium with a net export surplus. Use a Production Function diagram to clearly and accurately show (on the left) Ireland's initial labor and economic output equilibrium. In addition, use a Desired Saving-Desired Investment diagram to clearly and accurately show (on the right) Ireland's initial desired saving, desired investment, and net exports. These diagrams should be drawn in BLACK.
  2. In 2009, an economic crisis led to a substantial decline in total factor productivity. Based only on this information, clearly and accurately show on your diagrams above what effects this would have on economic output, desired saving, desired investment, net exports, and the real interest rate. These changes should be drawn in RED.
  3. Provide an economic explanation of the changes that you have shown in your diagrams above. Be sure to explain why these changes take place.
  4. Because of the economic crisis, a substantial number of workers left Ireland and moved to other countries. Based only on this information, clearly and accurately show on your diagrams above what effects this would have on economic output, desired saving, desired investment, net exports, and the real interest rate. These changes should be drawn in BLUE.
  5. Provide an economic explanation of the changes that you have shown in your diagrams above. Be sure to explain why these changes take place.
- Analytical question #3 (Fall 2012). *Desired Saving - Desired Investment Model.*

Assume that the world is composed of only two large open economies — the U.S. and China — with perfect capital mobility and that the U.S. engages in large persistent net foreign borrowing.

1. Based only on this information, use an open economy Desired Saving - Desired Investment Model diagram for each country (the U.S. on the left, China on the right) to clearly and accurately show each economy's initial (1) equilibrium real interest rate, (2) desired saving, (3) desired investment, (4) net exports. These diagrams should be drawn in BLACK.

2. Now suppose that China experiences a large increase in its total factor productivity, a gain that also increases the expected future marginal product of capital that results in an increase in China's net export balance. Incorporating only this new information, clearly and accurately show in your diagrams above what effects, if any, this would have on each country's (1) real interest rate, (2) desired saving, (3) desired investment, and (4) net export balance. These effects should be drawn in RED.
3. Provide an economic explanation of what you have shown in your diagrams above. Discuss what, if anything, happens to each country's (1) real interest rate, (2) desired saving, (3) desired investment, and (4) net export balance. Be sure to explain why these effects take place and what causes them.
4. Subsequently, there is an increase in the U.S. national saving rate although the U.S. continues to engage in net foreign borrowing. Incorporating only this new information, clearly and accurately show in your diagrams above what effects, if any, this would have on each country's (1) real interest rate, (2) desired saving, (3) desired investment, and (4) net export balance. These effects should be drawn in BLUE.
5. Provide an economic explanation of what you have shown in your diagrams above. Discuss what, if anything, happens to each country's (1) real interest rate, (2) desired saving, (3) desired investment, and (4) net export balance. Be sure to explain why these effects take place and what causes them.

## SECTION 6: The Source of Growth and the Solow Model, Part 1

### 6.1. The Sources of Economic Growth

- From the Cobb-Douglas production function  $Y = AF(K, L) = AK^{\alpha_K}L^{\alpha_L}$ , with  $\alpha_K + \alpha_L = 1$ , we can derive the *growth accounting formula*.

Take the log of both sides of the equation:

$$\begin{aligned}\log Y &= \log(AK^{\alpha_K}L^{\alpha_L}) \\ \log Y &= \log A + \alpha_K \log K + \alpha_L \log L\end{aligned}$$

By total differentiation:

$$\begin{aligned}\frac{\Delta Y}{Y} &= \frac{\Delta A}{A} + \alpha_K \frac{\Delta K}{K} + \alpha_L \frac{\Delta L}{L} \\ g_Y &= g_A + \alpha_K g_K + \alpha_L g_L\end{aligned}$$

where:

1.  $\alpha_K$  is the output elasticity with respect to  $K$
  2.  $\alpha_L$  is the output elasticity with respect to  $L$
  3.  $g_Y$  is the growth rate of  $Y$ , economic output
  4.  $g_A$  is the growth rate of  $A$ , total factor productivity
  5.  $g_K$  is the growth rate of  $K$ , the capital stock
  6.  $g_L$  is the growth rate of  $L$ , the labor force
- Accounting for growth using empirical evidence:
    - a. Collect data on  $g_Y$ ,  $g_K$ , and  $g_L$ .
    - b. Estimate  $\alpha_K$  and  $\alpha_L$ . For the U.S.:  $\alpha_K = 0.3, \alpha_L = 1 - \alpha_K = 0.7$ . It means that a 1% increase in  $K$  increases  $Y$  by 0.3% and that a 1% increase in  $L$  increases  $Y$  by 0.7%
    - c. Calculate total factor productivity:  $A = \frac{Y}{K^{\alpha_K}L^{\alpha_L}}$ , also known as the *Solow residual*.

=> Productivity growth is a more important source of variation in growth rates across countries than is factor accumulation.

### 6.2. The Solow Growth Model (Things to Remember)

- Assumptions:
  1. The labor force grows at a constant rate, i.e.,  $g_L = g_{L0}$
  2. There is no productivity growth, i.e.,  $g_A = 0$ . The level of productivity is fixed at  $A_0$ .
  3. The economy is closed, i.e.,  $X = M = NX = 0$ .
  4. There is no government spending, i.e.,  $G = 0$ .
  5. Saving is a fixed proportion of income, i.e.,  $S_t = s_0 Y_t$ , where  $s_0$  is the fixed saving rate between 0 and 1.

- The Solow Growth Model combines:

1. Per-worker production function

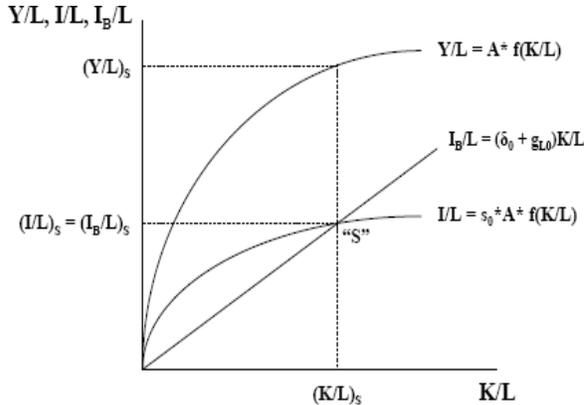
$$\frac{Y_t}{L_t} = A_0 f\left(\frac{K_t}{L_t}\right)$$

2. Per-worker investment (or saving) function,

$$\frac{I_t}{L_t} = s_0 \frac{Y_t}{L_t} = s_0 A_0 f\left(\frac{K_t}{L_t}\right)$$

3. Per-worker balanced investment function

$$\frac{I_B}{L_t} = (\delta_0 + g_{L0}) \frac{K_t}{L_t}$$



- The level of  $\frac{K_t}{L_t}$  at which  $\Delta\left(\frac{K_t}{L_t}\right) = 0$  is called the *steady state*. At the steady state level of  $\frac{K_t}{L_t}$ , which we indicate as  $\left(\frac{K_t}{L_t}\right)_s$ , we have that investment per worker = balanced investment per worker (i.e.  $\frac{I_t}{L_t} = \frac{I_B}{L_t}$ ).
- At the steady state level of capital per worker  $\left(\frac{K_t}{L_t}\right)_s$  :
  1.  $\Delta\left(\frac{K_t}{L_t}\right) = 0$ , which means  $\frac{\Delta K_t}{K_t} = \frac{\Delta L_t}{L_t}$ , i.e.  $g_K = g_L$  : the capital stock grows at exactly the same rate as the labor force.
  2.  $\Delta\left(\frac{Y_t}{L_t}\right) = 0$ , which means  $\frac{\Delta Y_t}{Y_t} = \frac{\Delta L_t}{L_t}$ , i.e.  $g_Y = g_L$  : economic output grows at exactly the same rate as the labor force.

### 6.3. How to Derive the Functions Described Above

1. Per-worker production function:

$$\begin{aligned} \frac{Y_t}{L_t} &= A_0 F\left(\frac{K_t}{L_t}, \frac{L_t}{L_t}\right) \\ &= A_0 F\left(\frac{K_t}{L_t}, 1\right) \\ &= A_0 f\left(\frac{K_t}{L_t}\right) \\ y_t &= A_0 f(k_t) \end{aligned}$$

where  $k_t$  is called the capital-labor ratio. This result follows from the fact that we are assuming that  $F(K_t, L_t)$  has constant returns to scale: if you divide  $K_t, L_t$  by  $L_t$ , also  $Y_t$  will be divided by  $L_t$ .

Let's show it in more detail for the Cobb-Douglas production function, which as we showed, has constant returns to scale!

$$\begin{aligned}\frac{Y_t}{L_t} &= \frac{A_0 K_t^{\alpha_K} L_t^{1-\alpha_K}}{L_t} \\ &= A_0 \left(\frac{K_t}{L_t}\right)^{\alpha_K}\end{aligned}$$

So for the Cobb-Douglas function:

$$F(K_t, L_t) = K_t^{\alpha_K} L_t^{1-\alpha_K}$$

and:

$$\begin{aligned}f\left(\frac{K_t}{L_t}\right) &= \left(\frac{K_t}{L_t}\right)^{\alpha_K} \\ f(k_t) &= k_t^{\alpha_K}\end{aligned}$$

2. *Per-worker investment function* (also called *per-worker saving function*). Because  $I_t = S_t$  in a closed economy, then  $\frac{I_t}{L_t} = \frac{S_t}{L_t}$ , which implies:

$$\frac{I_t}{L_t} = s_0 \frac{Y_t}{L_t} = s_0 A_0 f\left(\frac{K_t}{L_t}\right)$$

we call it the *per-worker investment function* or the *per-worker saving function*.

3. *Per-worker balanced investment function*:

- The capital stock is determined by:

(a) Investment:  $I_t = Y_t - C_t$

(b) Depreciation:  $D_t = \delta_0 K_t$ , where  $0 < \delta_0 < 1$  is a fixed constant (i.e. it doesn't depend on the amount of capital you have).

It follows that the change in capital stock can be represented as follows:

$$\begin{aligned}\Delta K_t &= I_t - D_t \\ &= I_t - \delta_0 K_t\end{aligned}$$

and the percentage change in the capital stock is:

$$\frac{\Delta K_t}{K_t} = \frac{I_t}{K_t} - \delta_0$$

this will be useful below.

- The capital accumulation equation is determined by:

(a) Investment per worker

(b) Depreciation per worker

(c) Capital dilution:  $K D_t = g_{L0} \left(\frac{K_t}{L_t}\right)$ . We are looking at how  $\frac{K_t}{L_t}$  evolves over time. If the labor force grows faster than the capital stock ( $\frac{\Delta K_t}{K_t} < \frac{\Delta L_t}{L_t}$ ),  $\frac{K_t}{L_t}$  will decrease. Therefore have to take into account  $g_{L0} = \frac{\Delta L_t}{L_t}$

Remember that:

$$\begin{aligned}\frac{\Delta\left(\frac{K_t}{L_t}\right)}{\frac{K_t}{L_t}} &= \frac{\Delta K_t}{K_t} - \frac{\Delta L_t}{L_t} = \\ &= \frac{I_t}{K_t} - \delta_0 - g_{L0}\end{aligned}$$

Therefore:

$$\begin{aligned}\Delta\left(\frac{K_t}{L_t}\right) &= \frac{I_t}{K_t} \times \frac{K_t}{L_t} - \delta_0 \frac{K_t}{L_t} - g_{L0} \frac{K_t}{L_t} \\ &= \frac{s_0 Y_t}{L_t} - (\delta_0 + g_{L0}) \frac{K_t}{L_t} \\ &= s_0 A_0 f\left(\frac{K_t}{L_t}\right) - (\delta_0 + g_{L0}) \frac{K_t}{L_t}\end{aligned}$$

- The *per-worker balanced investment function* is determined by setting  $\Delta\left(\frac{K_t}{L_t}\right) = 0$  :

$$\begin{aligned}s_0 A_0 f\left(\frac{K_t}{L_t}\right) - (\delta_0 + g_{L0}) \frac{K_t}{L_t} &= 0 \\ s_0 A_0 f\left(\frac{K_t}{L_t}\right) &= (\delta_0 + g_{L0}) \frac{K_t}{L_t} \\ &= \frac{I_B}{L_t}\end{aligned}$$

## Exercises

- Multiple choice questions:

1. If the contribution from capital stock growth is 3.0% and the contribution from productivity growth is 1.6%, then real economic output will grow by:
  - (a) 1.4%.
  - (b) 1.6%.
  - (c) 3.0%.
  - (d) 4.6%.
  - (e) An indeterminate rate.
2. The per-worker production function in the Solow model assumes:
  - (a) Constant returns to scale and increasing marginal productivity of capital.
  - (b) Constant returns to scale and diminishing marginal productivity of capital.
  - (c) Increasing returns to scale and diminishing marginal productivity of capital.
  - (d) Decreasing returns to scale and diminishing marginal productivity of capital.
3. In a steady state:
  - (a) Both consumption-per-worker and the capital-to-labor ratio are constant.
  - (b) Consumption-per-worker is constant but the capital-to-labor ratio can change.
  - (c) Capital and labor are inversely related to one another by definition.
  - (d) Consumption-per-worker can change but the capital-to-labor ratio is constant.
4. Steady-state investment-per-worker is positively related to the capital-to-labor ratio because the higher the capital-to-labor ratio:
  - (a) The lower the capital depreciation rate.
  - (b) The greater the amount of resources available for capital investment.
  - (c) The more investment-per-worker is required to replace depreciating capital.
  - (d) The less the economy needs to equip new workers with the same high level of capital.
5. Once an economy described by the Solow growth model has reached its steady state, the economy is:
  - (a) Not growing.
  - (b) Growing at the same pace as the labor force.
  - (c) Growing at the combined labor force growth rate and depreciation rate.
  - (d) Growing at the depreciation rate.
6. Suppose that total factor productivity is constant, the capital stock is growing at 1% per year, and the output elasticity with respect to capital is 0.4. How fast will the economy be growing when it is at its steady state?
  - (a) 0.4%
  - (b) 0.6%
  - (c) 1.0%
  - (d) 1.4%
  - (e) Indeterminate.

7. Capital per person is higher in Japan than in the United States. As a result:
- Per capita income is higher in Japan.
  - Total factor productivity is higher in Japan.
  - The marginal product of capital is higher in Japan.
  - None of the above.
8. The “IT Revolution” of the late 1990’s led to an increase in productivity but also to an increase in the rate of depreciation because computers have to be replaced more often. According to the Solow Growth Model:
- Output-per-worker will fall.
  - Output-per-worker will rise.
  - The effect on output-per-worker is indeterminate.
  - Economic growth will be lower in the new steady state.
  - Economic growth will be higher in the new steady state.
9. Low-income countries tend to have faster labor force growth rates than high-income countries. Compared to a situation where the labor force growth rates were identical there would now be:
- Higher saving rates in high-income countries than in low-income countries.
  - Greater income differences between high-income and low-income countries.
  - Smaller income differences between high-income and low-income countries.
  - Lower depreciation rates in high-income countries than in low-income countries.
10. In microeconomic theory the real wage rate is positively related to the amount of capital each worker has to work with. Given this, what happens to the real wage rate in an economy described by the Solow Growth Model if an earthquake destroys half of the capital stock?
- It will decrease in the short-run but increase in the long-run.
  - It will increase in the short-run but not change in the long-run.
  - It will decrease in the short-run but not change in the long-run.
  - It will increase in the short-run and also increase in the long-run.
- Analytical question #1. Solow Growth Model. In 1990, the Iraqi economy was operating at its potential level.
    - Use a Solow Growth Model diagram to clearly and accurately show Iraq’s initial steady state. This diagram should be drawn in BLACK.
    - As a consequence of the Gulf War in 1991, a substantial portion of Iraq’s capital stock was destroyed. Based only on this information, clearly and accurately show the effects on Iraq’s capital-to-labor ratio and its level of income-per-worker. These changes should be drawn in RED.
    - Subsequently, the U.N. imposed economic sanctions that made it much more difficult to import spare parts for the repair and maintenance of its capital equipment, causing depreciations rates to increase. Assume that the war had a much larger effect on Iraq’s capital stock than did the sanctions. Incorporating this additional information, clearly and accurately show the additional effects on Iraq’s capital-to-labor ratio and its level of income-per-worker. These changes should be drawn in BLUE.
    - Provide a brief economic explanation of each of the changes you have shown in your diagram above. Be sure to discuss any adjustment process that occurs during the transition period from Iraq’s initial steady state to its final steady state including what happens to the level of income-per-worker and to the rate of economic growth both during the transition period and in the long-run equilibrium.

- Analytical question #2 (Spring 2012). *The Solow Growth Model*.

Suppose that the economy is initially at its steady state.

1. Based only on this information, use a Solow Growth Model diagram to clearly and accurately show the economy's initial (1) level of output-per-worker, (2) capital-to-labor ratio, and (3) steady state. This diagram should be drawn in BLACK.
2. According to some supply-side economists, permanently lower marginal income tax rates will stimulate faster growth of the labor force. Assuming that this hypothesis is correct, and incorporating only this new information, clearly and accurately show in your diagram above what effects, if any, a permanent reduction in marginal income tax rates would have on (1) the level of output-per-worker, (2) the capital-to-labor ratio, and (3) the steady state. These effects should be drawn in RED.
3. Provide an economic explanation of what you have shown in your diagram above. Discuss what, if anything, happens to (1) the level of output-per-worker, (2) the capital-to-labor ratio, and (3) the steady state. Be sure to explain why these effects take place and what causes them.
4. In addition to the effect on the growth rate of the labor force, these supply-side economists also assume that permanently lower marginal income tax rates increase total factor productivity such that the tax cut is completely self-financing, i.e., there would be no long-run change in the deficit-to-GDP ratio as a result of the tax cut. Assuming that this additional hypothesis is correct, and incorporating only this new information, clearly and accurately show in your diagram above what effects, if any, a permanent reduction in marginal income tax rates would have on (1) the level of output-per-worker, (2) the capital-to-labor ratio, and (3) the steady state. These effects should be drawn in BLUE.
5. Provide an economic explanation of what you have shown in your diagram above. Discuss what happens to (1) the level of output-per-worker, (2) the capital-to-labor ratio, and (3) the steady state. Be sure to explain why these effects take place and what causes them.

## SECTION 7: The Source of Growth and the Solow Model, Part 2

### 7.1. Disequilibrium Dynamics

- Assume the economy is below its steady state level of  $\frac{K}{L}$ , i.e.  $(\frac{K}{L})_1 < (\frac{K}{L})_S$ . Then  $\frac{I}{L} > \frac{I_B}{L} \Rightarrow \frac{K}{L}$  will increase and  $(\frac{K}{L})_2 > (\frac{K}{L})_1$ . This process continues until  $\frac{K}{L} = (\frac{K}{L})_S$
- Assume the economy is above its steady state level of  $\frac{K}{L}$ , i.e.  $(\frac{K}{L})_1 > (\frac{K}{L})_S$ . Then  $\frac{I}{L} < \frac{I_B}{L} \Rightarrow \frac{K}{L}$  will decrease and  $(\frac{K}{L})_2 < (\frac{K}{L})_1$ . This process continues until  $\frac{K}{L} = (\frac{K}{L})_S$

### 7.2. Changes in the Saving Rate

- Assume the economy is at its steady state level  $(\frac{K}{L})_S$ , and its saving rate  $s$  increases:
  - the per-worker investment function will rotate up
  - at  $(\frac{K}{L})_{S_1}$  we have  $\frac{I}{L} > \frac{I_B}{L} \Rightarrow \frac{K}{L}$  will increase. This process continues until  $\frac{K}{L} = (\frac{K}{L})_{S_1}$
  - the steady state level of  $\frac{K}{L}$  will increase from  $(\frac{K}{L})_S$  to  $(\frac{K}{L})_{S_1}$
- How fast the economy is growing:
  - at the initial steady state, S:  $g_Y = g_{L0} = g_K$
  - at the new steady state, S:  $g_Y = g_{L0} = g_K$
  - during the transition period between S and S<sub>1</sub>:
    - a. because  $\frac{Y}{L}$  was increasing,  $g_Y > g_{L0}$  and
    - b. because  $\frac{K}{L}$  was increasing,  $g_K > g_{L0}$
- Increasing the saving rate  $s$  results in:
  1. A higher capital-labor ratio,  $\frac{K}{L}$ ,
  2. Higher output per worker,  $\frac{Y}{L}$ ,
  3. Faster growth during the transition period, but
  4. No change in the long-term economic growth rate.

### 7.3. Changes in the Labor Force Growth Rate, $g_L$

- Assume the economy is at its steady state level  $(\frac{K}{L})_S$ , and the labor force growth rate  $g_L$  increases. Then:
  - the per-worker balanced investment function will rotate up.
  - at the initial  $(\frac{K}{L})_S$ ,  $\frac{I}{L} < \frac{I_B}{L} \Rightarrow \frac{K}{L}$  will decrease. This process continues until  $\frac{K}{L} = (\frac{K}{L})_{S_1}$
  - the steady state level of  $\frac{K}{L}$  will decrease from  $(\frac{K}{L})_S$  to  $(\frac{K}{L})_{S_1}$
- How fast is the economy growing:
  - at the initial steady state, S:  $g_{Y0} = g_{L0} = g_{K0}$
  - at the new steady state, S<sub>1</sub>:  $g_{Y1} = g_{L1} = g_{K1}$
  - during the transition period between S and S<sub>1</sub>:

- a. because  $\frac{Y}{L}$  was decreasing,  $g_Y < g_{L1}$  and
  - b. because  $\frac{K}{L}$  was decreasing,  $g_K < g_{L1}$
- Faster labor force growth rate,  $g_L$ , results in:
    1. A lower capital-labor ratio,  $\frac{K}{L}$ ,
    2. Lower output per worker,  $\frac{Y}{L}$ ,
    3. Slower growth during the transition period, but
    4. A higher long-term economic growth rate.

## 7.4. Productivity Change in the Solow Model

- Assume the economy is at its steady state level  $(\frac{K}{L})_S$ , and the level of productivity decreases. Then:
  - the per-worker production and per-worker investment functions will rotate down
  - at the initial  $(\frac{K}{L})_S$ ,  $\frac{Y}{L}$  is now lower
  - at the initial  $(\frac{K}{L})_S$ ,  $\frac{I}{L} < \frac{I_B}{L} \Rightarrow \frac{K}{L}$  will decrease. This process continues until  $\frac{K}{L} = (\frac{K}{L})_{S_1}$
  - the steady state level of  $\frac{K}{L}$  will decrease from  $(\frac{K}{L})_S$  to  $(\frac{K}{L})_{S_1}$
- How fast is the economy growing:
  - at the initial steady state, S:  $g_Y = g_{L0} = g_K$
  - at the new steady state, S<sub>1</sub>:  $g_Y = g_{L0} = g_K$
  - during the transition period between S and S<sub>1</sub>:
    - a. because  $\frac{Y}{L}$  was decreasing,  $g_Y < g_{L0}$  and
    - b. because  $\frac{K}{L}$  was decreasing,  $g_K < g_{L0}$
- A decrease in productivity, A, results in:
  1. A lower capital-labor ratio,  $\frac{K}{L}$ ,
  2. Lower output per worker,  $\frac{Y}{L}$ ,
  3. Slower growth during the transition period, but
  4. No change in long-term economic growth rate.

## To Sum up

- Factors that shift the production function:
  - Changes in productivity,  $\Delta A$
- Factors that shift the saving function:
  - Changes in the saving rate,  $\Delta s$ .
  - Changes in productivity,  $\Delta A$
- Factors that shift the balanced investment function:
  - Changes in the labor force growth rate,  $\Delta g_L$ .
  - Changes in the depreciation rate,  $\Delta \delta$ .

## Exercises

1. In the long-run, the Solow growth model demonstrates that in the absence of productivity growth:
  - (a) Per-worker income will decline.
  - (b) The economy will stop growing.
  - (c) The economy will reach a steady state with no per-worker income growth.
  - (d) The economy will grow at the sum of the depreciation rate and the labor force growth rate.
2. Suppose the economy is initially at its steady state and an earthquake then destroys 20% of the capital stock. How would you expect this to affect income-per-worker in the long run (compared to its pre-earthquake steady state)?
  - (a) Income-per-worker would increase.
  - (b) Income-per-worker would not change.
  - (c) Income-per-worker would decrease.
  - (d) Income-per-worker would initially decline but eventually increase
3. For an economy initially at its steady-state, an increase in government purchases would:
  - (a) Rotate the per-worker production function higher and increase the capital-to-labor ratio.
  - (b) Rotate the per-worker investment function higher and increase the capital-to-labor ratio.
  - (c) Rotate the per-worker investment function lower and decrease the capital-to-labor ratio.
  - (d) Rotate the per-worker production function lower and decrease in the capital-to-labor ratio.
4. Suppose an economy described by the Solow growth model is initially at a steady state with an economic growth rate of 3%. An earthquake then destroys 25% of the capital stock and kills 25% of the labor force. If these are the only effects then after the earthquake the growth rate of per-worker output:
  - (a) Declines permanently.
  - (b) Does not change but the level of economic output declines.
  - (c) Initially declines but then returns to zero once the economy returns to a steady state.
  - (d) Initially increases but then returns to zero once the economy returns to a steady state
5. Suppose an economy described by the Solow model is initially in a steady state with an economic growth rate of 4%. If the fraction of income that consumer spend now increases, this will:
  - (a) Lead to an economic boom as demand increases.
  - (b) Have no effect because consumption does not enter the Solow model.
  - (c) Initially lead to economic growth of less than 4% but steady state economic growth will return to 4%.
  - (d) Initially lead to economic growth of more than 4% but steady state economic growth will return to 4%.
6. In the Solow Growth Model, the faster growth of output that results from an increase in the saving rate is temporary because:
  - (a) Of diminishing marginal product of capital.
  - (b) The increasing stock of capital depreciates at a faster rate.
  - (c) The economy settles into a steady state in which saving no long increases.
  - (d) With a larger stock of capital, consumption is encouraged more than investment.

7. Suppose that the economy is initially at its steady state. Then an earthquake destroys half of the capital stock but does not affect the labor force. In response to the earthquake, the saving rate increases. Then, comparing the new (post-earthquake) steady state to the initial (pre-earthquake) steady state:
- Output-per-worker will be higher.
  - Output-per-worker will be lower.
  - Output-per-worker stays the same.
  - What happens to output-per-worker is indeterminate.

• Analytical question #1 (Fall 2011). *Solow Growth Model*.

Suppose that the Irish economy is a small open economy with perfect capital mobility that can be described by the Solow Growth Model.

- In 2008, Ireland's economy was in a steady state. Use a Solow Growth Model diagram to clearly and accurately show Ireland's initial equilibrium position. This diagram should be drawn in BLACK.
- In 2009, an economic crisis led to a substantial decline in total factor productivity. Based only on this information, clearly and accurately show on your diagram above what effects this would have on the capital-to-labor ratio, output-per-worker, and investment-per-worker. These changes should be drawn in RED.
- Provide an economic explanation of the changes that you have shown in your diagram above. Be sure to explain why these changes take place.
- Because of the economic crisis, a substantial number of workers left Ireland and moved to other countries. Based only on this information, clearly and accurately show on your diagram above what effects this would have on the capital-to-labor ratio, output-per-worker, and investment-perworker. These changes should be drawn in BLUE.
- Provide an economic explanation of the changes that you have shown in your diagram above. Be sure to explain why these changes take place.
- Provide an economic explanation of the adjustment process that occurs as the economy moves from its initial steady state to its final steady state. Be sure to include a discussion of what happens to the capital-to-labor ratio, income-per-worker, and the rate of economic growth both during the transition period and at the final steady state (also comparing it to the rate of economic growth at the initial steady state).

• Analytical question #2 (Fall 2012). *Desired Saving – Desired Investment Model and the Solow Growth Model*.

Suppose that a “large” open economy with perfect capital mobility has a real interest rate that equates national saving and desired investment that is below the world real interest rate.

- Based only on this information, use a Desired Saving – Desired Investment diagram to clearly and accurately show the economy's initial (1) real interest rate, (2) desired saving, (3) desired investment, and (4) net export balance. This diagram should be drawn in BLACK.
- Provide an economic explanation of what you have shown in your diagrams above.
- Now suppose that the country undertakes a significant fiscal expansion. Based only on this additional information, clearly and accurately show the effects of this fiscal expansion on (1) the real interest rate, (2) desired saving, (3) desired investment, and (4) the net export balance. These effects should be drawn in RED.
- Provide an economic explanation of what you have shown in your diagrams above. Discuss what happens to the economy's (1) real interest rate, (2) desired saving, (3) desired investment, and (4) net export balance. Be sure to explain why these takes place.

5. Suppose that a “large” open economy with perfect capital mobility is at its steady state. Based only on this information, use a Solow Growth Model diagram to clearly and accurately show the economy’s steadystate level of (1) income-per-worker, (2) investment-per-worker, and (3) the capital-to-labor ratio. This diagram should be drawn in BLACK.
6. Provide an economic explanation of what you have shown in your diagram above.
7. Now suppose that the country undertakes a significant fiscal expansion. Based only on this additional information, clearly and accurately show (1) the immediate direct effect of this fiscal expansion and (2) any subsequent effects of this fiscal expansion on the steady-state level of (1) income-per-worker, investment-per-worker, and (3) the capital-to-labor ratio. These effects should be drawn in RED.
8. Provide an economic explanation of what you have shown in your diagrams above. Discuss what happens to the economy’s steady-state level of (1) income-per-worker, (2) investment-per-worker, and (3) the capital-to-labor ratio. Be sure to explain why these takes place.

## SECTION 8: The Source of Growth and the Solow Model, Part 3

### 8.1. The Solow Model with Productivity Growth<sup>1</sup>

- Remember, in steady state  $\Delta(\frac{K}{L}) = 0$ , or equivalently  $\frac{I}{L} = \frac{I_B}{L}$ :

$$\underbrace{sAf\left(\frac{K_t}{L_t}\right)}_{I/L} = \underbrace{(\delta + g_L)\frac{K_t}{L_t}}_{I_B/L}$$

Using a Cobb-Douglas production function with  $\alpha = 0.3$ , we know that  $Af(\frac{K_t}{L_t}) = A(\frac{K_t}{L_t})^{0.3}$ , and so:

$$\underbrace{sA\left(\frac{K_t}{L_t}\right)^{0.3}}_{I/L} = \underbrace{(\delta + g_L)\frac{K_t}{L_t}}_{I_B/L}$$

Solving for  $\frac{K_t}{L_t}$ , the steady state level of capital can be written as:

$$\left(\frac{K_t}{L_t}\right)_S = \left(\frac{sA}{\delta + g}\right)^{(1/0.7)} = \left(\frac{sA}{\delta + g_L}\right)^{1.43}$$

The steady state output-per-worker is:

$$\begin{aligned} \left(\frac{Y_t}{L_t}\right)_S &= A\left(\frac{K_t}{L_t}\right)_S^{0.3} = A\left[\left(\frac{sA}{\delta + g_L}\right)^{1.43}\right]^{0.3} = \\ &= A^{[1+(1.43 \times 0.3)]} \left(\frac{s}{\delta + g_L}\right)^{(1.43 \times 0.3)} \\ &= A^{1.43} \left(\frac{s}{\delta + g_L}\right)^{(0.43)} \end{aligned}$$

We were therefore able to express the steady levels of  $(\frac{K_t}{L_t})$  and  $(\frac{Y_t}{L_t})$  as functions of  $A$ ,  $s$ ,  $\delta$  and  $g_L$ .

- Take aways:
  - With no technology growth, the growth rates of  $(\frac{K_t}{L_t})$  and  $(\frac{Y_t}{L_t})$  are zero in steady state because  $A$  is constant over time and  $s$ ,  $\delta$ , and  $g_L$  are just numbers.
  - With technology growth, we have<sup>2</sup>:

$$g\left(\frac{K}{L}\right) = 1.43g_A + \underbrace{1.43g\left(\frac{s}{\delta + g_L}\right)}_{=0} = 1.43g_A$$

and:

$$g\left(\frac{Y}{L}\right) = 1.43g_A + \underbrace{0.43g\left(\frac{s}{\delta + g_L}\right)}_{=0} = 1.43g_A$$

once again if  $g_A = 0$ , then the growth rates of  $(\frac{K_t}{L_t})$  and  $(\frac{Y_t}{L_t})$  are zero in steady state.

<sup>1</sup>Not required, just for your personal curiosity.

<sup>2</sup>Taking logs and totally differentiating to work with growth rates, as we did for the growth accounting formula.

## 8.2. Technology as a Production Input

- In the *Solow model*, total factor productivity  $A$  has been treated as an *exogenous variable*.
- In modern, high-income economies total factor productivity is largely analogous with technology:
  1. Technology increases the efficiency with which labor and capital are used together.
  2. In this sense technology can be treated as a factor input into the production process.
- Technology is characteristically different from capital and labor. It is
  - *non-rival*: more than one person can use the technology at the same time
  - *non-excludable*: one person cannot prevent another person from using the technology
- Examples:
  1. *Rival and excludable goods*: private goods (food, clothing, cars, personal electronics)
  2. *Rival and non-excludable goods*: common goods (fish stocks, timber, coal)
  3. *Non-rival and excludable goods*: club goods (cinemas, private parks, satellite television)
  4. *Non-rival and non-excludable goods*: public goods (free-to-air television, air, national defense)
- Because technology is largely non-excludable, the private sector is likely to spend too little, rather than too much, on developing new technologies.

## 8.3. Policies to Promote Productivity

- Several government policies that have been adopted to promote productivity, including:
  1. Building infrastructure.
  2. Increasing human capital.
  3. Encouraging research and development.
- *Building infrastructure*: government can promote improved infrastructure by:
  1. direct government expenditures such as building roads, bridges, ports, tunnels, etc.,
  2. providing tax incentives for private infrastructure spending, or
  3. streamlining or removing barriers for private sector investment in infrastructure.
- *Increasing human capital*: the knowledge and skills that workers acquire through education and training. Government can encourage human capital by:
  1. its educational policies and its worker training programs,
  2. its public health programs, and
  3. removing barriers to business formation to promote human capital in the form of entrepreneurial skill
- *Encouraging research and development*: research and development is the efforts to directly increase the growth rate of technology. Government can promote R&D by:
  1. direct government expenditures on R&D,
  2. providing tax incentives for private R&D spending,
  3. providing patents, copyrights, and other intellectual property rights protection.

## 8.4. Institutions and Property Rights

- In low-income economies total factor *productivity is not always analogous with technology*.
- Productivity growth, or productivity, then is everything that contributes to economic growth that is over and above the contributions from capital and labor. While this includes technology it also includes other important factors such as the *institutions* that govern economic and business activity
- Institutions are:
  1. The set of rules,
  2. Customs,
  3. Practices, and
  4. Organizations

that govern the behavior of individuals and firms.

- The most basic and fundamental set of institutions that affect economic growth are *property rights*, i.e. the protections of property, including intellectual property, from expropriation by the government, or other individuals or firms.

## Exercises

1. Robert Fogel, a Nobel Laureate in Economics, has argued that better health and/or a higher level of nutrition of workers is important in generating higher standards of living. In the Solow model, we would represent such a change as:
  - (a) An increase in total factor productivity.
  - (b) An increase in the labor force growth rate.
  - (c) A one time increase in the labor force because this effectively leads to more workers.
  - (d) Slower depreciation rates because workers are healthier.
  - (e) Slower rates of decreasing returns to capital accumulation because workers are healthier.
2. Private businesses tend to spend too little on research and development because:
  - (a) Governments tend to spend too much on research and development.
  - (b) Patent laws make it difficult to reap the full benefits of such spending.
  - (c) The results from research and development are often nonexcludable.
  - (d) Investments that increase the capital stock are a better way to boost productivity.
3. One difference between a policy of direct spending by the government on research and development (R&D) and an alternative policy of tax incentives to encourage private sector spending on R&D is:
  - (a) The former causes an increase in national saving while the latter causes a decrease in national saving.
  - (b) The former causes a decrease in national saving while the latter causes an increase in national saving.
  - (c) The former improves the productivity of R&D while the latter only raises the level of R&D spending.
  - (d) The former raises the level of R&D spending while the latter also improves the productivity of R&D.
4. The non-rivalrous nature of technological ideas suggests that:
  - (a) Patent law protection is ultimately inefficient.
  - (b) Technological change increases exponentially.
  - (c) Technological ideas developed in one industry can be used in other industries.
  - (d) Technological ideas developed in one industry cannot be used in another industry.
5. A key difference between human capital and technology is that:
  - (a) Human capital is nonrival.
  - (b) Human capital is excludable.
  - (c) Technology is an input in the production of new technology.
  - (d) Scarce resources are used in the production of human capital.
6. Because original ideas are likely to become known and used by others, without the inventor's knowledge or consent:
  - (a) We refer to ideas as rival.
  - (b) Technology is inherently exogenous.
  - (c) New ideas contribute little to economic growth.
  - (d) Technology is the key driver of economic growth.

## SECTION 9: Money and Inflation

### 9.1. What is Money?

- Money is a financial asset that serves three functions:
  1. unit of account: money is how value in the economy is measured.
  2. store of value: money is a means of preserving purchasing power.
  3. medium of exchange: money is the financial assets that can be used to finalize transactions
- In the U.S., there are two measures of those financial assets that serve as money, called monetary aggregates.
  1. The  $M1$  money supply: Currency + Travelers' checks + Demand deposits + Other checkable deposits
  2. The  $M2$  money supply:  $M1$  + Small time deposit + Savings deposits + Retail MMMF's
- Three groups affect the money supply:
  1. The central bank conducts monetary policy: the U.S. central bank is the Federal Reserve System.
  2. Depository institutions (i.e., banks) accept deposits and make loans.
  3. The public (i.e., people and firms) holds money as currency and coin and as bank deposits.

### 9.2. The Quantity Theory of Money

- The *quantity theory of money* is the relationship between money and nominal income (or output) in the economy (this relationship is what we are interested in) => it is a theory about the long run, as it assumes that wages and prices are completely flexible.

1. Starting point: *equation of exchange* (an identity!):

$$M \times V \equiv P \times Y$$

where:

$M$  = the money supply,

$V$  = the velocity of money,

$P$  = the general price level, and

$Y$  = real GDP.

Rearranging, we get the *velocity of money*: the “turn-over” rate of the money supply:

$$V \equiv \frac{P \times Y}{M}$$

Furthermore, we assume  $V = \bar{V}$ , i.e. velocity is constant, since:

- (a) Velocity is determined by the institutions that affect the way consumers and businesses conduct transactions
- (b) Institutions and payments technologies were assumed to change very gradually

As a result:

$$\Delta M \rightarrow \Delta(P \times Y)$$

2. Some important results follow:

- *Long-run neutrality of money*: changes in the money supply, a nominal variable, will not affect real variables (don't affect  $Y$ , which is a real variable!) in the long-run. Therefore:

$$\Delta M \rightarrow \Delta P$$

i.e. changes in the quantity of money lead to proportional changes in the price level.

This is an application of the *classical dichotomy*: nominal variables have no effect on real variables in the long-run, and the real and nominal sectors of the economy are independent of one another.

- *The quantity theory of inflation*: the quantity theory of money can also be used to explain inflation (in the long-run):

$$\begin{aligned} M \times V &\equiv P \times Y \\ \frac{\Delta M}{M} + \frac{\Delta V}{V} &\approx \frac{\Delta P}{P} + \frac{\Delta Y}{Y} \\ g_M + g_V &\approx \pi + g_Y \end{aligned}$$

if  $V = \bar{V}$  ( $V$  is constant over time), then  $g_V = 0$  and:

$$\begin{aligned} g_M &\approx \pi + g_Y \\ \pi &\approx g_M - g_Y \end{aligned}$$

The inflation rate equals the growth rate of the money supply minus the growth rate of (real) economic output.

### 9.3. Inflation and Interest Rates

- The *Fisher equation* is:

$$i = r + \pi^e$$

since  $r$  (a real variable) is unaffected by inflation or expected inflation (which are nominal variables), but is only determined by saving and investment decisions, then changes in the nominal interest rate will be proportional to changes in expected inflation. This is called the *Fisher effect*:

$$\Delta i \approx \Delta \pi^e$$

The Fisher effect is:

1. Reasonably accurate in the long run, but
  2. Not very accurate in the short run.
- Inflation imposes costs whether inflation is:
    1. Anticipated: Shoe-leather costs, Menu costs, Tax distortions, Increased variability of relative prices, Loss of the dollar yardstick
    2. Unanticipated: Increased uncertainty, Increased variability of relative prices, and Inflation uncertainty is higher when the level of inflation is already high.

## Exercises

1. According to the Quantity Theory of Money, in a steadily growing economy, if the money supply growth rate doubles, then:
  - (a) Inflation will also double.
  - (b) Inflation will more than double.
  - (c) Inflation will increase but not double.
  - (d) Inflation will not change but the economy will grow more quickly.
2. According to the Fisher Effect, if real interest rates are positive and expected inflation doubles, then:
  - (a) Real interest rates will also double.
  - (b) Nominal interest rates will also double.
  - (c) Nominal interest rates will more than double.
  - (d) Nominal interest rates will increase but not double.
3. While Chairman of the Federal Reserve, Alan Greenspan argued that lower inflation reduces the pricing power of business firms, forcing them to increase productivity to maintain profit margins. This view:
  - (a) Contradicts the quantity theory of money.
  - (b) Is an implication of the equation of exchange.
  - (c) Reflects Greenspan's views on the velocity of money.
  - (d) Suggests that the per-worker production function rotates lower as inflation falls.
4. Suppose total factor productivity and the labor force are fixed, the capital stock is growing at 1% per year, the output elasticity with respect to capital is 0.4, and the money supply is growing at 2% per year. Then according to the Growth Accounting Formula and the Quantity Theory of Money, the inflation rate will be:
  - (a) 1.0%.
  - (b) 1.6%.
  - (c) 2.0%.
  - (d) 2.4%.
5. Suppose an economy is at its steady state with constant total factor productivity. If the labor force is growing at 3% and the money supply is growing at 9%, then according to the quantity theory of money, the inflation rate is:
  - (a) 3%.
  - (b) 6%.
  - (c) 9%.
  - (d) 12%.
6. Suppose that an economy is at its steady state with its labor force growing by 3% per year and its money supply growing by 5% per year. According the quantity theory of money, if the money supply growth rate then increases to 7% per year:
  - (a) Inflation was initially 2% but then rises to 4%.
  - (b) Inflation was initially 5% but then rises to 7%.
  - (c) Inflation was initially 2% but then rises to 7%.
  - (d) Economic growth was initially 3% but then rises to 5%.

7. When the central bank increases the money supply, interest rates generally decline. It is widely believed that lower interest rates cause an increase in real economic output. This observation:
- (a) Contradicts the Fisher effect.
  - (b) Contradicts the classical dichotomy.
  - (c) Contradicts the equation of exchange.
  - (d) Contradicts the constant velocity of money assumption.
8. Suppose that the central bank is committed to maintaining a fixed price level. If the economy starts below its steady state, then according to the Solow growth model and the Quantity Theory of Money:
- (a) Inflation will accelerate as the economy approaches its steady state.
  - (b) Inflation will decelerate as the economy approaches its steady state.
  - (c) The money supply growth rate will accelerate as the economy approaches its steady state.
  - (d) The money supply growth rate will decelerate as the economy approaches its steady state.
9. In the quantity theory of money, the assumption that total output is fixed is based on the view that:
- (a) The velocity of money is constant.
  - (b) Wages and prices are perfectly flexible in the long run.
  - (c) The demand for real money balances is proportional to income.
  - (d) Changes in the quantity of money lead to proportional changes in the price level.
  - (e) None of the above.
10. The quantity theory of money:
- (a) Implies that changes in the money supply never have an impact on real variables.
  - (b) Is used by classical economists to explain how frequent changes in velocity lead to frequent changes in the price level.
  - (c) Gives mathematical grounding for the view that a country's central bank determines the general price level through control of the money supply.
  - (d) All of the above.
  - (e) None of the above.

## SECTION 10: Business Cycles

### 10.1. Business Cycles Basics

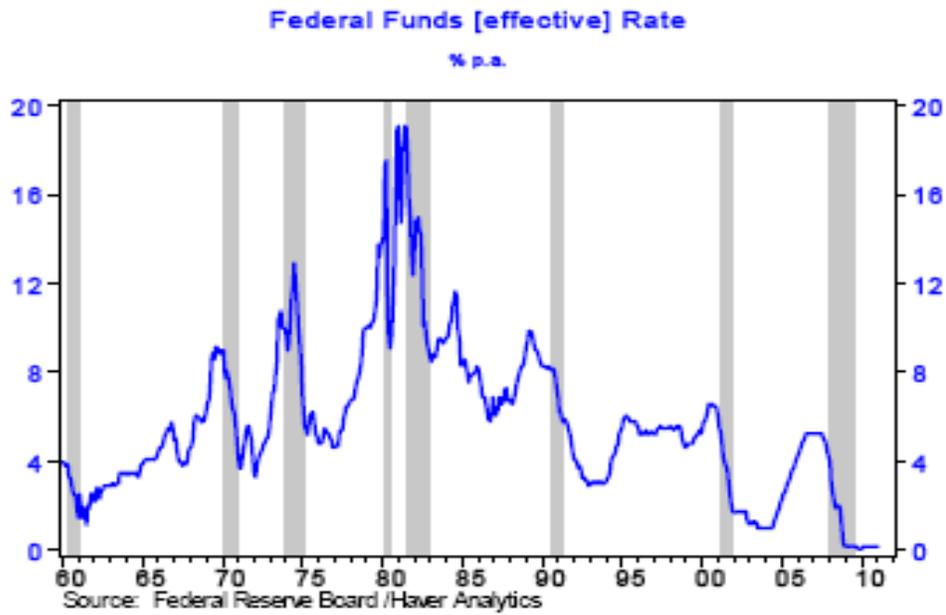
- Business cycles are divided into 4 parts:
  1. the *peak*: the maximum level that aggregate economic activity reaches before it begins to contract.
  2. the *contraction or recession*: the period of time when aggregate economic activity is shrinking
  3. the *trough*: the lowest level that aggregate economic activity reaches before it begins a sustained expansion
  4. the *recovery and expansion*: the period of time when aggregate economic activity is growing
- The business cycle is the sequence from one peak to the next peak or from one trough to the next trough
- Macro variables exhibit co-movement with aggregate economic activity that can be classified by the:
  1. *Direction*: Procyclical, Countercyclical, or Acyclical.
  2. *Timing*: Leading, Coincident, Lagging, or Not designated
  3. *Volatility*: Higher, Similar, Lower, or Not designated

### 10.2. Macro Variable and the Business Cycle

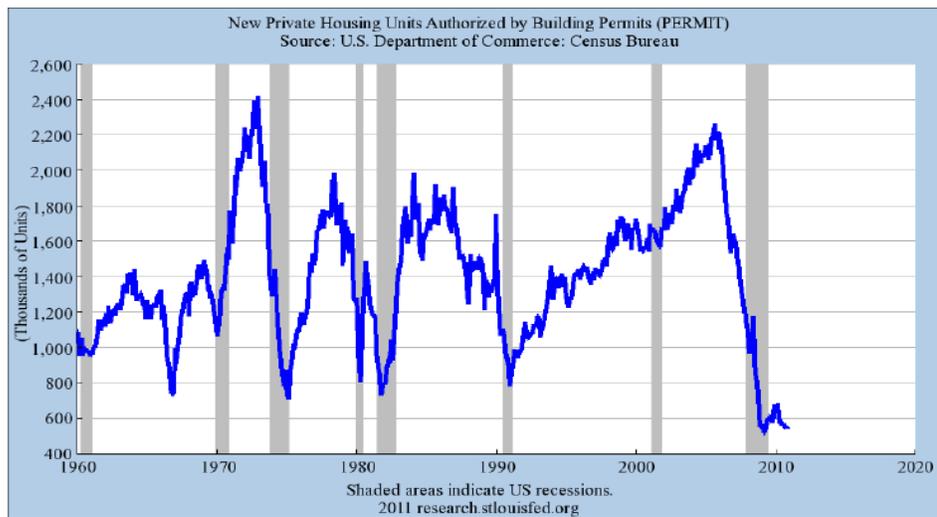
- Direction: the unemployment rate is a countercyclical variable



- Direction: the Federal Fund's rate is a procyclical variable

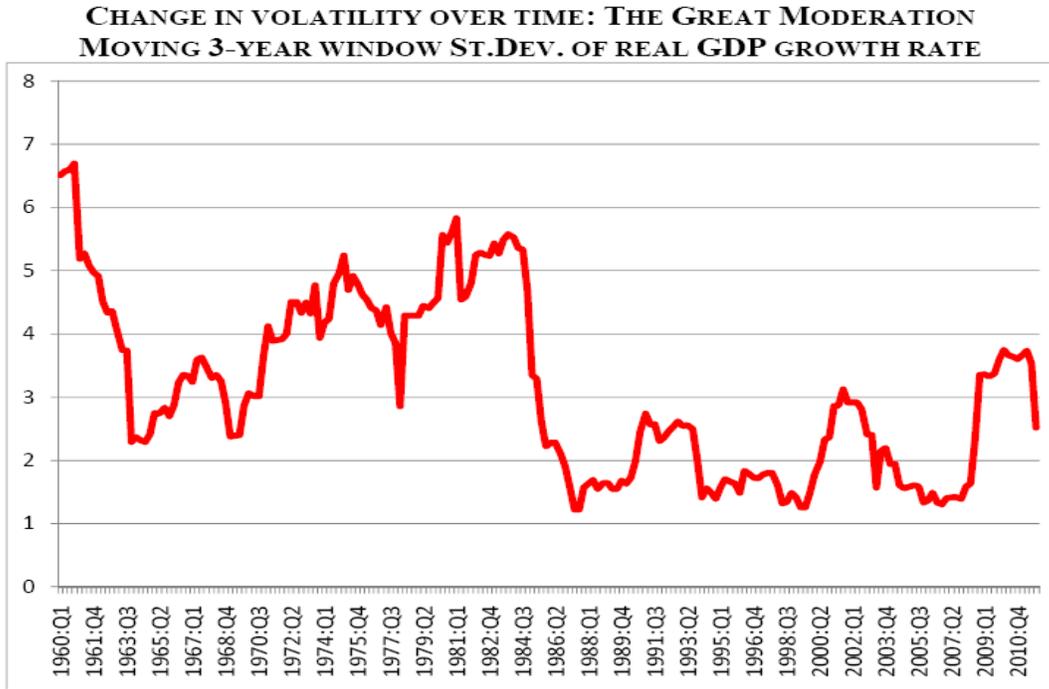


- Timing: leading indicator



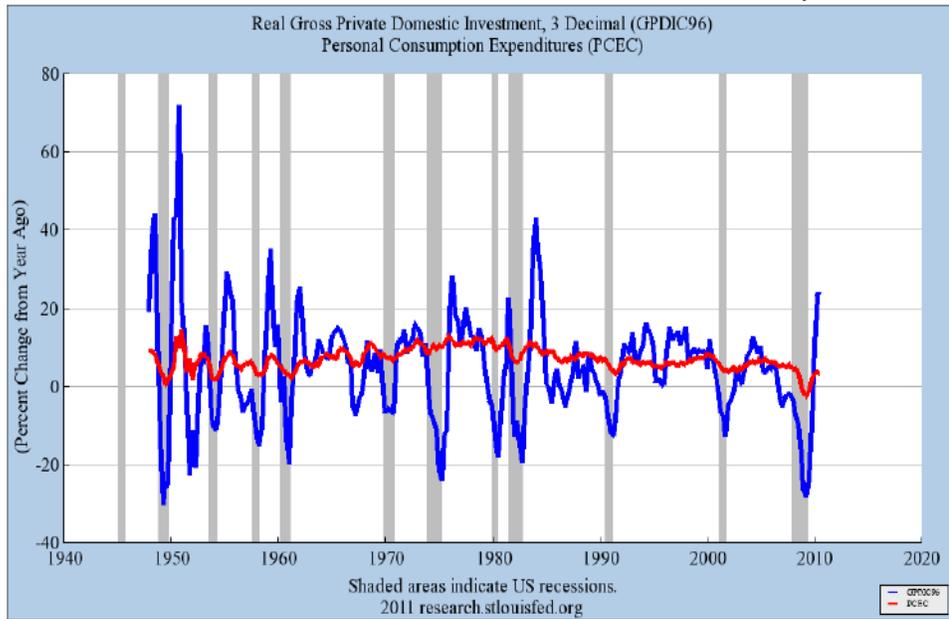
The housing market is a leading indicator of economic downturns

- Volatility: the Great Moderation



We refer to as Great Moderation when we talk about the period 1984-2007

- Volatility: Investment is much more volatile than consumption:



### 10.3. Time Horizon in Macroeconomics

- *In the long-run*, the prices of all goods and services, as well as the prices of all factor inputs, are completely flexible. (classical dichotomy and long-run neutrality of money).
  - Classical economists emphasize:
    1. Long-run models where
    2. Prices are completely flexible, and markets are
    3. Quick to adjust to long-run equilibrium levels so
    4. The policy focus should be on economic growth,
    5. Not on short-term business fluctuations.
- *In the short-run*, the prices of some goods and services, as well as the prices of some factor inputs are slow to respond to changes in supply and demand, i.e., are sticky. ( no classical dichotomy and long-run neutrality of money).
  - Keynesian economists emphasize:
    1. Short-run models where
    2. Prices are sticky, and markets are
    3. Slow to adjust to long-run equilibrium levels so
    4. The policy focus should be on stabilization,
    5. In addition to (long-term) economic growth.
- Differing views about price flexibility vs. price stickiness reflects differing views about market structure:
  1. If markets are perfectly competitive then price flexibility is more likely.
  2. If markets exhibit monopolistic competition then price stickiness is more likely

### 10.4. Idea Behind "Sticky Prices" and Short-Run Models (The Big Picture!)<sup>1</sup>

- Economists believe that most short-run fluctuations (business cycles) are the result of demand shocks. However, supply shocks do happen in some cases and are very important when they do occur, so don't forget about them!
- But why are demand shocks such a big problem? Why would we have to consider calling in the government to help deal with them? And why can't firms deal with demand shocks on their own?
- The answer to these questions is that the prices of many goods and services are inflexible (slow to change, or "sticky") in the short run.
- Economists believe that a combination of unexpected changes in demand and inflexible prices are the key to understanding the short-run fluctuations that affect real-world economies.

#### A Simple Example

- **Setup**

After extensive market research, Buzzer concludes that it could earn a modest profit if it builds and staffs an appropriately sized factory to build an environmentally friendly SUV, which it decides to call the Prion.

Buzzer's marketing economists collaborate with Buzzer's engineers and conclude that expected profits will be maximized if the firm builds a factory that has an optimal output rate of 900 cars per week.

If the factory operates at this rate, it can produce Prions for only \$36,500 per vehicle. This is terrific because the firm's estimates for demand indicate that a supply of 900 vehicles per week can be sold at a price of \$37,000 per vehicle – meaning that if everything goes according to plan, Buzzer Auto should make an accounting profit of \$500 on each Prion that it produces and sells. Expecting these future conditions, Buzzer decides to build the factory, staff it with workers, and begin making the Prion.

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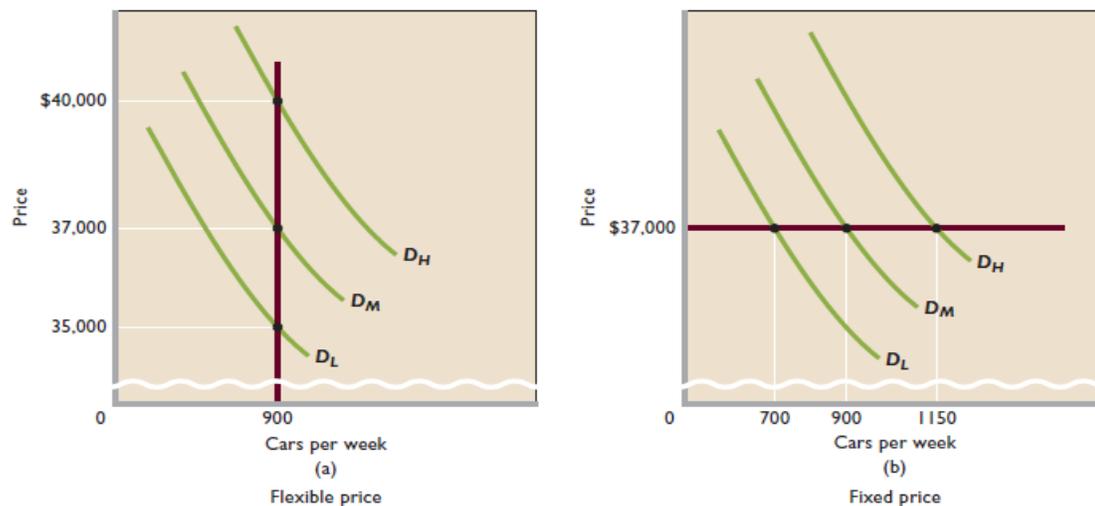
<sup>1</sup>This section is adapted from *Economics (McConnell), 18th Edition*.

- **Key point**

If sales expectations are always fulfilled, Buzzer Auto will never contribute to any of the short-run fluctuations in output and unemployment that affect real-world economies (no business cycle!).

These facts imply that the short-run fluctuations in output and unemployment that we do see in the real world must be the result of shocks and things not going according to plan. In particular, business cycle fluctuations typically arise because the actual demand that materializes ends up being either lower or higher than what firms were expecting.

**FIGURE 23.1 The effect of unexpected changes in demand under flexible and fixed prices.** (a) If prices are flexible, then no matter what demand turns out to be, Buzzer Auto can continue to sell its optimal output of 900 cars per week since the equilibrium price will adjust to equalize the quantity demanded with the quantity supplied. (b) By contrast, if Buzzer Auto sticks with a fixed-price policy, then the quantity demanded will vary with the level of demand. At the fixed price of \$37,000 per vehicle, the quantity demanded will be 700 cars per week if demand is  $D_L$ , 900 cars per week if demand is  $D_M$ , and 1150 cars per week if demand is  $D_H$ .



- **Demand shocks and Flexible Prices**

Assume prices are completely flexible, then:

- If demand is unexpectedly low at  $D_L$ , the market price can adjust downward to \$35,000 per vehicle so that the quantity demanded at that price will still be equal to the factory’s optimal output rate of 900 cars per week.
- On the other hand, if demand is unexpectedly high at  $D_H$ , the market price can adjust upward to \$40,000 per vehicle so that the quantity demanded will still be equal to the factory’s optimal output rate of 900 cars per week.

Applying this logic to the economy as a whole, if the prices of goods and services could always adjust quickly to unexpected changes in demand, then the economy could always produce at its optimal capacity since prices would adjust to ensure that the quantity demanded of each good and service would always equal the quantity supplied.

- **Demand shocks and Sticky Prices**

In reality, many prices in the economy are inflexible and are not able to change rapidly when demand changes unexpectedly. Consider the extreme case shown in Figure 23.1b, in which the price of Prions is totally inflexible, fixed at \$37,000 per Prion.

- Here, if demand unexpectedly falls from  $D_H$  to  $D_L$ , the quantity demanded at the fixed price of \$37,000 will only be 700 cars per week, which is 200 cars fewer than the factory’s optimal output of 900 cars per week.
- On the other hand, if demand is unexpectedly high at  $D_H$ , the quantity demanded at the fixed price of \$37,000 will be 1150 cars per week, which is 250 cars more than the factory’s optimal output of 900 cars per week.

- **Bottom line:**

- This simplified story about a single car company explains why economists believe that a combination of unexpected changes in demand and inflexible prices are the key to understanding the short-run fluctuations that affect real-world economies.
- If prices were flexible, then the firm could always operate at the factory's optimal output level because prices would always adjust to ensure that it could sell its optimal output of 900 cars per week no matter what happens to demand.
- But if prices are inflexible, then an unexpected decline in demand that persists for any length of time will result in increasing inventories that will eventually force the firm's management to cut production to less than the optimal output level of 900 cars per week. When this happens, not only will output fall, but unemployment will also rise. The firm will lay off workers because fewer employees will be needed to produce fewer cars.

## Exercises

1. A leading countercyclical variable reaches:
  - (a) A peak before the peak of the business cycle.
  - (b) A peak before the trough of the business cycle.
  - (c) A peak with the peak of the business cycle.
  - (d) A trough before the trough of the business cycle.
2. A procyclical variable:
  - (a) Increases during expansions and decreases during contractions.
  - (b) Increases during contractions and decreases during expansions.
  - (c) Changes in the opposite direction as aggregate economic activity.
  - (d) Has signed a contract to ride on the professional bicycle tour.
3. Staggered price setting:
  - (a) Reduces price stickiness.
  - (b) Occurs in all sectors of the economy.
  - (c) Occurs in only a few sectors of the economy.
  - (d) Is the lack of coordination by firms in changing prices.
4. The classical view believes that:
  - (a) Prices are sticky.
  - (b) Economies move slowly to their long-run equilibrium.
  - (c) An increase in the money supply has no effect on the real economy even in the short-run.
  - (d) An increase in the money supply leads to increases in saving and investment.
5. The Keynesian view believes that:
  - (a) Economies move quickly to their long-run equilibrium.
  - (b) That government policies should pursue active policies to stabilize economic fluctuations.
  - (c) That the long-run is more important than short-run fluctuations.
  - (d) That the classical dichotomy holds in the short-run.

## SECTION 11: The IS Curve

### 11.1. Derivation of the IS curve

- The *IS curve* is the inverse relationship between aggregate output and the real interest rate when the goods market is in equilibrium. How do we derive it?
- *Starting point*: goods market equilibrium exists only when planned spending exactly equals the amount that is actually produced (or equivalently when the demand for goods equals the supply of goods):

$$\begin{aligned} Y &= Y_{pe} \\ Y &= C + I_p + G + NX \end{aligned}$$

where:

1. *Actual expenditures*,  $Y$ , are the total amount of spending on domestically produced goods and services that households, businesses, the government, and foreigners *actually make*.
  2. *Planned expenditures*,  $Y_{pe}$ , are the total amount of spending on domestically produced goods and services that households, businesses, the government, and foreigners want to make.
- Planned expenditures,  $Y_{pe}$ , include:

1. *Consumption expenditures*,  $C$  (durable goods spending + non-durable goods spending + services spending):

$$C = \bar{C} + mpc \times Y_D - c \times r$$

where:

$\bar{C}$  = autonomous consumption expenditure (consumer confidence or sentiment (+), household wealth (+), and expected future income (+))

$Y_D$  = disposable income =  $Y - T$ , (where  $T = \bar{T}$  are the autonomous taxes)

$mpc$  = the marginal propensity to consume ( $\frac{\Delta C}{\Delta Y}$ ), with  $0 < mpc < 1$

$r$  = the real increase rate, and

$c$  = a parameter reflecting how sensitive  $C$  is to  $r$ .

2. *Planned investment spending*,  $I_p$  (fixed investment + inventory investment):

$$I_p = \bar{I} - d \times r$$

where:

$\bar{I}$  = autonomous planned investment (business confidence or sentiment (+), expected future profits and/or cash flow (+), and changes in technology (+))

$r$  = the real interest rate, and

$d$  = a parameter reflecting how sensitive  $I_p$  is to  $r$ .

3. *Net exports*,  $NX$  (Exports-Imports):

$$NX = \bar{NX} - x \times r$$

where:

$\bar{NX}$  = autonomous net exports (domestic preferences for foreign goods (-), foreign preferences for domestic goods (+), and foreign trade barriers (-)).

$r$  = the real increase rate, and

$x$  = a parameter reflecting how sensitive  $NX$  is to  $r$ .

4. Government purchases,  $G$ :

$$G = \bar{G}$$

where  $\bar{G}$  = autonomous government purchases, which are determined within the political system

- Substituting into the goods market equilibrium:

$$Y = \bar{C} + mpc \times Y_D - c \times r + \bar{I} - d \times r + \bar{G} + \bar{NX} - x \times r$$

rearranging, it gives us a formula for the  $IS$  curve:

$$Y = \frac{(\bar{C} + \bar{I} + \bar{G} + \bar{NX} - mpc \times \bar{T})}{(1 - mpc)} - \frac{(c + d + x)}{(1 - mpc)} \times r$$

which, again, is the inverse relationship between aggregate output and the real interest rate when the goods market is in equilibrium.

- Implications:

1. The  $IS$  curve shifts when there is a change in:

- (a) Autonomous consumption,  $\bar{C}$ ,
- (b) Autonomous planned investment,  $\bar{I}$ ,
- (c) Autonomous net exports,  $\bar{NX}$ ,
- (d) Autonomous government purchases,  $\bar{G}$ , or
- (e) Autonomous taxes,  $\bar{T}$ .

2. The effect on output would be the same for identical changes in:

- (a) Autonomous consumption,  $\bar{C}$ ,
- (b) Autonomous planned investment,  $\bar{I}$ ,
- (c) Autonomous net exports,  $\bar{NX}$ , or
- (d) Autonomous government purchases,  $\bar{G}$ .

3. The effect on output would be the opposite and smaller for an identical change in:

- (a) Autonomous taxes,  $\bar{T}$ .

4. The slope of the  $IS$  curve changes if we have a change in:

- (a)  $c$ , the parameter reflecting how sensitive  $C$  is to  $r$ .
- (b)  $d$ , the parameter reflecting how sensitive  $I_p$  is to  $r$ .
- (c)  $x$ , the parameter reflecting how sensitive  $NX$  is to  $r$ .

5. There is a shift and a change in the slope when the  $mpc$  changes.

## Exercises

- The IS curve shows the combination of output and the real interest rate for which:
  - The goods market is in equilibrium.
  - The labor market is in equilibrium.
  - The financial market is in equilibrium.
  - All three markets are in equilibrium.
- If planned expenditures are below actual output, then as the economy approaches equilibrium:
  - Saving is rising.
  - Actual output is rising.
  - Unemployment is falling.
  - Planned expenditures is falling.
  - All of the above.
  - None of the above.
- Any change that reduces desired saving relative to desired investment (for a given level of output) causes the real interest rate to  $\_ \_ \_ \_ \_$  and shifts the IS curve to the  $\_ \_ \_ \_ \_$ .
  - Increase; left.
  - Increase; right.
  - Decrease; left.
  - Decrease; right.
- An increase in labor supply would cause the IS curve to:
  - Shift to the right.
  - Shift to the left.
  - Remain unchanged.
  - Become steeper.
  - Become flatter.
- An increase in the firms' expected future profits would cause the IS curve to:
  - Shift to the right.
  - Shift to the left.
  - Remain unchanged.
  - Become steeper.
  - Become flatter.
- A sharp decline in the stock market would cause:
  - Saving to decrease.
  - The real interest rate to increase.
  - A movement along the IS curve.
  - A decrease in autonomous consumption.
- When debt levels are very high, increases in the real interest rate have a larger effect on consumer spending, business investment, and net exports than they do when debt levels are much lower. As a result, higher debt levels would have the effect of:
  - Making the IS curve flatter.
  - Making the IS curve steeper.
  - Making the MP curve flatter.
  - Making the MP curve steeper.

- Analytical question – Suppose that the economy is in goods market equilibrium with the real interest rate at  $r_0$  and output at  $Y_0$ .
  1. Use a goods market diagram to clearly and accurately show the economy's initial equilibrium. This diagram should be drawn in BLACK.
  2. Now suppose that because of a sudden financial crisis, there is a collapse of consumer and business sentiment. Based only on this information, clearly and accurately show the effect of the financial crisis on the economy's equilibrium level of output if the real interest rate does not change. This change should be drawn in RED.
  3. Provide an economic explanation of what you have shown in your diagram above. Be sure to discuss what happens to economic output and to explain why these changes take place.

## SECTION 12: Monetary Policy and Aggregate Demand

### 12.1. The Federal Reserve and Monetary Policy

- Central banks use nominal short-term interest rates as their primary policy tool.
  - In the U.S., the Federal Reserve conducts monetary policy by setting a target for the federal funds rate (a nominal rate!). It does so through open market operations, which allow the Fed to control the amount of reserves in the banking system and, thus, the fed funds rate.
- Central banks control short-term nominal interest rate but it is real interest rates that matter for real economic activity.
  - Changes in the nominal interest rate will affect the real interest rate only if expected inflation remains unchanged in the short-run.
  - This is true if prices are sticky (i.e. in the short run), in which case changes in monetary policy that affect short-term nominal interest rates will not have an immediate effect on either actual or expected inflation.
  - The ability of central banks to control real interest rates in the short-term does not imply that they can control them in the long-run (when all prices are flexible).

### 12.2. The Monetary Policy Curve

- In the short-run, when prices are sticky, monetary policy can be used to influence real economic activity, given that changes in the nominal interest rate affect the real interest rate.
- Central banks seek to keep inflation low. To stabilize inflation, central banks will raise the nominal interest rate by more than any rise in expected inflation so that the real interest rate rises when there is a rise in inflation  
=> this is known as the *Taylor principle*
- The monetary policy curve, *MP*, represents the positive relationship between the real interest rate that the central bank sets and the inflation rate (by following the Taylor principle):

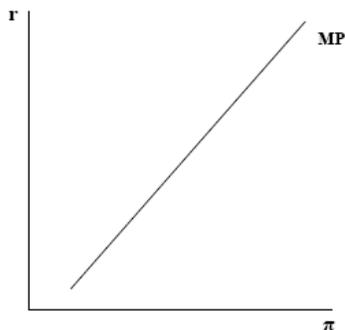
$$r = \bar{r} + \lambda\pi$$

where:

$\bar{r}$  = the autonomous component of the real interest rate set by the monetary authorities,

$\pi$  = the inflation rate

$\lambda$  = the responsiveness of the  $r$  to  $\pi$



- Therefore two kinds of adjustments can happen:
  1. Automatic adjustments: as  $\pi$  changes, also  $r$  changes (movement along the MP curve)
  2. Autonomous adjustments: changes in the autonomous real interest rate  $\bar{r}$  (shift in the MP curve): expansionary ( $\Delta\bar{r} < 0$ ) or contractionary ( $\Delta\bar{r} > 0$ ) monetary policy
- Compare two scenarios:
  - if the central bank follows the Taylor principle, then as  $\pi^e$  (and  $\pi$ ) increases, the central bank (through a reduction in the money supply) increases  $i$ . If prices are sticky,  $\pi^e$  is not affected and  $r$  will increase as well (the opposite happens if  $\pi$  decreases).
  - if the central bank didn't follow the Taylor principle, an increase in  $\pi^e$  (and  $\pi$ ) would reduce  $r$ , which would cause higher  $Y$  (look at the  $IS$  curve), which would cause even higher  $\pi$ , and so on and so forth.

### 12.3. The Money Market and Interest Rates

- The analysis of the money market is complementary to the analysis of the Taylor rule. It shows the mechanism through which the Fed sets the nominal interest rate. Higher inflation induces a higher real interest rate, as it was the case when we looked at the  $MP$  curve.
- In equilibrium the demand for real money balances is equal to the supply of real money balances:

$$\frac{M^d}{P} = \frac{M^s}{P}$$

where, with  $i$  being the nominal interest rate, and  $Y$  the real economic output:

$$\frac{M^d}{P} = L\left(\underset{(-)}{i}, \underset{(+)}{Y}\right)$$

and the money supply curve  $\frac{M^s}{P}$  is assumed to be fixed by the central bank through open-market operations.

- The real demand for money changes because of:
  - A change in nominal income
  - A change in the price level
- The real supply of money changes because of:
  - A change in the nominal money supply
  - A change in the price level
- Implications:
  - when the money supply increases ( $M^s \uparrow$ ), the nominal interest rate decreases ( $i \downarrow$ )
  - when real economic output increases ( $Y \uparrow$ ), the nominal interest rate increases ( $i \uparrow$ )
  - when the price level increases ( $P \uparrow$ ), the nominal interest rate increases ( $i \uparrow$ )

## 12.4. Aggregate Demand

- The aggregate demand curve,  $AD$ , is the inverse relationship between inflation and economic output:
  1. As the inflation rate rises, the real interest rate will also increase along the  $MP$  curve.
  2. As the real interest rate increases, economic output will also decrease along the  $IS$  curve.
  3. Thus, higher inflation leads to lower economic output.
- Combining the formula for the  $IS$  curve:

$$Y = \frac{(\bar{C} + \bar{I} + \bar{G} + \bar{NX} - mpc \times \bar{T})}{(1 - mpc)} - \frac{(c + d + x)}{(1 - mpc)} \times r$$

and the Taylor principle:

$$r = \bar{r} + \lambda\pi$$

we get an expression that relates inflation and economic output:

$$Y = \frac{(\bar{C} + \bar{I} + \bar{G} + \bar{NX} - mpc \times \bar{T})}{(1 - mpc)} - \frac{(c + d + x)}{(1 - mpc)} \times \bar{r} - \frac{(c + d + x)}{(1 - mpc)} \lambda\pi$$

- Any factor that shifts the  $IS$  or the  $MP$  curve will also shift the  $AD$  curve in the same direction:
  1. Changes in autonomous consumption,
  2. Changes in autonomous planned investment,
  3. Changes in autonomous government purchases,
  4. Changes in autonomous taxes,
  5. Changes in autonomous net exports,
  6. Changes in the autonomous real interest rate.

## Exercises

1. The exogenous variable in the monetary policy curve is:
  - (a) The inflation rate,  $\pi$ .
  - (b) The real interest rate,  $r$ .
  - (c) The policy parameter,  $\lambda$ .
  - (d) The autonomous component,  $r$ .
2. A movement along the MP curve implies:
  - (a) An automatic adjustment of the real interest rate.
  - (b) An autonomous adjustment of aggregate demand.
  - (c) An automatic adjustment of the nominal interest rate.
  - (d) An autonomous adjustment in the unemployment rate.
3. If a central bank did NOT follow the Taylor Principle, an increase in inflation would lead to:
  - (a) A further increase in inflation.
  - (b) A decrease in aggregate output.
  - (c) An increase in the real interest rate.
  - (d) A decrease in the nominal interest rate.
4. Ceteris paribus, an autonomous tightening of monetary policy would cause:
  - (a) The real interest rate to rise and net exports to increase.
  - (b) The real interest rate to fall and net exports to increase.
  - (c) The real interest rate to rise and net exports to decline.
  - (d) The real interest rate to fall and net exports to decline.
5. Suppose that the central bank decides to increase  $\lambda$  in the MP curve. This is an example of:
  - (a) Autonomous monetary policy easing.
  - (b) Autonomous monetary policy tightening.
  - (c) Leftward movement along the MP curve.
  - (d) Rightward movement along the MP curve.
6. When debt levels are very high, changes in interest rates have a much smaller effect on consumer spending, business investment, and net export. This would:
  - (a) Flatten the monetary policy curve.
  - (b) Steepen the monetary policy curve.
  - (c) Make a given autonomous monetary policy action less effective in changing economic output than when debt levels are low.
  - (d) Make a given autonomous monetary policy action more effective in changing economic output than when debt levels are low.
7. In the aggregate demand curve, the endogenous variable is:
  - (a) Economic output.
  - (b) Inflation.
  - (c) The real interest rate.

- (d) The demand for real money balances.
8. If the interest rate sensitivity of investment spending increases, then:
- (a) Both the IS and AD curves will become flatter.
  - (b) Both the IS curve and the AD curve become steeper.
  - (c) The IS curve becomes flatter but the AD curve becomes steeper.
  - (d) The IS curve becomes steeper but the AD curve becomes flatter.
9. Suppose the central bank surprisingly and substantially reduces the real interest rate and that this drastic action leads to increased worries among households and businesses about what information the central bank might have about the economy. The effects of these actions would be analyzed by:
- (a) A leftward shift of the MP curve.
  - (b) A rightward shift of the MP curve.
  - (c) A leftward shift of the MP curve and a rightward shift of the IS curve.
  - (d) A rightward shift of the MP curve and a leftward shift of the IS curve.
10. If the nominal interest rate is above its equilibrium level:
- (a) The supply of real money balances will decline.
  - (b) The quantity of real money balances people are holding is too low.
  - (c) People are selling financial assets in order to increase their real money balances.
  - (d) All of the above.
  - (e) None of the above
- Analytical question:
    1. Suppose that the central bank becomes fearful of future inflation and engages in an autonomous tightening of monetary policy. Based only on this information, clearly and accurately show the effect of this monetary policy tightening on the economy's equilibrium level of output and the real interest rate assuming that the actual inflation rate does not change.
    2. Suppose that the central bank responds to an increase in inflation by increasing the real interest rate. Based only on this information, clearly and accurately show the effect of this monetary policy response on the economy's equilibrium level of output and on the real interest rate.
    3. Suppose that the economy experiences an increase in business confidence. Based only on this information, clearly and accurately show the effect on the economy's equilibrium level of output assuming that the actual inflation rate does not change.

## SECTION 13: The Phillips Curve and Aggregate Supply

### 13.1. The Phillips Curve

- The short run Phillips curve we are working with is an expectation augmented version of the Phillips curve in which expected inflation is adaptive and we allow for the possibility of supply shocks:

$$\pi_t = \pi_{t-1} - \omega(U_t - U_N) + \rho_t$$

where:

$\pi_t$  = inflation rate at time t

$\pi_{t-1}$  = inflation rate at time t-1

$\omega$  = the sensitivity of to changes in U

$U_t$  = the unemployment rate at time t

$U_N$  = the natural rate of unemployment

$\rho_t$  = supply shock (if no supply shock at time t, then  $\rho_t = 0$ )

- What the formula tells us:

1. *inverse relationship between inflation and the unemployment gap*: when unemployment is unusually low (below  $U_N$ ), the demand for labor will exceed the supply of labor and wages will rise more quickly. Because wages are a major input into total costs, more rapidly rising wages leads to higher inflation.
2. *positive one-for-one relationship between inflation and expected inflation*: specifically, we are assuming that inflation expectations are determined in an *adaptive* (or backward-looking) way:  $\pi^e = \pi_{t-1}$ .
3. the Phillips curve has also been adjusted to account for *supply shocks*, i.e. events that affect inflation that are independent of:
  - (a) Labor market conditions, and/or
  - (b) Inflationary expectations.

- Implications:

1. Short-run versus long-run:
  - (a) There may be a short-run trade-off between unemployment and inflation  
=> Short-run Phillips curve
  - (b) There is no long-run trade-off between unemployment and inflation, because in the long run  $U = U_N$  (this result is consistent with the classical dichotomy)  
=> Long-run Phillips curve, with  $\pi = \pi^e$
2. Wages and prices are sticky:
  - (a) The more flexible wages and prices are, the more they and inflation respond to the unemployment gap, i.e.,  $\omega$  is larger.
  - (b) If wages and prices were completely flexible, then  $\omega = \infty$  and the short-run Phillips curve becomes vertical and identical to the long-run Phillips curve.

- The accelerationist Phillips curve follows:

$$\begin{aligned}\pi_t - \pi_{t-1} &= -\omega(U_t - U_N) + \rho_t \\ \Delta\pi_t &= -\omega(U_t - U_N) + \rho_t\end{aligned}$$

so, in the absence of supply shocks ( $\rho_t = 0$ ):

if  $U_t < U_N$ , then  $\Delta\pi_t > 0$

if  $U_t = U_N$ , then  $\Delta\pi_t = 0$

if  $U_t > U_N$ , then  $\Delta\pi_t < 0$

this is why  $U_N$  is also referred to as the Non-Accelerating Inflation Rate of Unemployment (NAIRU).

## 13.2. The Aggregate Supply Curve

- The aggregate supply curve represents the relationship between:
  1. The quantity of output that businesses are willing to produce, and
  2. The inflation rate
- Because there are both long-run and short-run Phillips curves, there are both long-run and short-run aggregate supply curves

### 13.2.1. The long-run aggregate supply curve, LRAS

- The *long-run aggregate supply curve, LRAS*, depends upon:
  1. The amount of labor,  $L$ ,
  2. The amount of capital,  $K$ , and
  3. The total factor productivity,  $A$ , of the economy
- The level of aggregate output supplied at the natural rate of unemployment is referred to as the *natural rate of output*, or as *potential output*,  $Y_P$ .
- The LRAS curve will shift if there is :
  1. A change in the amount of labor,  $\Delta L$
  2. A change in the amount of capital,  $\Delta K$ ,
  3. A change in the total factor productivity,  $\Delta A$ ,
  4. A change in the natural rate of unemployment,  $\Delta U_N$ .

### 13.2.2. The short-run aggregate supply curve, SRAS

- The *short-run aggregate supply curve, SRAS*, is derived from the short-run Phillips curve by replacing the unemployment gap,  $U - U_N$ , with the output gap,  $Y - Y_P$ , using Okun's Law:

$$U - U_N = -0.5 \times (Y - Y_P)$$

Specifically, under our assumptions, the SRAS looks like:

$$\begin{aligned}\pi_t &= \pi_{t-1} + 0.5\omega(Y_t - Y_P) + \rho_t \\ &= \pi_{t-1} + \gamma(Y_t - Y_P) + \rho_t\end{aligned}$$

- The SRAS curve will shift if there is:
  1. A change in expected inflation
  2. A price shock
  3. A change in potential output  $Y_P$

## Exercises

1. Friedman and Phelps argued that the original Phillips Curve analysis suffered from:
  - (a) Implicitly assuming that wages and prices were sticky.
  - (b) Implicitly assuming that firms and workers respond to real wages.
  - (c) Implicitly assuming that wages and prices were completely flexible.
  - (d) Implicitly assuming that firms and workers respond to nominal wages.
2. As wages and prices become more flexible:
  - (a) The Phillips Curve becomes flatter.
  - (b) Inflation becomes less responsive to the output gap.
  - (c) Inflation becomes more responsive to the output gap.
  - (d) There is no trade-off between inflation and unemployment.
3. Suppose that the World Trade Organization concludes an agreement with its member countries to significantly reduce trade barriers, resulting in a sharp increase in globalization. As a result, workers have less bargaining power over wages and businesses have less pricing power. Then:
  - (a) The short-run PC and AS curve will both be flatter
  - (b) The short-run PC and AS curve will both be steeper
  - (c) The short-run PC will be flatter but the short-run AS curve will be steeper
  - (d) The short-run PC will be steeper but the short-run AS curve will be flatter
4. When wages and prices are completely flexible:
  - (a) Unemployment is unaffected by changes in economic output.
  - (b) Inflation is determined by expected inflation and price shocks.
  - (c) Expansionary monetary and fiscal policies have no effect on the economy.
  - (d) All of the above.
  - (e) None of the above.
5. In the long-run:
  - (a) The Phillips Curve is vertical with respect to output.
  - (b) Inflation has a large impact on output and employment.
  - (c) The Aggregate Supply curve is vertical with respect to unemployment.
  - (d) The economy reaches the output level that is consistent with the natural rate of unemployment.
6. Which of the following changes would cause a direct upward shift in the SRAS curve?
  - (a) An increase in the labor force.
  - (b) An increase in production costs.
  - (c) An increase in the money supply.
  - (d) An increase in government purchases.
7. Suppose that the actual unemployment rate is above the natural rate of unemployment. Then the economy should be experiencing:
  - (a) Deflation.
  - (b) Disinflation.

- (c) Rising inflation.
  - (d) A steady inflation rate.
8. Suppose that a new technology provides faster and better matching between people seeking jobs and business firms seeking qualified workers. This would:
- (a) Shift both the short-run and long-run Phillips Curves to the left.
  - (b) Shift both the short-run and long-run Phillips Curves to the right.
  - (c) Shift the short-run Phillips Curve to the left and the long-run Phillips Curve to the right.
  - (d) Shift the short-run Phillips Curve to the right and the long-run Phillips Curve to the left.
9. Given the accelerationist Phillips curve,  $\Delta\pi = -0.3(U - 6) + \rho$ , if inflation in the preceding period was 3 percent, unemployment is 6 percent, and there is a price shock of 2 percent then the current inflation rate is:
- (a) 0.2 percent.
  - (b) 1 percent.
  - (c) 3 percent.
  - (d) 5 percent.

• Analytical Question #1 (Spring 2011). IS–MP–PC Model.

Suppose that the economy is initially in general equilibrium.

1. Use IS–MP–Phillips Curve diagrams to clearly and accurately show the economy’s initial economic situation. These diagrams should be drawn in BLACK.
2. Provide an economic explanation of what you have shown in your diagrams above.
3. Now suppose that as a result of turmoil in North Africa and the Middle East, there is a sharp increase in crude oil prices that causes inflation to increase. In turn, higher crude oil prices results in higher gasoline prices, causing in a substantial and permanent decline in consumer sentiment. On your diagrams above, clearly and accurately show the initial (or first year) effects of these changes on economic output, the real interest rate, inflation, and unemployment. These changes should be drawn in RED.
4. Provide an economic explanation of what you have shown in your diagrams above. Be sure to discuss what happens to economic output, the real interest rate, inflation, and unemployment and explain why these changes take place.
5. On your diagrams above, clearly and accurately show the final (long-run) equilibrium from the effects described in part 3 on economic output, the real interest rate, inflation, and unemployment. These changes should be drawn in BLUE.
6. Provide an economic explanation of how the economy moves from its initial (first-year) shortrun equilibrium to its final long-run equilibrium. Be sure to discuss what happens to economic output, the real interest rates, inflation, and unemployment and explain why these changes take place. Clearly identify the economy’s long-run equilibrium values for economic output, the real interest rate, inflation, and unemployment.

• Analytical Question #2 (Fall 2011). IS–MP–PC Model.

Suppose that the economy is initially in general equilibrium.

1. Use IS–MP–Phillips Curve diagrams to clearly and accurately show the economy’s initial economic situation. These diagrams should be drawn in BLACK.
2. Provide an economic explanation of what you have shown in your diagrams above.

3. Now suppose that there is a sharp decline in crude oil prices that causes inflation to decrease. In reaction to these events, the central bank engages in an expansionary monetary policy. On your diagrams above, clearly and accurately show the initial (or first year) effects of these changes on economic output, the real interest rate, and inflation. These changes should be drawn in RED.
  4. Provide an economic explanation of what you have shown in your diagrams above. Be sure to discuss what happens to economic output, the real interest rate, inflation, and unemployment and explain why these changes take place.
  5. On your diagrams above, clearly and accurately show the final long-run equilibrium from the effects described in part c on economic output, the real interest rate, and inflation. These changes should be drawn in BLUE.
  6. Provide an economic explanation of how the economy moves from its initial (or first-year) short-run equilibrium to its final long-run equilibrium. Be sure to discuss what happens to economic output, the real interest rate, and inflation and explain why these changes take place. Clearly identify the economy's long-run equilibrium values for economic output, the real interest rate, and inflation.
- Analytical Question #3 (Fall 2012). The AD – AS Model.

Suppose an economy, which is characterized by sticky wages and prices, has an initial, i.e., Year 0, unemployment rate that is substantially above the natural rate of unemployment.

1. Based only on this information, use an AD – AS model diagram to clearly and accurately show the economy's current (1) economic output and (2) inflation. This diagram should be drawn in BLACK.
2. Provide an economic explanation of what you have shown in your diagram above.
3. In Year 1, a deep global economic recession caused a sharp decline in exports. Weak global demand also caused the price of imported crude oil to fall by one-third, subtracting 2 percentage points from inflation. The unemployment rate rose. Incorporating only this new information, clearly and accurately show in your diagram above the Year 1 effects, if any, from the declines in exports and imported crude oil prices have on (1) economic output and (2) inflation. These effects should be drawn in RED.
4. Provide an economic explanation of what you have shown in your diagram above. Discuss what, if anything, happens in Year 1 to (1) economic output and (2) inflation. Be sure to explain why these effects take place and what causes them.
5. In Year 2, a sharp global economic recovery caused exports to return to their Year 0 level. Strong global demand caused the price of imported crude oil to increase by one-half, adding 2 percentage points to inflation. Incorporating only this new information, clearly and accurately show in your diagram above what Year 2 effects, if any, the increases in exports and oil prices have on (1) economic output and (2) inflation. These effects should be drawn in BLUE.
6. Provide an economic explanation of what you have shown in your diagram above. Discuss what, if anything, happens in Year 2 to (1) economic output and (2) inflation. Be sure to explain why these effects take place and what causes them.

# SECTION 14: The Aggregate Demand and Supply Model, Part 1

## 14.1. The Aggregate Demand and Supply Curves

### 14.1.1. The Aggregate Demand Curve

- The aggregate demand curve, AD, is the *inverse relationship between inflation and economic output when the goods market is in equilibrium.*
- The AD curve is downward sloping because a rise in inflation causes:
  1. The monetary authorities to increase real interest rates to control inflation, which
  2. Reduces planned expenditures, and
  3. Reduces the equilibrium level of output
- The AD curve will shift whenever there is:
  1. A change in autonomous consumption,
  2. A change in autonomous investment,
  3. A change in autonomous government purchases,
  4. A change in autonomous taxes,
  5. A change in autonomous net exports, or
  6. A change in autonomous monetary policy

### 14.2.1 The Aggregate Supply Curves

#### 1. LRAS:

- The long-run aggregate supply curve, LRAS, is the *vertical relationship between inflation and potential economic output.*
- The LRAS curve is vertical because a rise in inflation causes:
  1. No change in the factors of production,
  2. No change in total factor productivity, and
  3. No change in the natural rate of unemploymentdue to complete wage and price flexibility.
- The LRAS curve will shift whenever there is:
  1. A change in the quantity of labor,
  2. A change in the quantity of capital,
  3. A change in total factor productivity, or
  4. A change in the natural rate of unemployment

1. SRAS curve:

- The short-run aggregate supply curve, SRAS, is the *positive relationship between inflation and economic output* that firms are willing to supply
- The SRAS curve is positively sloped because a rise in output:
  1. Increases the demand for labor, causing
  2. The wage rate to rise more quickly, which
  3. Causes higher inflation

because of sticky wages and prices

- The SRAS curve will shift whenever there is:
  1. A change in expected inflation,
  2. A price shock, or
  3. A persistent output gap.

## 14.2. General Equilibrium in AD/AS Analysis

- *General equilibrium* exists when all markets are simultaneously in equilibrium, i.e., where:

$$AD = SRAS = LRAS$$

The economy is simultaneously in both short-run and long-run equilibrium.

- *Short-run equilibrium* exists when aggregate demand equals short-run aggregate supply, i.e., where:

$$AD = SRAS$$

Suppose the economy is in short-run equilibrium but not in long-run equilibrium:

1. if  $Y_1 > Y_P$ , then an increase in the demand for labor leads to:
  - (a) A faster increase in wages, which results in
  - (b) Higher inflation, and
  - (c) Higher inflation expectations, causing
  - (d) The SRAS curve to shift to the left
2. if  $Y_1 < Y_P$ , then a decrease in the demand for labor leads to:
  - (a) A slower increase in wages, which results in
  - (b) Slower inflation, and
  - (c) Slower inflation expectations, causing
  - (d) The SRAS curve to shift to the right.

Regardless of where short-run equilibrium is, the economy will adjust over time to its general equilibrium level at potential output:

- This dynamic is referred to as the economy's selfcorrecting mechanism.
- The mechanism occurs because inflationary expectations change to match actual inflation.

## Exercises

1. If the unemployment rate is below the natural rate of unemployment, then:
  - (a) There is slack in the labor market.
  - (b) The SRAS curve will shift to the left.
  - (c) The AD curve will shift to the right.
  - (d) Economic output is below its potential level.
2. If economic output is below its potential level, then ultimately:
  - (a) Inflation will rise.
  - (b) Unemployment will decline.
  - (c) The real interest rate will increase.
  - (d) All of the above.
  - (e) None of the above.
3. Suppose that there is a decline in both the unemployment rate and inflation. This could be caused by:
  - (a) A positive aggregate demand shock and a positive short-run aggregate supply shock.
  - (b) A positive aggregate demand shock and a negative short-run aggregate supply shock.
  - (c) A negative aggregate demand shock and a negative short-run aggregate supply shock.
  - (d) A negative aggregate demand shock and a negative long-run aggregate supply shock.
4. Suppose that both China and Japan have net export functions that can be written as  $NX = \overline{NX} - \alpha \times Y + \beta \times Y_F - \gamma \times r$  where  $Y_F$  is foreign economic activity. If both China and Japan are initially in general equilibrium and the Chinese government then engages in an expansionary fiscal policy, in the short-run Japan will experience:
  - (a) Higher economic output and higher inflation.
  - (b) Higher economic output but lower inflation.
  - (c) Lower economic output but higher inflation.
  - (d) Lower economic output and lower inflation.
5. Suppose that the central bank has a real interest rate target that it is committed to maintaining. If there is a sudden increase in wealth, then the central bank must respond by:
  - (a) Increasing government purchases.
  - (b) Decreasing government purchases.
  - (c) Engaging in open market sales of government securities.
  - (d) Engaging in open market purchases of government securities.
6. Suppose that the investment function is now given by  $I = \bar{I} - \delta \times r - v \times \pi$ . If the economy was initially in general equilibrium and there is now a sudden decline in oil prices, then:
  - (a) The AD and SRAS curves would simultaneously shift to the left.
  - (b) The AD and SRAS curves would simultaneously shift to the right.
  - (c) The AD curve would shift to the right while the SRAS curve would simultaneously shift to the left.
  - (d) The AD curve would shift to the left while the SRAS curve would simultaneously shift to the right.

7. The standard assumption is that the investment function is given by  $I = \bar{I} - \delta \times r$ . But suppose that the investment function is instead given by  $I = \bar{I} + v \times Y - \delta \times r$ . Then for any given change in autonomous monetary policy:
  - (a) The change in unemployment rate would be larger when compared with the standard assumption.
  - (b) The change in the unemployment rate would be smaller when compared with the standard assumption.
  - (c) The change in the unemployment rate would be indeterminate when compared with the standard assumption.
  - (d) There would be no difference in how the unemployment rate would change.
8. Suppose that the central bank has adopted a zero nominal interest rate policy and the economy has a negative output gap. Then the economy's self-adjustment mechanism will result in:
  - (a) An increase in both investment and net exports.
  - (b) A decrease in both investment and net exports.
  - (c) A decrease in investment but an increase in net exports.
  - (d) An increase in investment but a decrease in net exports.

• Analytical question #1 (Fall 2011). *AD-SRAS-LRAS Model*.

Suppose that the economy is initially in general equilibrium.

1. Use AD-SRAS-LRAS diagram to clearly and accurately show the economy's initial economic situation. This diagram should be drawn in BLACK.
2. Provide an economic explanation of what you have shown in your diagram above.
3. Now suppose that there is a sharp decline in crude oil prices that causes inflation to decrease. In reaction to these events, the central bank engages in an expansionary monetary policy. On your diagram above, clearly and accurately show the first year effects of these changes on economic output and inflation. These changes should be drawn in RED.
4. Provide an economic explanation of what you have shown in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.
5. On your diagram above, clearly and accurately show the second year effects on economic output and inflation. These changes should be drawn in BLUE.
6. Provide an economic explanation of what you have shown in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.
7. On your diagram above, clearly and accurately show the final long-run equilibrium for economic output and inflation. These changes should be drawn in GREEN.
8. Provide an economic explanation of how the economy moves from its second-year short-run equilibrium to its final long-run equilibrium. Be sure to discuss what happens to economic output and inflation and explain why these changes take place. Clearly identify the economy's long-run equilibrium values for economic output and inflation.

• Analytical question #2 (Spring 2011). *AD-AS Model*.

The United Kingdom's economy, which is characterized by sticky wages and prices, is currently in recession.

1. Based only on this information, use an AD-AS Model diagram to clearly and accurately show the U.K.'s current economic situation. This diagram should be drawn in BLACK.
2. Provide an economic explanation of what you have drawn in your diagram above.
3. Because of deep concerns about massive government budget deficits, the new U.K. government has decided to substantially reduce government purchases. Based only on this additional information, clearly and accurately show the first year effects of this fiscal contraction on the U.K.'s economic output and inflation in your diagram above. These effects should be drawn in RED.

4. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output, inflation, and unemployment and explain why these changes take place.
  5. After the fiscal contraction, consumer and business confidence collapsed. Based only on this additional information, clearly and accurately show the subsequent effects of the collapse in confidence on the U.K.'s economic output and inflation in your diagram above. These effects should be drawn in BLUE.
  6. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output, inflation, and unemployment and explain why these changes take place.
- Analytical question #3 (Fall 2012). *IS – MP – AD/AS Model*.

There are two scenarios in this problem.

1. *Scenario #1*. Suppose that the economy is in equilibrium at the natural rate of unemployment and is characterized by sticky wages and prices. Based only on this information, use IS – MP – AD/AS diagrams to clearly and accurately show the economy's initial (1) economic output, (2) inflation, and (3) real interest rate. These diagrams should be drawn in BLACK
2. Provide an economic explanation of what you have shown in your diagrams above.
3. Now suppose that the government increases government purchases. Based only on this additional information, clearly and accurately show the effects of this fiscal policy action on (1) economic output, (2) inflation, and (3) the real interest rate. These effects should be drawn in RED.
4. Now, immediately after the increase in government purchases, suppose the central bank changes monetary policy by enough to keep the actual unemployment rate at the natural rate of unemployment. Based only on this additional information, clearly and accurately show the effects of this monetary policy action on (1) economic output, (2) inflation, and (3) the real interest rate. These effects should be drawn in BLUE
5. Provide an economic explanation of what you have shown in your diagrams above as a result of both the increase in government purchases and the change in monetary policy.
6. *Scenario #2*. Suppose that the economy is in equilibrium at the natural rate of unemployment and is characterized by sticky wages and prices. Based only on this information, use IS – MP – AD/AS diagrams to clearly and accurately show the economy's initial (1) economic output, (2) inflation, and (3) real interest rate. These diagrams should be drawn in BLACK.
7. Now suppose that the government increases tax revenues. Based only on this additional information, clearly and accurately show the effects of this fiscal policy action on (1) economic output, (2) inflation, and (3) the real interest rate. These effects should be drawn in RED
8. Now, immediately after the increase in tax revenues, suppose the central bank changes monetary policy by enough to keep the actual unemployment rate at the natural rate of unemployment. Based only on this additional information, clearly and accurately show the effects of this monetary policy action on (1) economic output, (2) inflation, and (3) the real interest rate. These effects should be drawn in BLUE
9. Provide an economic explanation of what you have shown in your diagrams above as a result of both the increase in tax revenues and the change in monetary policy.
10. Indicate, for each of the following variables, whether its value is higher at the end of Scenario #1 or at the end of Scenario #2 or whether it is the SAME at the end of both scenarios. Provide an economic explanation of why
  - Income
  - Inflation
  - The real interest rate
  - Consumer spending
  - Investment

- Government purchases
- Tax revenues
- Exports
- Imports
- Private saving
- Government saving
- Foreign saving
- The demand for real money balances
- The supply of real money balances

## SECTION 15: The Aggregate Demand and Supply Model, Part 2

- Business cycle fluctuations are caused by the combination of:
  - Positive and negative aggregate demand and
  - Positive and negative aggregate supply shocks

hitting the economy both simultaneously and sequentially.

### 15.1. Aggregate Demand Shocks

- Positive demand shocks:
  1. Immediately shift the AD curve to the right,
  2. Initially leading to increases in economic output and to increases in inflation, and
  3. Ultimately resulting in:
    - (a) No change in economic output, but
    - (b) Permanently higher inflation.

*Examples:* increase in consumer confidence, increase in government expenditure, increase in expected future wages, increase in foreign preference for domestic goods, expansionary monetary policy ( $\bar{r}$  goes down).

- Negative demand shocks:
  1. Immediately shift the AD curve to the left,
  2. Initially leading to decreases in economic output and to decreases in inflation, and
  3. Ultimately resulting in:
    - (a) No change in economic output, but
    - (b) Permanently lower inflation.

*Examples:* businesses become more pessimistic about the economy, decrease in consumer wealth, increase in domestic preference for foreign goods, contractionary monetary policy ( $\bar{r}$  goes up).

### 15.2. Aggregate Supply Shocks

#### 15.2.1 Temporary Aggregate Supply Shocks

- Temporary negative ( $\rho_t > 0$ ) supply shocks:
  1. Immediately shift the SRAS curve to the left,
  2. Initially leading to decline in economic output and increase in inflation (i.e., stagflation), but
  3. Ultimately, resulting in no change in either:
    - (a) Economic output or
    - (b) Inflation.

*Examples:* disruption in oil supplies (so oil price goes up), rise in import prices when a currency declines in value, cost-push shock from workers pushing for higher wages that outpace productivity gains, increase in world food prices.

### 15.2.2 Permanent Aggregate Supply Shocks

- Permanent positive supply shocks:
  1. Immediately shift the LRAS curve to the right and increase potential output,
  2. Immediately shift the SRAS curve to the right and increase actual output,
  3. Initially leading to increases in economic output and to decreases in inflation, and
  4. Ultimately, resulting in:
    - (a) A permanent increase in economic output and
    - (b) A permanent decrease in inflation.

*Examples:* people decide to work more ( $L$  goes up), arrival of new immigrants ( $L$  goes up), genie creates new machines ( $K$  goes up), increase in total factor productivity, increase in retirement age ( $U_N$  goes down), permanent reduction of medical care costs (increase in  $A$ ), computer revolution (increase in  $A$ ).

## Exercises

1. According to the "self-correcting mechanism" within the AD-AS model framework:
  - (a) The aggregate demand curve shifts as needed to bring the economy to full employment.
  - (b) Inflation changes as needed to move the economy along the short-run aggregate supply curve until potential output is achieved.
  - (c) The long-run aggregate supply curve shifts until it intersects both the aggregate demand and short-run aggregate supply curves in general equilibrium.
  - (d) All of the above.
  - (e) None of the above.
2. Suppose that the economy is initially in general equilibrium. What would happen if there was some event that caused the natural rate of unemployment to increase?
  - (a) According to the Phillips curve, the ensuing negative unemployment gap would exert inflationary pressures.
  - (b) According to Okun's Law, the ensuing negative unemployment gap would be consistent with a positive output gap.
  - (c) According to the AD-AS framework, the LRAS curve would shift to the left and the ensuing positive output gap would be closed by subsequent leftward shifts in the SRAS curve, leading to higher equilibrium inflation.
  - (d) All of the above.
  - (e) None of the above.
3. The steeper the SRAS curve, the \_\_\_\_\_ the initial effect on inflation and the \_\_\_\_\_ the initial effect on unemployment for any given change in monetary or fiscal policy.
  - (a) Smaller; smaller.
  - (b) Smaller; larger.
  - (c) Larger; larger.
  - (d) Larger; smaller.
4. Will an adverse supply shock permanently increase inflation?
  - (a) A permanent shock will but a temporary shock will not.
  - (b) A temporary shock will but a permanent shock will not.
  - (c) Neither a permanent shock nor a temporary shock will.
  - (d) Both a permanent shock and a temporary shock will.
5. If wages and prices are completely flexible, then an unfavorable productivity shock would:
  - (a) Raise both the natural rate of unemployment and the actual unemployment rate.
  - (b) Raise the natural rate of unemployment but not the actual unemployment rate.
  - (c) Raise the actual unemployment rate but not the natural rate of unemployment.
  - (d) Raise neither the natural rate of unemployment or the actual unemployment rate.
6. Finland and Sweden have very similar economies and their aggregate demand curves are similarly responsive to inflation while their aggregate supply curves are similarly responsive to output gaps. If Finland has a larger positive output gap than Sweden, then:
  - (a) Inflation is lower in Finland than in Sweden.
  - (b) Inflation is higher in Finland than in Sweden.

- (c) Inflation will accelerate faster in Finland than in Sweden.
  - (d) Disinflation will be more rapid in Finland than in Sweden.
7. It has been argued that higher inflation causes business firms to become permanently less efficient because they now have more pricing power. If this were true and economic output was initially at its potential level, then compared to the standard model, a fiscal expansion would cause:
- (a) Disinflation.
  - (b) Higher inflation than in the standard model.
  - (c) Lower inflation than in the standard model.
  - (d) What happens to inflation is indeterminate; it could be either higher or lower than in the standard model.
8. Suppose that unemployment is at the natural rate of unemployment. Then all of the following would permanently increase inflation EXCEPT:
- (a) A decrease in income taxes.
  - (b) An expansionary monetary policy.
  - (c) An increase in the natural rate of unemployment.
  - (d) Unions bargaining for real wage increases in excess of productivity gains.
9. Suppose that the economy is initially in general equilibrium. It then experiences an adverse, permanent supply shock that causes a permanent decline in consumer and business confidence. If the central bank wanted to stabilize economic activity at the new potential output level, it should:
- (a) Autonomously ease monetary policy.
  - (b) Autonomously tighten monetary policy.
  - (c) Make no change in monetary policy.
  - (d) The change to monetary policy cannot be determined.
10. Suppose that the unemployment rate is initially at the natural rate of unemployment. The fiscal authorities then reduce taxes while the monetary authorities react immediately with an autonomous policy to completely offset the effects on economic activity of the fiscal expansion. The short-run effect of these two policy actions is to:
- (a) Increase the real interest rate.
  - (b) Decrease the real interest rate.
  - (c) Increase inflation.
  - (d) Decrease inflation.
11. Suppose that the economy is at potential output and is characterized by complete wage and price flexibility. If there is then an increase in government purchases:
- (a) Both real economic activity and inflation will increase
  - (b) Neither real economic activity nor inflation will increase
  - (c) Both nominal economic activity and inflation will increase
  - (d) Neither nominal economic activity nor inflation will increase
- Analytical question #1 (Spring 2011). *The IS-MP-AD-AS Model.*  
France is a country dominated by large powerful labor unions. Suppose the French economy, which is characterized by sticky wages and prices, is initially in general equilibrium.

1. Based only on this information, use IS-MP-AD-AS Model diagrams to clearly and accurately show the economy's initial economic situation. These diagrams should be drawn in BLACK.
  2. Provide an economic explanation of you what you have shown in your diagrams above.
  3. Suppose that in the following year, the French labor unions negotiate large, multi-year wage increases, well above those consistent with productivity gains. Because this was a multi-year agreement, consumers anticipated significant increases in their future income. Based only on this information, clearly and accurately show the first year effects of this labor agreement on economic activity, the real interest rate, and inflation in your diagrams above assuming that the unemployment declined. These effects should be drawn in RED.
  4. Provide an economic explanation of the changes you have shown in your diagrams above.
  5. Now suppose that the central bank adopts a real interest rate target at the initial equilibrium real interest rate. Assume that the central bank knows exactly what inflation is or will be in the current year. Based only on this additional information, clearly and accurately show the subsequent second year effects of this central bank policy on economic output, the real interest rate, and inflation in your diagrams above. These changes should be drawn in BLUE.
  6. Provide an economic explanation of the changes you have shown in your diagram above. Be sure to discuss what happens to economic output, the real interest rate, and inflation and explain why these changes take place.
- Analytical question #2 (Fall 2011). *AD—SRAS—LRAS Model.*

In 2007 the U.S. economy, which is characterized by sticky wages and prices, was in general equilibrium.

1. Use an AD—SRAS—LRAS diagram to clearly and accurately show the U.S.'s initial general equilibrium position. This diagram should be drawn in BLACK.
  2. In 2008, inflation increased. The price of imported oil jumped by half, directly adding 1.5 percentage points to inflation. Higher oil prices also caused a decline in consumer confidence. On your diagram above, clearly and accurately show the effects of these changes on economic output and inflation in 2008. These changes should be drawn in RED.
  3. Provide an economic explanation of the changes that you have shown in your diagram above. Be sure to explain why these changes take place.
  4. In 2009, the price on imported oil fell by one-third, directly subtracting 1.5 percentage points from inflation. Lower oil prices also caused consumer confidence to return to its 2007 level. On your diagram above, clearly and accurately show what effects these changes would have on economic output and inflation in 2009. These changes should be drawn in BLUE.
  5. Provide an economic explanation of the changes that you have shown in your diagram above. Be sure to explain why these changes take place.
  6. On your diagram above, clear and accurately show the economy's final general equilibrium position. This should be drawn in GREEN.
- Analytical question #3 (Fall 2012). *The AD/AS Model.*

Suppose an economy, which is characterized by sticky wages and prices, is at its natural rate of unemployment. Assume that the effect on economic output from any change in aggregate demand is greater than the effect on economic output from any (single year) change in short-run aggregate supply.

1. Based only on this information, use an AD – AS model diagram to clearly and accurately show the economy's initial (1) economic output, and (2) inflation. This diagram should be drawn in BLACK.
2. Provide an economic explanation of what you have drawn in your diagram above.
3. Suppose that in Year 1 there are substantial increases in (1) wealth and (2) income inequality that leads to less work effort by the most productive members of society. Based only on this additional information, clearly and accurately show the Year 1 effects of these increases in wealth and income inequality on (1) economic output and (2) inflation in your diagram above. These effects should be drawn in RED.

4. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to (1) economic output and (2) inflation and explain why these changes take place.
5. On your diagram above, clearly and accurately show the Year 2 effects on (1) economic output and (2) inflation. These effects should be drawn in BLUE.
6. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to (1) economic output and (2) inflation and explain why these changes take place.
7. On your diagram above, clearly and accurately show the economy's final (long-run) general equilibrium on (1) economic output and (2) inflation. These effects should be drawn in GREEN.
8. Compare (1) economic output, (2) inflation, (3) the real interest rate, (4) the actual unemployment rate, and (5) the natural rate of unemployment between the economy's initial general equilibrium and its final general equilibrium.

## SECTION 16: The Money Supply Process

### 16.1. The Fed's Balance Sheet Assets:

- Assets and Liabilities
  1. Assets:
    - (a) Government securities: acquired through open market operations
    - (b) Discount loans to depository institutions: banks' borrowings from the central bank or borrowed reserves. Borrowing rate is call the discount rate.
  2. Liabilities:
    - (a) Currency in circulation: held by the non-bank public
    - (b) Reserves: bank reserves held at the central bank (required reserves+excess reserves) and vault cash.
- A central bank "creates" money by changing the monetary base (also called high-powered money)

### 16.2 Control of the Monetary Base

- The monetary base,  $MB$ , equals:
  - Currency in circulation,  $C$  (also called "desired money holdings"), plus
  - Reserves in the banking system,  $R$
- Reserves are affected by:
  - (a) The Fed's open-market operations => change in reserves and in the monetary base
  - (b) The public's money asset mix => change in reserves but not in the monetary base
  - (c) Bank borrowings from the Fed => change in reserves and in the monetary base
- The monetary base has two components:
  1. Nonborrowed monetary base,  $MB_N$ 
    - (a) Created through open market operations
    - (b) The Fed exercises complete control
  2. Borrowed reserves,  $BR$ 
    - (a) Created through banks' borrowings from the Fed, i.e., through discount loans
    - (b) The Fed exercises less than complete control: the Fed can discourage or encourage bank borrowing by increasing or decreasing the discount rate, but banks decide whether and how much to borrow from the Fed at any given discount rate.

### 16.3. Multiple Deposit Creation

- An increase in the monetary base leads to a multiple expansion of the money supply.
  - For each \$1 of additional reserves the Fed supplies the banking system, deposits increase by a multiple amount.
  - This money supply process is called multiple deposit creation.
- The money multiplier tells us how much money supply  $M$  can be supported for a given monetary base  $MB$  (or equivalently how much the money supply  $M$  changes for a given change in the monetary base,  $MB$ )

$$\begin{aligned}m &= \frac{M}{MB} \\ &= \frac{D + C}{R + C} \\ &= \frac{D + C}{ER + RR + C} \\ &= \frac{1 + c}{rr + e + c}\end{aligned}$$

where the last step follows from dividing both numerator and denominator by  $D$  and where:

$c = \frac{C}{D}$  is the currency holding ratio

$e = \frac{ER}{D}$  is the excess reserves ratio

$rr = \frac{RR}{D}$  is the required reserves ratio

- Implications:
  1. If all banks make loans for the full amount of their excess reserves (which implies that  $e = 0$ ), and assuming no currency holding ( $c = 0$ ) the money supply will increase by a multiple amount, which is determined by the required reserve ratio,  $rr$  (in fact  $m = \frac{1}{rr}$ )
  2. The multiple deposit creation process will be smaller if:
    - (a) Borrowers hold some of the loan proceeds as cash and never deposit them ( $c > 0$ ), and/or
    - (b) Banks choose not to use all their excess reserves to buy securities or make loans ( $e > 0$ ).
  3. As long as  $rr + e < 1$ , then  $m > 1$ .
  4. Each unit of the monetary base allows  $\frac{1+c}{rr+e+c}$  units of money to be created.

### 16.4. Factors that Determine the Money Supply

- Several factors determine the money supply, given that  $M = m \times MB$ :

1. Changes in the monetary base:

(a) Changes in the nonborrowed monetary base:

1. determined by the central bank
2. the money supply is positively related to the non-borrowed monetary base  $MB_n$ .

(b) Changes in borrowed reserves from the Fed:

1. determined by commercial banks
2. the money supply is positively related to the level of borrowed reserves,  $BR$ , from the Fed.

2. Changes in the required reserves ratio:

- (a) determined by the central bank
- (b) the money supply is negatively related to the required reserve ratio  $rr$ .

3. Changes in currency holdings:

(a) determined by the public

(b) the money supply is negatively related to currency holdings  $c$ .

4. Changes in excess reserves:

(a) determined by commercial banks

(b) the money supply is negatively related to the amount of excess reserves  $e$ .

## Exercises

- The money supply would decrease by the greatest amount if the public \_\_\_\_\_ their currency ratio and the banks \_\_\_\_\_ their excess reserve ratio.
  - Decreased; decreased
  - Decreased; increased
  - Increased; decreased
  - Increased; increased
- If the Fed wanted to increase the money supply without using open-market operations, it could try to get the public to \_\_\_\_\_ their currency ratio and \_\_\_\_\_ banks' reserve requirements.
  - Decrease; lower
  - Decrease; raise
  - Increase; lower
  - Increase; raise
- The Fed can decrease the money supply by increasing:
  - The discount rate
  - The currency ratio
  - The monetary base
  - Reserve requirements
- Which of the following increases reserves in the banking system but does not change the monetary base:
  - The Fed's open market purchase of government bonds
  - The nonbank public's decrease of currency holding
  - An increase in discount loans held by the banking system
  - A decrease in the excess reserve ratio
- Changes in the currency holding ratio directly and immediately affect:
  - The monetary base
  - The money multiplier
  - Banks' holdings of government securities
  - The Fed's holdings of government securities
- Assume the  $rr$  ratio is 10 percent. If the excess reserve ratio is positive, then the money multiplier will be:
  - Larger than 10
  - Smaller than 10
  - Equal to 10
  - Indeterminate
- The money multiplier is equal to one if:
  - The reserve ratios  $rr$  and  $e$  are both zero
  - The currency holding ratio and the required reserve ratio are zero

- (c) The required reserve ratio and the excess reserve ratio sum to one
  - (d) The currency holding ratio is positive
8. Suppose that the central bank conducts an open market sale of government securities and the money supply increases. This:
- (a) Would shift the MP curve up.
  - (b) Would shift the AD curve to the left.
  - (c) Could be due to banks holding fewer excess reserves.
  - (d) Could only happen if the currency holding ratio declined.
  - (e) All of the above.
  - (f) None of the above.
9. In 2008, the Federal Reserve increased the assets on its balance sheet by more than 150%. However, the money supply increased by only 4.5%. This must have been due to:
- (a) Banks increasing their excess reserves, causing the money multiplier to increase.
  - (b) Banks increasing their excess reserves, causing the money multiplier to decrease.
  - (c) Banks decreasing their excess reserves, causing the money multiplier to increase.
  - (d) Banks decreasing their excess reserves, causing the money multiplier to decrease.
10. Suppose that the central bank conducts an open market purchase of government securities of \$100 billion while the commercial banking system increases its excess reserves by \$100 billion. This would:
- (a) Increase the monetary base and increase the money supply.
  - (b) Increase the monetary base but decrease the money supply.
  - (c) Increase the monetary base but not change the money supply.
  - (d) Decrease the monetary base and decrease the money supply.
  - (e) Decrease the monetary base but increase the money supply.
  - (f) Decrease the monetary base but not change the money supply.

• Exercise 8, *Mishkin*, pag. 141

Suppose the Federal Reserve conducts an open market purchase of \$100 million. Assuming the required reserves ratio is 10%, what would be the effect on the money supply in each of the following situations?

1. There is only one bank and the bank decides not to make a loan with its excess reserves
2. There is only one bank, and the bank decides to make a loan for the full amount of its excess reserves
3. There are many banks, all of which make loans for the full amount of their excess reserves

• Exercise 10, *Mishkin*, pag. 141

Calculate the money multiplier for the following values of the currency, excess reserves, and required reserves ratios and explain why the money multiplier decreases when the currency or excess reserves ratio increases:

Currency deposit ratio	0.5	0.7	0.5
Excess reserves ratio	0.01	0.01	0.9
Required reserves ratio	0.08	0.08	0.08

# SECTION 17: The Financial System and Economic Growth

## 17.1. The Role of the Financial System

- The role of the financial system is to *channel funds* from households, businesses, government and foreigners with surplus funds (i.e., saving) to households, businesses, and governments with a shortage of funds.
  1. *Direct finance* channels funds from lenders-savers to borrowers-spenders directly through the financial markets:
    - (a) *Borrowers borrow funds* (therefore creating a liability) directly from savers by selling (or issuing) financial instruments or securities which include: (1) *Equities*, which are a ownership share of a business, or (2) *Bonds*, which are a debt instrument that offer a stream of payments for a fixed period of time
    - (b) *Financial markets include*: (1) *Exchanges*: locations where buyers and sellers of securities conduct business, (2) *Investment banks*: financial institutions that trade securities and assist businesses and governments issue them.
  2. *Indirect finance* channels funds from lenders-savers (i.e., investors) to borrowers-spenders indirectly through a financial intermediary (banks (or depository institutions), insurance companies, pension funds, finance companies, mutual funds, and hedge funds). Financial intermediaries differ in the assets and liabilities they hold.

## 17.2. Information Challenges and the Financial System

- Financial intermediaries exist to alleviate two problems:
  1. *Asymmetric information*: exists when one party to a transactions has more accurate information than the other party.
    - (a) *Adverse selection*: takes place before a transaction is completed and arises because the party most eager to engage in a transaction is the one most likely to produce an unfavorable (i.e., adverse) outcome for you
    - (b) *Moral hazard*: occurs after a transaction is completed and arises when the other party will engage in activities that are undesirable from your point of view
  2. *Free-rider problems*: are barriers to information collection (that would help solve the asymmetric information problem).
- Financial intermediaries help solve asymmetric information and free-rider problems by:
  1. Issuing private (non-traded) loans to reduce the free-rider problem.
  2. Using credit standards to avoid adverse selection (screening)
  3. Imposing loan covenants (provisions into debt contracts) to prevent moral hazard (often include collateral requirements) => constant monitoring
- Examples of adverse selection:
  1. *Cars market*: there are two kinds of used cars in the market, bad used cars (commonly known as "lemons") and good used cars. Used-car owners sell their cars to car dealers. Dealers are unable to tell the difference between good cars and lemons. Sellers, on the other hand, have lived with their cars and know very well whether their car is a lemon or not. Adverse selection might be a problem by preventing any transaction to occur => complete breakdown in the cars market.

2. *Health insurance market*: high-risk individuals seek health insurance and low-risk individuals defer from health insurance. The healthy will avoid health insurance up until the point of requiring medical services to be paid. Problem: if only high-risk individuals seek health insurance and low-risk individuals shy away from it, where will the money come from to pay for the large medical bills of those high-risk individuals? Some "solutions": high premia, medical history.
- Examples of moral hazard:
    1. People who have insurance against auto theft are likely to take fewer precautions against having their car stolen than people who do not have insurance.
    2. People with unemployment insurance may search less intensely for jobs (issue behind unemployment benefits).
    3. Workers whose performance is not monitored may shirk.
    4. Construction contractors whose work is not closely inspected may do shoddy work, the flaws of which do not become apparent until after they are paid.
  - Examples of free-riding (mostly a problem of public goods):
    1. People who slack off at work expect to have much of their work done by fellow workers, even though they will receive the same salary, which depends on aggregate output.
    2. People who don't pay for dams to be constructed, although they will benefit from them by getting flood protection.

### 17.3. Government Regulation & Supervision

- Two approaches for improving the quality of information (and reduce information asymmetry!) in financial markets are:
  1. *Government regulation*: decrease information asymmetry by directly promoting transparency by requiring:
    - (a) disclosure of financial information by public firms (Securities and Exchange Commission (SEC) in the U.S.)
    - (b) adherence to generally accepted accounting standards (not always effective, often eluded)
 For instance *prudential regulation* (and the government's prudential supervision) is the rules set by the government to prevent banks from taking on too much risk by:
    - (a) limiting banks' risk levels by promoting disclosure of their activities
    - (b) restrict activities and asset categories that the government considers too risky for banks
    - (c) encouraging banks to diversify their assets
    - (d) promoting accurate disclosure of banks' financial conditions to the public
    - (e) holding adequate levels of capital as a cushion against loans that go bad.
  2. *Providing a safety net* (which nevertheless increase moral hazard): governments can create a safety net for bank deposits (e.g., deposit insurance) so that:
    - (a) depositors will be more willing to provide banks with funds
    - (b) deposit protection reduces contagion from one bank failure to another.

### 17.4. Why is Financial Development Important?

- Empirical evidence shows a strong positive relationship between:
  1. Financial development or deepening and
  2. Economic growth.

- Rajan and Zingales (1998): show that financial development reduces the costs of external finance to firms. They look at industrial sectors that are relatively more in need of external finance and, by looking at a large sample of countries over the 1980s, they conclude that those sectors develop disproportionately faster in countries with more developed financial markets.
- Honohan (2004): show that financial depth is negatively associated with headcount poverty.
- Levine et al. (2000): they find that legal and accounting systems help account for differences in financial development across countries and that legal and accounting reforms that strengthen creditor rights, contract enforcement, and accounting practices can boost financial development and accelerate economic growth.

## Exercises

1. Direct finance involves:
  - (a) Selling physical assets.
  - (b) Borrowing from the Federal Reserve.
  - (c) Issuing securities in financial markets.
  - (d) Borrowing monies from commercial banks.
  - (e) All of the above
2. Firms will borrow from banks if:
  - (a) A free-rider problem exists.
  - (b) A moral hazard problem exists.
  - (c) They are unable to issue securities.
  - (d) An adverse selection problem exists.
  - (e) They need funds to expand operations.
3. That lenders must select from a pool of borrowers, some of which are likely to be poor credit risks, is known as:
  - (a) Free rider problem.
  - (b) Moral hazard problem.
  - (c) Adverse selection problem.
  - (d) Asymmetric information problem.
4. The risk that a borrower has more information about their previous behavior than a potential lender is known as the:
  - (a) Free rider problem.
  - (b) Moral hazard problem.
  - (c) Adverse selection problem.
  - (d) Asymmetric information problem.
5. During the Great Depression good credit risks were less likely to seek loans when real interest rates rose. This process illustrates:
  - (a) Moral hazard.
  - (b) Debt deflation.
  - (c) Adverse selection.
  - (d) Adverse monetary policy.
6. Moral hazard arises because:
  - (a) Adverse selection exists.
  - (b) Free-rider problems exist.
  - (c) Of the law of diminishing marginal opportunity costs.
  - (d) One party to an economic transaction possesses more information than another.
7. The tyranny of collateral:
  - (a) Suggests that government tax rates are too high.

- (b) Generates problems of moral hazard and adverse selection.
  - (c) Implies that when a person has very few assets it may be difficult to acquire financing.
  - (d) Implies that government regulation can decrease moral hazard problems in the financial sector.
8. Suppose you have money to lend but will do so only if you are compensated for the risk of default. If you set a high interest rate on your loan a likely consequence is that:
- (a) You will be prosecuted for predatory lending.
  - (b) Competition from other lenders will force you to lower your interest rate.
  - (c) Safe borrowers will look elsewhere and only risky borrowers will find your terms attractive.
  - (d) Risky borrowers will look elsewhere and only safe borrowers will find your terms attractive.
9. When property rights are well defined and inexpensive to enforce:
- (a) Little or no collateral is needed to secure a loan.
  - (b) Banks become less dominant among intermediaries.
  - (c) Poor borrowers are at no disadvantage relative to wealthy borrowers.
  - (d) Collateral is an efficient solution to asymmetric information problems.
10. Suppose the government declares some financial institutions “too big to fail” so that they would be rescued by the government if they were to go bankrupt. This declaration is most likely to increase problems associated with:
- (a) Free-riding.
  - (b) Moral hazard.
  - (c) Adverse selection.
  - (d) Prudential supervision.
11. From the perspective of households and businesses deciding where to deposit their money, the key advantage of the private loans issued by financial intermediaries is:
- (a) Increased transparency.
  - (b) Improved marketability.
  - (c) The ability to earn relatively high interest rates.
  - (d) The incentive for the financial intermediary to collect information.
12. Asymmetric information discourages the movement of funds from savers to borrowers because:
- (a) Big risks have high payoffs.
  - (b) Risk taking is economically and financially inefficient.
  - (c) The prudent choice is always preferable to the risky choice because of risk aversion.
  - (d) The loss arising from a failed project must be borne by the borrower rather than the lender.
  - (e) All of the above.
13. Suppose that a health care insurance company is concerned that a policy holder will eat unhealthy foods during the lifetime of their insurance contract. The insurer faces the problem of:
- (a) Moral hazard.
  - (b) Adverse selection.
  - (c) Opportunity costs.
  - (d) Competitive disadvantage.
  - (e) All of the above.

## SECTION 18: Macroeconomic Policy, Part 1

### 18.1. The Objectives of Macroeconomic Policy

- Two main objectives, achieved through stabilization policies (fiscal and monetary policy):
  1. *Stabilizing output around potential output:*
    - (a) stabilizing economic output around potential output will also stabilize the unemployment rate around the natural rate of unemployment: when  $Y = Y_P$  then  $U = U_N$
    - (b) achieve maximum sustainable employment. Challenge: difficult to determine  $U_N$  exactly (changes over time, uncertainty, etc.), which leads to much controversy and many stabilization policy challenges
    - (c) zero unemployment rate is both unattainable and undesirable because of frictional unemployment, and structural unemployment.
  2. *Stabilizing inflation at a low level:*
    - (a) high inflation has always been accompanied by a high variability of inflation
    - (b) empirical evidence also shows that high inflation reduces long-run economic growth
    - (c) central banks pursue price stability with a goal of maintaining actual inflation,  $\pi$ , close to an inflation target level  $\pi^T$  (generally between 1 and 3 percent, set with care to avoid debt-deflation and zero lower bound). In other words, objective of minimizing the inflation gap  $\pi - \pi^T$ .
- In most economies, the principle responsibility for stabilization policy lies with the central bank and monetary policy. Hierarchical mandates vs. Dual mandates:
  1. Hierarchical mandates require achieving the primary policy objective as a pre-condition of pursuing other policy goals.
  2. Dual mandates require pursuing two policy goals as co-equal objectives even if there is a conflict between the goals.

### 18.2. Response to a Negative Aggregate Demand Shock

1. *No policy response:* output and inflation gap in the short run, lower inflation and no output gap in the long run. Unfavorable because output will remain below potential for some time and if inflation was initially at its target level, the fall in inflation is undesirable
2. *Policy response:* can eliminate both the output gap and the inflation gap in the short run by using expansionary fiscal or monetary policy. Assume monetary policy is used:
  - (a) a central bank's expansionary monetary policy of stabilizing inflation will also stabilize economic output. Thus, there is no conflict between the dual objectives of stabilizing inflation and stabilizing economic activity after an aggregate demand shock: *divine coincidence*.
  - (b) monetary policy has *no effect on the equilibrium real interest rate*, which is the long run level of the real interest rate, the equilibrium real interest rate is determined by saving and investment decisions, and doesn't depend on the central bank's decision to respond to the aggregate demand shock.

Given the negative aggregate demand shock, the equilibrium real interest rate will stabilize to a lower long run level.

### 18.3. Response to a Permanent Negative Aggregate Supply Shock

1. *No policy response*: output and inflation gap in the short run, higher inflation and lower output in the long run. Unfavorable because output will move towards a lower level and inflation will increase over time to stabilize at a higher level.
2. *Policy response*: can eliminate both the output gap and the inflation gap in the short run by using expansionary fiscal or monetary policy and stabilizing output at a lower level. Assume monetary policy is used:
  - (a) a central bank contractionary monetary policy of stabilizing inflation will also stabilize economic output (at its new, lower potential level). Thus, there is no conflict between the dual objectives of stabilizing inflation and stabilizing economic activity, and the *divine coincidence holds*.
  - (b) monetary policy has *no effect on the equilibrium real interest rate*, which is the long run level of the real interest rate, the equilibrium real interest rate is determined by saving and investment decisions, and doesn't depend on the central bank's decision to respond to the permanent aggregate supply shock.

Given the negative permanent aggregate supply shock, the equilibrium real interest rate will stabilize to a higher long run level.

## Exercises

1. Which statement is a good argument in support of policy activism?
  - (a) Activist policies help to ensure stability of the real interest rate.
  - (b) Policy lags are generally longer than the time it takes the self-correcting mechanism to work.
  - (c) Well-considered policies can assist the economy's self-correcting mechanism, thus reducing the variability of inflation and unemployment.
  - (d) All of the above.
  - (e) None of the above.
2. A good reason for policy makers to pursue a goal of stabilizing inflation is that:
  - (a) In a stable economy, there is little or no structural inflation.
  - (b) High unemployment causes human misery and lost output.
  - (c) High inflation is always accompanied by high variability of inflation.
  - (d) Low inflation reduces long-run economic growth.
3. Suppose that wages and prices are very (but not completely) flexible. In this case:
  - (a) Supply shocks will destabilize inflation but have minimal impact on economic output.
  - (b) Demand shocks will destabilize economic output but have minimal impact on inflation.
  - (c) Policies to stabilize inflation are probably needed more than policies to stabilize economic activity.
  - (d) All of the above.
  - (e) None of the above.
4. A positive AD shock will likely result in:
  - (a) Permanent increase in inflation only if the central bank responds by increasing interest rates.
  - (b) Permanent increase in output only if the central bank responds by increasing interest rates.
  - (c) Permanent increase in output only if the central bank does not respond by increasing interest rates.
  - (d) Permanent increase in inflation only if the central bank does not respond by increasing interest rates.
5. When a permanent positive supply shock hits:
  - (a) The output gap returns to zero in the long-run only if the central bank decreases the money supply.
  - (b) The output gap returns to zero in the long-run only if the central bank increases the money supply.
  - (c) There may be no permanent effect on inflation if the central bank decreases interest rates.
  - (d) There may be no permanent effect on inflation if the central bank increases interest rates.
6. When a permanent negative supply shock hits the economy:
  - (a) There is no permanent effect on inflation if the central bank raises interest rates.
  - (b) In the long-run, the output gap returns to zero only if the central bank raises interest rates.
  - (c) The long-run equilibrium level of output depends on whether and how the central bank responds.
  - (d) All of the above.
  - (e) None of the above.

7. Suppose the economy is initially in general equilibrium. If the economy now experiences a temporary negative supply shock and the central bank reacts to keep unemployment at the natural rate of unemployment, then:
  - (a) Both the policy interest rate and the equilibrium real interest rate would increase.
  - (b) The policy interest rate would increase but the equilibrium real interest rate would not change.
  - (c) The policy interest rate would decrease but the equilibrium real interest rate would not change.
  - (d) The policy interest rate would increase but the equilibrium real interest rate would decrease.
  - (e) The policy interest rate would decrease but the equilibrium real interest rate would increase.
  
8. Suppose that the unemployment rate is initially at the natural rate of unemployment. The fiscal authorities then reduce taxes while the monetary authorities react immediately with an autonomous policy to completely offset the effects on economic activity of the fiscal expansion. The short-run effect of these two policy actions is to:
  - (a) Increase the real interest rate.
  - (b) Decrease the real interest rate.
  - (c) Increase inflation.
  - (d) Decrease inflation.

• Analytical Question #1. *AD – SRAS – LRAS Model.*

Suppose that the economy is initially in general equilibrium, that supply-side effects on output are larger than demand-side effects, and that the economy can be characterized by sticky wages and prices.

1. Based only on this information, use an AD-AS model diagram to clearly and accurately show the economy's initial general equilibrium situation. This diagram should be drawn in BLACK.
2. In the following year, the government enacts a contractionary fiscal policy by increasing personal tax rates because of concerns over a rising debt-to-GDP ratio. This results in a sharp reduction in the labor force participation rate. On your diagram above, clearly and accurately show what happens to economic output and inflation. These changes should be drawn in RED.
3. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.
4. In the following year, the central bank begins targeting inflation at the initial inflation rate. On your diagram above, clearly and accurately show what happens to economic output and inflation. These changes should be drawn in BLUE.
5. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.

• Analytical Question #2 (Spring 2011). *AD-SRAS-LRAS Model.*

The unemployment rate was at the natural rate of unemployment in 1995.

1. Use an AD – AS diagram to clearly and accurately show the economy's initial economic situation. This diagram should be drawn in BLACK.
2. Provide an economic explanation of what you have shown in your diagram above.
3. The following year, the commercialization of the Internet generated a large increase in autonomous investment spending and total factor productivity. The effect from the change in total factor productivity was much larger than the effect from the increase in investment spending. On your diagram above, clearly and accurately show the effects of this on economic output and inflation. These changes should be drawn in RED.
4. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.

5. As a result of the changes above, the stock market rose sharply in the following year, generating substantial increases in wealth and expected future incomes. On your diagram above, clearly and accurately show the effects on economic output and inflation from these additional changes. These changes should be drawn in BLUE.
  6. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.
  7. Suppose that in 1998 the Federal Reserve kept the real interest rate at its 1995 level. On your diagram above, clearly and accurately show the effects on economic output and inflation from this Federal Reserve behavior. These changes should be drawn in GREEN.
  8. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.
- Analytical question #3 (Spring 2012). *The AD-AS Model.*

In 1996, the U.S. economy, which is characterized by sticky wages and prices, was at its full-employment level of output with actual inflation at its target rate. The Federal Reserve has adopted an inflation target and they react to any deviations contemporaneously. However, they are unaware that any decisions to change monetary policy only affect the economy after a lag of one year.

1. Based only on this information, use an AD-AS diagram (on the bottom) to clearly and accurately show the economy's initial levels of economic output and inflation. This diagram should be drawn in BLACK.
2. Provide an economic explanation of what you have shown in your diagram above.
3. In 1997, the commercialization of the Internet led to a permanent increase in total factor productivity. Incorporating only this additional information, clearly and accurately show in your diagram above what effects this would have on economic output and inflation. These effects should be drawn in RED.
4. Provide an economic explanation of what you have shown in your diagram above. Discuss what happens to economic output, inflation, and the real interest rate. Be sure to explain why this takes place.
5. In 1998, no further exogenous shocks hit the economy. Incorporating only this additional information, clearly and accurately show in your diagram above what effects this would have on economic output and inflation. These effects should be drawn in BLUE.
6. Provide an economic explanation of what you have shown in your diagram above. Discuss what happens to economic output, inflation, and the real interest rate. Be sure to explain why this takes place.
7. On your diagrams above, clearly and accurately show the final (long-run general) equilibrium assuming there are no other exogenous shocks to the economy. These changes should be shown in GREEN.
8. Discuss what happens to economic output, inflation, and the real interest rate during the economy's adjustment

## SECTION 19: Financial Crises and the Economy

### 19.1. Asymmetric Information and Financial Crises

- Asymmetric information creates two basic types of problems in the financial system.
  1. Adverse selection
  2. Moral hazard
- Agency Theory provides an explanation for how asymmetric information can generate:
  1. Adverse selection problems, and
  2. Moral hazard problemsand provides a basis for the definition of a financial crisis.
- A financial crisis occur when:
  1. A disruption in the financial system
  2. Increases asymmetric information which
  3. Prevents the financial system from channeling funds efficiently from savers-leaders to borrowers-spenders

### 19.2. Dynamics of Financial Crises

- Financial crises progress in stages:
  1. The initiation of the financial crisis leads to a
  2. Banking crisis which may precipitate a
  3. Debt deflation

#### 19.2.1. The initiation of the financial crisis

1. Mismanagement of financial innovation, and/or financial liberalization, and/or
  - (a) Financial innovation occurs when an economy introduces new types of loans and/or new types of other financial products.

Financial innovation can be mismanaged if there is not an accurate and full understanding of the risks associated with the new financial products
  - (b) Financial liberalization occurs when an economy reduces or eliminates restrictions on financial markets and/or financial institutions.

Financial liberalization can be mismanaged if there is not an accurate and full understanding of the risks associated with the new financial environment
  - (c) Credit booms – rapid expansions of credit – can be created in the short-run by financial innovation and/or financial liberalization.

Credit booms have several effects:

    1. Financial institution expand their lending activities to take advantage of the new products and/or the new environment.
    2. This results in an increase in credit supply and an increase in economic activity.

3. However, these are typically riskier loans
- (d) Credit busts– a rapid contraction of credit – usually follow credit booms as an increasing number of riskier loans go bad.
  1. This generates a deleveraging process as bank capital is reduced because of larger loan losses.
  2. This results in a decrease in credit supply and a decline in economic activity
2. An asset price boom and bust, and/or
  - (a) An asset price boom or bubble occurs when asset prices are well above their fundamental economic values
    1. Bubbles are driven by “irrational” investor psychology.
    2. Fundamental economic values are based on “realistic” assessments of the assets’ future income streams.
  - (b) During asset price busts, asset prices drop.
    1. Firms are now more likely to make riskier investments as the value of their collateral also declines (which is an increase in moral hazard)
    2. Banks now tighten lending standards in reaction to the increase in risky investments, reducing the supply of credit and reducing economic activity.
    3. Banks are also forced to deleverage because the value of their assets has declined, reducing the supply of credit and reducing economic activity
3. An increase in uncertainty.

Financial crises often begin during periods of high uncertainty brought about by:

- (a) The beginning of a recession, and/or
- (b) A stock market crash, and/or
- (c) The failure of a major financial institution

When uncertainty increases, accurate information is more difficult to obtain.

- (a) This aggravates adverse selection problems.
- (b) This aggravates moral hazard problems.
- (c) Banks now tighten lending standards in reaction to the increase in risky investments, reducing the supply of credit and reducing economic activity.

### **19.2.2. Banking crisis**

A bank panic occurs when multiple banks fail simultaneously

1. Runs on banks, ie., massive withdrawals by depositors, may occur.
2. Banks may be forced to sell their assets quickly into an illiquid markets, ie., hold a fire sale
3. These activities may cause the bank to become insolvent, ie., have negative net worth
4. Fewer operating banks reduce the amount of information there is about the creditworthiness of borrowers-spenders.
  - (a) This aggravates adverse selection problems.
  - (b) And reduces the supply of credit and reduces economic activity

### **19.2.3. Debt Deflation**

A debt deflation occurs when a substantial unanticipated decline in the price level leads to a deterioration in borrowing firms' net worth in real terms because of the increased value of liabilities in real terms.

1. Leaders face an increase in both adverse selection and moral hazard problems.
2. Borrowers' spending is reduced and economic activity declines.

### **The 2007-2009 Financial Crisis**

See professor Wood's notes.

## Exercises (First Three are from Section 18)

- Analytical Question #1. *AD – SRAS – LRAS Model.*

Suppose that the economy is initially in general equilibrium, that supply-side effects on output are larger than demand-side effects, and that the economy can be characterized by sticky wages and prices.

1. Based only on this information, use an AD-AS model diagram to clearly and accurately show the economy's initial general equilibrium situation. This diagram should be drawn in BLACK.
2. In the following year, the government enacts a contractionary fiscal policy by increasing personal tax rates because of concerns over a rising debt-to-GDP ratio. This results in a sharp reduction in the labor force participation rate. On your diagram above, clearly and accurately show what happens to economic output and inflation. These changes should be drawn in RED.
3. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.
4. In the following year, the central bank begins targeting inflation at the initial inflation rate. On your diagram above, clearly and accurately show what happens to economic output and inflation. These changes should be drawn in BLUE.
5. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.

- Analytical Question #2 (Spring 2011). *AD-SRAS-LRAS Model.*

The unemployment rate was at the natural rate of unemployment in 1995.

1. Use an AD – AS diagram to clearly and accurately show the economy's initial economic situation. This diagram should be drawn in BLACK.
2. Provide an economic explanation of what you have shown in your diagram above.
3. The following year, the commercialization of the Internet generated a large increase in autonomous investment spending and total factor productivity. The effect from the change in total factor productivity was much larger than the effect from the increase in investment spending. On your diagram above, clearly and accurately show the effects of this on economic output and inflation. These changes should be drawn in RED.
4. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.
5. As a result of the changes above, the stock market rose sharply in the following year, generating substantial increases in wealth and expected future incomes. On your diagram above, clearly and accurately show the effects on economic output and inflation from these additional changes. These changes should be drawn in BLUE.
6. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.
7. Suppose that in 1998 the Federal Reserve kept the real interest rate at its 1995 level. On your diagram above, clearly and accurately show the effects on economic output and inflation from this Federal Reserve behavior. These changes should be drawn in GREEN.
8. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.

- Analytical question #3 (Spring 2012). *The AD-AS Model.*

In 1996, the U.S. economy, which is characterized by sticky wages and prices, was at its full-employment level of output with actual inflation at its target rate. The Federal Reserve has adopted an inflation target and they react to any deviations contemporaneously. However, they are unaware that any decisions to change monetary policy only affect the economy after a lag of one year.

1. Based only on this information, use an AD-AS diagram (on the bottom) to clearly and accurately show the economy's initial levels of economic output and inflation. This diagram should be drawn in BLACK.

2. Provide an economic explanation of what you have shown in your diagram above.
  3. In 1997, the commercialization of the Internet led to a permanent increase in total factor productivity. Incorporating only this additional information, clearly and accurately show in your diagram above what effects this would have on economic output and inflation. These effects should be drawn in RED.
  4. Provide an economic explanation of what you have shown in your diagram above. Discuss what happens to economic output, inflation, and the real interest rate. Be sure to explain why this takes place.
  5. In 1998, no further exogenous shocks hit the economy. Incorporating only this additional information, clearly and accurately show in your diagram above what effects this would have on economic output and inflation. These effects should be drawn in BLUE.
  6. Provide an economic explanation of what you have shown in your diagram above. Discuss what happens to economic output, inflation, and the real interest rate. Be sure to explain why this takes place.
  7. On your diagrams above, clearly and accurately show the final (long-run general) equilibrium assuming there are no other exogenous shocks to the economy. These changes should be shown in GREEN.
  8. Discuss what happens to economic output, inflation, and the real interest rate during the economy's adjustment
- Analytical Question #4 (Spring 2013). *The AD/AS Model*.

Suppose that the economy, which is characterized by sticky wages and prices, is initially in general equilibrium and that supply-side assumptions hold.

1. Based only on this information, use an AD/AS diagram to clearly and accurately show the economy's initial (1) economic output and (2) inflation. These diagrams should be drawn in BLACK.
2. In Year 1, because of massive budget deficits and a rapidly rising debt-to-GDP ratio, the government compromised by (1) permanently reducing government purchases by \$200 billion and (2) permanently increasing marginal income tax rates to generate an additional \$200 billion in tax revenue. Incorporating only this additional information, clearly and accurately show in your diagram above the Year 1 effects, if any, this would have on the economy's (1) economic output and (2) inflation. These effects should be drawn in RED.
3. Provide an economic explanation of what you have shown in your diagrams above. Discuss what, if anything, happens in Year 1 to the economy's (1) economic output and (2) inflation. Be sure to explain why these effects take place.
4. In Year 2, the central bank decides to target the inflation rate at its initial general equilibrium level. Incorporating only this additional information, clearly and accurately show in your diagram above the Year 2 effects, if any, on the economy's (1) economic output and (2) inflation. These effects should be drawn in BLUE.
5. Provide an economic explanation of what you have shown in your diagrams above. Discuss what, if anything, happens in Year 2 to the economy's (1) economic output and (2) inflation. Be sure to explain why these effects take place.

## SECTION 20: Macroeconomic Policy, Part 2

### 20.1. Response to a Negative Temporary Aggregate Supply Shock

1. *No policy response*: output and inflation gap in the short run, no output and inflation gap in the long run. Unfavorable because output will remain below potential for some time and inflation will remain above target for some time (if inflation is initially at its target level).
2. *Policy response*: can eliminate either the output gap or the inflation gap (but not both) in the short run by using expansionary fiscal or monetary policy. Assume monetary policy is used to stabilize inflation:
  - (a) Monetary policy leads to larger deviations of economic output from its potential level in the short-run. Thus, there is a conflict between the dual objectives of stabilizing inflation and stabilizing economic activity and the divine coincidence does not hold.
  - (b) monetary policy has *no effect on the equilibrium real interest rate*, which is the long run level of the real interest rate, the equilibrium real interest rate is determined by saving and investment decisions, and doesn't depend on the central bank's decision to respond to the aggregate demand shock.

### 20.2. Stabilizing Inflation and Economic Activity

- Main results:
  1. If most shocks to the economy are aggregate demand shocks, then a monetary policy that stabilizes inflation will also stabilize economic output, even in the short-run.
  2. If most shocks to the economy are permanent aggregate supply shocks, then a monetary policy that stabilized inflation will also stabilize economic output (at its new potential level), even in the short-run.
  3. If most shocks to the economy are temporary aggregate supply shocks, then a policy to stabilize inflation will lead to larger deviations in the output gap in the short-run.
  4. If most shocks to the economy are temporary aggregate supply shocks, then a policy to stabilize inflation will still stabilize economic output in the long-run.

### 20.3. How Active Should Policy Be?

- Major dichotomy between:
  1. Non-activists: they believe that wages and prices are very flexible, even in the short-run, so that the economy's self-correcting mechanism is very rapid.
    - Therefore, government activity to reduce high unemployment when it develops is unnecessary.
    - Most economists adhering to the classical school of thought would espouse this point of view.
  2. Activists: they believe that wages and prices are very sticky so that the economy's selfcorrecting mechanism can be very slow.
    - Therefore, government activity to reduce high unemployment when it develops is justified.
    - Most economists adhering to the Keynesian school of thought would espouse this point of view.
- In general, neither monetary nor fiscal policy can respond immediately to aggregate demand and aggregate supply shocks because of:

1. The data lag,
2. The recognition lag,
3. The legislative lag,
4. The implementation lag, and
5. The effectiveness lag.

This weakens the case for activism, and often cause policies to be pro-cyclical instead of counter-cyclical

## 20.4. The Taylor Rule

- The Taylor Rule is a guide to how the central bank should set its real (or nominal) federal funds rate target depending on both:
  1. The output gap, and
  2. The inflation gap.

Therefore the Taylor rule is a similar but also somewhat different approach to monetary policy from the monetary policy curve.

- The Taylor rule is given by:

$$r = 2.0 + 0.5(\pi - \pi_T) + 0.5(Y - Y_P)$$

Because  $r = i - \pi$ , the Taylor rule is also:

$$i_{FF} = \pi + 2.0 + 0.5(\pi - \pi_T) + 0.5(Y - Y_P)$$

- The Taylor rule has some of the same intuition as the MP curve:
  1. The inflation gap term in the Taylor rule indicates that the central bank should increase the real interest rate as inflation increases, similar to a movement along the MP curve.
  2. The output gap term in the Taylor rule indicates that the central bank should increase the real interest rate as output increases, similar to an autonomous tightening of monetary policy when the central bank stabilizes inflation.
- Milton Friedman: “inflation was always and everywhere a monetary phenomenon”: in other words a central bank can target any inflation rate in the long run simply by making changes in autonomous monetary policy, but cannot affect  $Y_p$  and  $r^*$  (this is consistent with our AS/AD model).

## 20.5. Causes of Inflationary Monetary Policy

- If central banks can target any inflation rate in the long-run, why are their periods of time when inflation is unacceptably high? Generally because the government has pursued a high employment goal.
- Two types of inflation can result from policies designed to promote high employment.
  - Cost-push inflation results from temporary negative supply shocks, including wage increases beyond what productivity gains would justify.

In the long-run:

1. Economic output is at its potential level.
2. The unemployment rate is at the natural rate.
3. The real interest rate is at its equilibrium level.
4. Inflation is permanently higher.

- Demand-pull inflation results from aggregate demand policies that attempt to maintain economic output above potential output

In the long-run:

1. Economic output is at its potential level.
2. The unemployment rate is at the natural rate.
3. The real interest rate is at its equilibrium level.
4. Inflation is permanently higher.

## Exercises

1. A change in the equilibrium real interest rate would result from:
  - (a) A change in expected inflation.
  - (b) A discretionary monetary policy change.
  - (c) A change in the central bank's target inflation rate.
  - (d) All of the above.
  - (e) None of the above.
2. Which shocks to the macroeconomy cause a change in the equilibrium real interest rate:
  - (a) Only permanent supply shocks.
  - (b) Only temporary supply shocks.
  - (c) Only aggregate demand shocks.
  - (d) Aggregate demand, temporary supply, and permanent supply shocks.
  - (e) Aggregate demand and permanent supply shocks but not temporary supply shocks.
  - (f) Aggregate demand and temporary supply shocks but not permanent supply shocks.
3. When a temporary negative supply shock hits the economy, then in the short-run:
  - (a) If the central bank focuses on stabilizing output, it can also stabilize inflation.
  - (b) If the central bank focuses on stabilizing inflation, it can also stabilize output.
  - (c) If the central bank focuses on stabilizing output, it cannot also stabilize inflation.
  - (d) If the central bank focuses on stabilizing employment, it can also stabilize inflation.
4. If most shocks to the economy are \_\_\_\_\_ shocks, then \_\_\_\_\_:
  - (a) AD; there is a trade-off between the dual objectives in the short-run.
  - (b) Temporary AS; stabilizing inflation will not stabilize employment in the short-run.
  - (c) Temporary AS; stabilizing output will not stabilize inflation in the long-run.
  - (d) Permanent AS; there is a trade-off between the dual objectives in the short-run.
5. Non-activists believe that \_\_\_\_\_:
  - (a) Wages and prices are very sticky.
  - (b) Wages and prices are very flexible.
  - (c) Lags in policy implementations make it more important for policymakers to act quickly.
  - (d) Policy should respond to temporary aggregate supply shocks but not aggregate demand shocks.
6. According to the Taylor Rule, which of the following will lead to a higher federal funds rate?
  - (a) A decrease in inflation.
  - (b) A decrease in unemployment.
  - (c) An increase in unemployment.
  - (d) A decrease in economic output.
7. According to the Taylor rule, which of the following will lead to the largest increase in the nominal federal funds rate?
  - (a) A one percentage point increase in output.
  - (b) A two percentage point decrease in output.

- (c) A one percentage point increase in the inflation rate.
  - (d) A two percentage point increase in the target inflation rate.
  - (e) A one percentage point decrease in the target inflation rate.
8. According to the Taylor rule, if both economic output and inflation are rising, then:
- (a) The real interest rate target should be 2%.
  - (b) The real interest rate target should be above 2%.
  - (c) The real interest rate target should be below 2%.
  - (d) The real interest rate target is indeterminate.
9. In 2009, actual inflation was 1%, the target inflation rate was 2%, and the output gap was minus 7%. According to the Taylor rule, the nominal federal funds rate should have been (fill in the blank): \_ \_  
\_
10. In 2008 and 2009, the federal funds rate was well below the rate suggested by the Taylor rule. The most likely explanation for this discrepancy is that:
- (a) The Fed's dual mandate prevents a close reliance on the Taylor rule.
  - (b) Policy makers decided that the Taylor rule underestimated the risk of inflation.
  - (c) The Taylor rule is not intended to guide monetary policy in response to aggregate supply shocks.
  - (d) All of the above.
  - (e) None of the above.
11. Suppose that the data for a particular economy suggests that its aggregate demand curve is both steep and shifts frequently. It might be reasonably inferred that:
- (a) The policy lags are quite long.
  - (b) Wages and prices are quite flexible.
  - (c) The central bank has an active policy emphasis on stabilizing economic output.
  - (d) All of the above.
  - (e) None of the above.

• Analytical Question #1 (Fall 2012) *The AD/AS Model*.

There are two scenarios in this problem. Suppose an economy, which is characterized by sticky wages and prices, is at potential output. Assume that the effect on economic output from any change in aggregate demand is greater than the effect on economic output from any (single year) change in short-run aggregate supply.

1. Based only on this information, use a pair of AD – AS model diagrams to clearly and accurately show the economy's initial (1) economic output, and (2) inflation. These diagrams should be drawn in BLACK.
2. **For Scenario #1**, suppose that the central bank has adopted inflation targeting at the initial general equilibrium inflation rate. Now in Year 1 there is a sharp decline in oil prices. Based only on this additional information, clearly and accurately show the Year 1 effects of the decline in oil prices on (1) economic output and (2) inflation in your diagram above. These effects should be drawn in RED.
3. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to (1) economic output and (2) inflation and explain why these changes take place.

4. **For Scenario #2**, suppose that the central bank has adopted unemployment targeting at the natural rate of unemployment. Now in Year 1 there is a sharp decline in oil prices. Based only on this additional information, clearly and accurately show the Year 1 effects of the decline in oil prices on (1) economic output and (2) inflation in your diagram above. These effects should be drawn in RED.
5. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to (1) economic output and (2) inflation and explain why these changes take place.
6. On your diagram above, clearly and accurately show the Year 2 effects on (1) economic output and (2) inflation. These effects should be drawn in BLUE.
7. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to (1) economic output and (2) inflation and explain why these changes take place.
8. Compare and contrast the differences—both short-run and long-run—between the central bank adopting a target inflation rate or adopting a target unemployment rate.

## SECTION 21: Exchange Rates and International Economic Policy, Part 1

### 21.1. Foreign Exchange Rates and Markets

1. The nominal exchange rate,  $E$ , is the relative price of one currency in terms of another currency
  - (a) Exchange rates can be quoted two ways: (1) The amount of foreign currency per unit of domestic currency, a *direct quote* (for example, the number of yen per dollar), (2) The amount of domestic currency per unit of foreign currency, an *indirect quote* (for example, the number of dollars per euro)
  - (b) The foreign exchange market (an over-the-counter market) is where exchange rates are determined: (1) The *spot exchange rate* is the exchange rate for spot transactions, which are immediate exchanges of bank deposits, (2) The *forward exchange rate* is the exchange rate for forward transactions, which are exchanges of bank deposits at some specified future date
  - (c) Changes in the foreign exchange rate: (1) An appreciation occurs when a currency increases in value so that it is worth more in terms of another currency, (2) A depreciation occurs when a currency decreases in value so that it is worth less in terms of another currency.
2. The real exchange rate (also called the terms of trade),  $\epsilon$ , is the relative price of goods in one country in terms of another country.

$$\epsilon = E \frac{P}{P^*}$$

where:

$E$  = nominal exchange rate (direct quote)

$P$  = the domestic general price level

$P^*$  = the foreign general price level.

Implications:

- (a) When the real exchange rate is low (i.e.,  $< 1$ ), domestic goods are cheap relative to foreign goods.
- (b) When the real exchange rate is high (i.e.,  $> 1$ ), domestic goods are expensive relative to foreign goods
- (c) If prices are sticky, then nominal and real exchange rates should move together. Therefore if a country's currency appreciates, then that country's: (1) Exported goods become more expensive to foreigners who buy fewer of them, and (2) Imported goods becomes less expensive to domestic residents who buy more of them.

### 21.2. Exchange Rates in the Long-Run

- The law of one price says that if:
  1. Two countries produce an identical good and
  2. Transportation costs and trade barriers are low, then

the price of the good will be the same in both countries, when exchange rates are taken into consideration.

- Purchasing power parity, or PPP, is an application of the law of one price to national price levels (the law of one price applies to a single commodity). It says that the exchange rate between any two currencies will adjust to reflect changes in the price levels of the two countries. If PPP holds, then the real exchange rate is equal to one, i.e., the purchasing power of the dollar is the same as the purchasing power of other currencies => this seems to hold in the long run.

### 21.3. Exchange Rates in the Short-Run

- Two approaches to determining exchange rates in the short-run
  1. The asset market approach emphasizes the demand for the stock of domestic assets.
  2. An approach that emphasizes the demand for flows of exports and imports over short period of time.
- Model:
  1. The most important determinant of the quantity of domestic assets demanded is the expected return on domestic assets relative to foreign assets,  $E_{t+1}^e$ . Once we fix  $E_{t+1}^e$ , the lower the current exchange rate  $E$ , the more likely the dollar is to rise in value (appreciate) which raises the expected return on dollar (domestic) assets, therefore the higher the demand for dollars => the demand curve for dollar assets is downward sloping
  2. The quantity supplied of dollar-denominated assets is fixed with respect to the exchange rate => the supply curve for dollar assets is vertical
- Implications: supply and demand determine the equilibrium exchange rate  $E^*$  and:
  - a. An exchange rate higher than the equilibrium exchange rate of  $E^*$  implies that the quantity of dollar assets supplied is greater than the quantity demanded (excess supply).
  - b. An exchange rate lower than the equilibrium exchange rate of  $E^*$  implies that the quantity of dollar assets supplied is greater than the quantity demanded (excess demand).
- Assuming that the supply curve does not shift, then changes in the exchange rate are caused by changes in the demand for dollar-denominated assets. The demand for domestic assets will change if there are changes in:
  1. The domestic real interest rate,  $r_D$ : an increase in the domestic real interest rate shifts the demand curve for domestic assets,  $D$ , to the right and causes the domestic currency to appreciate,  $E$  goes up.
  2. The foreign real interest rate,  $r_F$ : an increase in the foreign real interest rate shifts the demand curve for domestic assets,  $D$ , to the left and causes the domestic currency to depreciate,  $E$  goes down.
  3. The expected future exchange rate,  $E_{t+1}^e$  (for example: increase in demand for domestically produced traded goods relative to foreign tradable goods, such as a rise in demand for exports=>  $E_{t+1}^e$  goes up; increase in demand for foreign tradable goods relative to domestic tradable goods, such as a rise in demand for imports=>  $E_{t+1}^e$  goes down): an increase in the expected future exchange rate shifts the demand curve to the right and causes the domestic currency to appreciate,  $E$  goes up.
- An exogenous rise in the exchange rate,  $E$ :
  1. Creates a negative aggregate demand shock because it
    - (a) Makes export more expensive to foreigners who buy fewer exports so  $X$  goes down, and
    - (b) Makes imports less expensive to domestic residents who buy more imports so  $M$  goes up, so that
    - (c) Net exports decrease,  $NX$  goes down.
  2. Creates a temporary positive supply shock because it
    - (a) Makes imports less expensive, and
    - (b) Reduces the domestic aggregate price level.

Therefore it leads to declines in both economic activity, and inflation.

## Exercises

- Exchange rates are very volatile. The major cause of this volatility is:
  - Changes in net exports.
  - Changes in the expected value of the currency.
  - Different monetary policies between countries.
  - Foreign exchange interventions by central banks.
  - Disagreements between domestic and foreign policy makers.
- Suppose a country has a flexible exchange rate. It then experiences a large permanent decline in the foreign demand for its domestically produced goods. This will tend to cause:
  - Domestic economic output to increase.
  - Domestic economic output to decrease.
  - No change in domestic economic output.
  - An indeterminate change in economic output.
- During the Asian economic crisis in 1997, capital flight from Asia led to a surge in capital inflows to the U.S. If the U.S. economy was at potential output with a flexible exchange rate before the crisis, then as a result of these capital inflows, all of the following would be true except:
  - The U.S. dollar would appreciate.
  - The IS curve in the U.S. would shift to the left.
  - The MP curve in the U.S. would shift to the left.
  - The AD curve in the U.S. would shift to the left.
- For a given real exchange rate, a nominal appreciation of the domestic currency will result from:
  - A decrease in the prices of foreign goods.
  - An increase in the prices of foreign goods.
  - An increase in the prices of domestic goods.
  - An increase in the domestic rate of inflation.
- Suppose the nominal exchange rate—Canadian dollar per Brazilian real—is constant. If the price level in Brazil rises by four percent while the price level in Canada rises by eight percent, then the real exchange rate has \_\_\_\_\_ by \_\_\_\_\_ percent.
  - risen; four
  - risen; one-half
  - declined; two
  - declined; four
  - declined; one-half
- In the short-run, an increase in the U.S. money supply would cause the value of the dollar to \_\_\_\_\_ and U.S. net exports to \_\_\_\_\_ :
  - Increase; increase.
  - Increase; decrease.
  - Decrease; increase.
  - Decrease; decrease.

7. Suppose that the economy is in general equilibrium with a flexible exchange rate. The economy now experiences a temporary aggregate negative supply shock. The country's (nominal) exchange rate will:
- Appreciate in both the short-run and the long-run.
  - Appreciate in the short-run but depreciate in the long-run.
  - Depreciate in the short-run but appreciate in the long-run.
  - Depreciate in the short-run but not change in the long-run.
  - Appreciate in the short-run but not change in the long-run.
8. In the short-run, who benefits the most from an overvalued currency:
- Domestic producers of exported goods.
  - Domestic consumers of domestic goods.
  - Domestic consumers of imported goods.
  - Domestic producers of goods that compete with imported goods.
9. Suppose that a haircut in Berkeley costs \$20, while the price for the same haircut in Mumbai, India is 600 Indian rupees (Rs.). At which nominal exchange rate is the dollar price lower for the Mumbai haircut?
- \$0.04/Rs.
  - \$0.029/Rs.
  - 20Rs./\$
  - 25Rs./\$
10. Suppose an item sells for \$125 in the United States and for 62,500 pesos in Chile. According to the law of one price, the nominal exchange rate (pesos/dollar) should be:
- 0.002
  - 500
  - 31,313
  - Either \$125 or 62,500 pesos, but not both.
11. Taken by itself, if participants in the foreign exchange markets come to expect an increase in the value of the U.S. dollar:
- The actual value of the U.S. dollar will fall.
  - The actual value of the U.S. dollar will rise.
  - The actual value of the U.S. dollar will not be affected.
  - What happens to the actual value of the U.S. dollar cannot be determined.
12. The purchase of foreign currency by a central bank will tend to cause:
- An appreciation of the domestic currency.
  - A depreciation of the domestic currency.
  - An increase in the value of foreign exchange, but no change in the value of the domestic currency.
  - A decrease in the value of foreign exchange, but no change in the value of the domestic currency.
- Analytical question. Open Economy AD—AS Model with the Foreign Exchange Market (Fall 2011). Argentina (the domestic economy) and Brazil (the foreign economy) are major trading partners that are initially in general equilibrium with flexible exchange rates.

1. Based only on this information, use an open economy AD—AS model diagram for each country, as well as a diagram of the foreign exchange market for the Argentine peso, to clearly and accurately show each economy's initial equilibrium position and equilibrium in the foreign exchange market. These diagrams should be shown in BLACK.
2. Provide an economic explanation of what you have drawn in your diagrams above.
3. Now suppose that the Argentine central bank conducts a contractionary monetary policy. On your diagrams above, clearly and accurately show what happens to economic output, inflation, and the Argentine peso exchange rate. These changes should be drawn in RED.
4. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output, inflation, and the exchange rate and explain why these changes take place.
5. The year after (the events in part 3 occur), the Brazilian government conducts an expansionary fiscal policy. On your diagrams above, clearly and accurately show what happens to economic output, inflation, and the Argentine peso exchange rate. These changes should be drawn in BLUE.
6. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output, inflation, and the exchange rate and explain why these changes take place.

## SECTION 22: Exchange Rates and International Economic Policy, Part 2

### 22.1. Intervention in the Foreign Exchange Market

- Foreign exchange interventions are international financial transactions engaged in by central banks to influence exchange rates.

1. An intervention in which the central bank buys domestic currency leads to a loss of international reserves and an appreciation of the domestic currency because of:

- decline in international reserves held by the central bank as it sells some of its foreign assets holdings in the foreign exchange markets
- decline in reserves held by the banking system => decline in the domestic money supply and a rise in the nominal interest rate => increase in the real interest rate,  $r_D$  (because of price stickiness)

*Central bank buys domestic currency:  $IR \downarrow$  and  $R \downarrow \implies M \downarrow \implies i_D \uparrow \implies r_D \uparrow \implies E \uparrow$*

2. An intervention in which the central bank sells the domestic currency to purchase foreign assets leads to an increase in international reserves and a depreciation of the domestic currency because of:

- increase in international reserves held by the central bank as it buys some of its foreign assets holdings in the foreign exchange markets
- increase in reserves held by the banking system => decline in the domestic money supply and a rise in the nominal interest rate => increase in the real interest rate,  $r_D$  (because of price stickiness)

*Central bank sells domestic currency:  $IR \uparrow$  and  $R \uparrow \implies M \uparrow \implies i_D \downarrow \implies r_D \downarrow \implies E \downarrow$*

### 22.2. Fixed Exchange Rate Regime

- Fixed versus flexible exchange rate:

1. In a *fixed exchange rate regime*, the value of a currency is pegged relative to the value of one other currency (called the anchor currency).
2. In a floating or *flexible exchange rate regime*, the value of a currency is determined by supply and demand in the foreign exchange market.

Intermediate case: *managed float regime* (sometimes called a dirty float), in which countries attempt to influence their exchange rates by buying and selling currencies but not to peg it to an anchor currency

- Overvalued versus undervalued currency:

1. *Overvalued currency*: a currency is overvalued when the fixed or par value of the exchange rate,  $E_{par}$ , is above the equilibrium exchange rate,  $E^* \implies$  the central bank must buy the domestic currency in the foreign exchange market in order to keep the exchange rate fixed ( $IR \downarrow$  and  $R \downarrow \implies M \downarrow \implies i_D \uparrow \implies r_D \uparrow \implies E \uparrow$ )
2. *Undervalued currency*: a currency is undervalued when the fixed or par value of the exchange rate,  $E_{par}$ , is below the equilibrium exchange rate,  $E^* \implies$  the central bank must sell the domestic currency in the foreign exchange market in order to keep the exchange rate fixed ( $IR \uparrow$  and  $R \uparrow \implies M \uparrow \implies i_D \downarrow \implies r_D \downarrow \implies E \downarrow$ )

- Devaluation and Revaluation:
  1. A *devaluation* occurs when a central bank resets the par exchange rate at a lower level; it generally does this because it will eventually run out of international reserves by keeping an overvalued currency
  2. A *revaluation* occurs when a central bank resets the par exchange rate at a higher level; it generally does this because it does not want to continue acquiring the international reserves needed to maintain an undervalued currency.
- The *policy trilemma* (or impossible trinity) describes the situation in which a country can only pursue two of the following three policies at the same time:
  1. Free capital mobility,
  2. A fixed exchange rate, and
  3. An independent monetary policy.

U.S.: free capital mobility and independent monetary policy

Hong Kong: free capital mobility and fixed exchange rate

China: fixed exchange rate and independent monetary policy

- Advantages and Disadvantages of Pegged Exchange Rates:
  1. Advantages: monetary policy in the pegging country will be non-inflationary if the anchor country has a non-inflationary monetary policy:
    - (a) Anchoring inflation expectations to the inflation rate in the anchor country if the exchange rate target is credible.
    - (b) Keeping inflation under control by tying the inflation rate for internationally traded goods to that found in the anchor country.
  2. Disadvantages: a pegging country with capital mobility can no longer pursue an independent monetary policy:
    - (a) Economic shocks in the anchor country will be directly transmitted to the pegging country.
    - (b) The pegging country's monetary policy response to its own domestic economic shocks cannot be different than the monetary policy response of the anchor country.
- Why with fixed exchange rate and perfect capital mobility you have no independent monetary policy:
 

If the real interest rate increases in the larger country (to which your country is pegged), then:

  1. The larger country's currency will appreciate and
  2. The smaller country's currency will depreciate.
  3. The smaller country's currency will now be overvalued.

In order to maintain the fixed exchange rate, the smaller country will have to:

4. Sell the anchor currency (losing international reserves) and
5. Buy its domestic currency (reducing liquidity in the banking system), causing
6. An increase in the real interest rate.

## Exercises

1. With fixed exchange rates, all of the following are true except:
  - (a) The central bank can always cause the currency to weaken.
  - (b) The central bank cannot use autonomous monetary policy to stabilize economic output.
  - (c) The central bank will accumulate international reserves when the currency wants to weaken.
  - (d) The central bank will accumulate international reserves when the currency wants to strengthen.
2. The purchase of foreign currency by a central bank will tend to cause:
  - (a) An appreciation of the domestic currency.
  - (b) A depreciation of the domestic currency.
  - (c) An appreciation of the foreign currency but no change in the domestic currency.
  - (d) A depreciation of the foreign currency but no change in the domestic currency.
3. Under a system of fixed exchange rates, what happens if a country's currency is undervalued?
  - (a) The currency appreciates.
  - (b) The currency depreciates.
  - (c) The central bank loses international reserves.
  - (d) The central bank gains international reserves.
4. One of the chief advantages of fixing an exchange rate is that:
  - (a) It can be an effective means of reducing inflation.
  - (b) The currency can be used to promote export growth.
  - (c) A country will always be able to pursue an independent monetary policy.
  - (d) It allows the monetary authorities to actively respond to fluctuations in either inflation or unemployment.

• Analytical Question #1 (Fall 2011). *Open Economy AD – AS Model with a Foreign Exchange Market.*

In the early 1990s, France and Germany were major trading partners with flexible exchange rates. Both economies were initially in general equilibrium and could be characterized with sticky wages and prices.

1. Based only on this information, use an open economy AD – AS model diagram for each country as well as a diagram of the foreign exchange market for the German mark to clearly and accurately show each economy's initial equilibrium and equilibrium in the foreign exchange market. These diagrams should be drawn in BLACK.
2. The following year, the Bundesbank (Germany's central bank) conducted a contractionary monetary policy because Germany's inflation rate was judged to be too high. On your diagrams above, clearly and accurately show what happens to economic output and inflation in each country as well as to the German mark exchange rate. These changes should be drawn in RED.
3. Provide an economic explanation of what you have drawn in your diagrams above. Be sure to discuss what happens to economic output and inflation in each country as well as to the German mark exchange rate and explain why these changes take place.
4. Immediately following the German contractionary monetary policy, but in the same year, France decides to fix its exchange rate with Germany at its initial fundamental level, a level that France is committed to maintaining. On your diagrams above, clearly and accurately show how this decision would affect economic output and inflation in each country as well as to the German mark exchange rate. These changes should be drawn in BLUE.

5. Provide an economic explanation of what you have drawn in your diagrams above. Explain exactly what the Banque de France (France's central bank) must do to maintain this fixed exchange rate. Be sure to discuss what happens to economic output and inflation in each country as well as to the exchange rate and explain why these changes take place.

- Analytical Question #2 (Fall 2012). *The Open Economy AD/AS Model with a Foreign Exchange Market.*

There are two scenarios in this problem, both involving only Argentina (the domestic economy) and Brazil (the foreign economy). The Argentine currency is the peso and the Brazilian currency is the réal.

1. **Scenario #1.** Suppose that the Argentine economy, which is characterized by perfect capital mobility and sticky wages and prices, is at potential output with a flexible exchange rate. Based only on this information, use an AD – AS model diagram (on the left) and a Foreign Exchange diagram (on the right) to clearly and accurately show the Argentine economy's initial (1) economic output, (2) inflation, and (3) equilibrium exchange rate (using a direct quotation). These diagrams should be drawn in BLACK.
2. In Year 1, the Argentine government engages in a large fiscal expansion. Based only on this additional information, clearly and accurately show the Year 1 effects of this fiscal expansion on (1) economic output, (2) inflation, and (3) the exchange rate on your diagrams above. These effects should be drawn in RED.
3. Provide an economic explanation of what you have drawn on your diagrams above. Be sure to discuss what happens to (1) economic output, (2) inflation, (3) the exchange rate, and (4) net exports and explain why these changes take place.
4. On your diagrams above, clearly and accurately show the Year 2 effects on (1) economic output, (2) inflation, and (3) the exchange rate. These effects should be drawn in BLUE.
5. Provide an economic explanation of what you have drawn on your diagrams above. Be sure to discuss what happens to (1) economic output, (2) inflation, (3) the exchange rate, and (4) net exports and explain why these changes take place.
6. **Scenario #2.** Suppose that the Argentine economy, which is characterized by perfect capital mobility and sticky wages and prices, is at potential output with a fixed exchange rate. The Argentine central bank is firmly committed to maintaining the fixed exchange rate at its initial equilibrium value. Based only on this information, use an AD – AS model diagram (on the left) and a Foreign Exchange diagram (on the right) to clearly and accurately show the Argentine economy's initial (1) economic output, (2) inflation, and (3) equilibrium exchange rate (using a direct quotation). These diagrams should be drawn in BLACK.
7. In Year 1, the Argentine government engages in a large fiscal expansion. Based only on this additional information, clearly and accurately show the Year 1 effects this fiscal expansion on (1) economic output, (2) inflation, and (3) the exchange rate on your diagrams above. These effects should be drawn in RED.
8. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to (1) economic output, (2) inflation, (3) the exchange rate, and (4) net exports and explain why these changes take place.
9. On your diagrams above, clearly and accurately show the Year 2 effects on (1) economic output, (2) inflation, and (3) the exchange rate. These effects should be drawn in BLUE.
10. Provide an economic explanation of what you have drawn in your diagrams above. Be sure to discuss what happens to (1) economic output, (2) inflation, (3) the exchange rate, and (4) net exports and explain why these changes take place.
11. Identify whether Argentina's (1) economic output, (2) inflation, (3) real interest rate, (4) exchange rate, and (5) net exports are higher under Scenario #1 with a flexible exchange rate or Scenario #2 with a fixed exchange rate.

- Analytical Question #3 (Spring 2013). *The Open Economy AD/AS Model with a Foreign Exchange Market.*

Suppose that the French economy, which is characterized by perfect capital mobility and sticky wages and prices, is at potential output with a fixed exchange rate with Germany. The French central bank is firmly committed to maintaining the fixed exchange rate at its initial equilibrium value.

1. Based only on this information, use an AD – AS diagram (on the left) and a Foreign Exchange diagram (on the right) to clearly and accurately show the French economy's initial (1) economic output, (2) inflation, and (3) equilibrium exchange rate (using a direct quotation). These diagrams should be drawn in BLACK.
2. Now suppose that in Year 1, the German government engages in a large fiscal contraction. Based only on this additional information, clearly and accurately show in your diagrams above the Year 1 effects of this German fiscal contraction on French (1) economic output, (2) inflation, and (3) the exchange rate. These effects should be drawn in RED.
3. Provide an economic explanation of what you have drawn in your diagrams above. Be sure to discuss what happens to (1) economic output, (2) inflation, (3) the exchange rate, and (4) net exports and explain why these changes take place.
4. On your diagrams above, clearly and accurately show the Year 2 effects of (1) economic output, (2) inflation, and (3) the exchange rate. These effects should be drawn in BLUE.
5. Provide an economic explanation of what you have drawn in your diagrams above. Be sure to discuss what happens to (1) economic output, (2) inflation, (3) the exchange rate, and (4) net exports and explain why these changes take place.

## SECTION 23: Fiscal Policy and the Government Budget

### 23.1. The Government Budget

- The government budget consists of:
  1. Outlays or government spending:
    - (a) Government purchases: expenditures on goods and services for consumption or investment:  
 $G = G_C + G_I$
    - (b) Transfer payments: direct payments to individuals (unemployment insurance benefits, Social security benefits, Medicare, etc.)
    - (c) Grants-in-aid to state and local governments: federal assistance to state and local governments.
    - (d) Net Interest Payments: interest payments to holders of government debt
  2. Receipts or tax revenues:
    - (a) Personal taxes,
    - (b) Contributions for social insurance,
    - (c) Taxes on production and imports,
    - (d) Corporate taxes, and
    - (e) Grants-in-aid to state and local governments
- The government budget deficit is given by:

$$Deficit = (G + TRANSFERS + INTEREST) - TAXES$$

- The government budget constraint is:

$$Deficit = \Delta B + \Delta M$$

where:

$\Delta B$  = the change in the amount of debt held by the public

$\Delta M$  = the change in the money supply

- Therefore, government outlays must be financed by:
  1. Tax revenues,
  2. Borrowing from the public, and/or
  3. Changes in the money supply.

Combining the two expressions above, you get in fact that:

$$TAXES + \Delta B + \Delta M = \underbrace{(G + TRANSFERS + INTEREST)}_{\text{Government Outlays}}$$

- The U.S. government finances its budget deficits primarily by borrowing from the public. Therefore:
  - a. the correlation between budget deficits and the debt-to-GDP ratio is high
  - b. because of recent large budget deficits the debt to GDP ratio has been high and is rising

## 23.2 Fiscal Policy in the Long-Run

- In the long-run, the economic impact of current budget deficits is whether or not they constitute a burden on future generations
  1. Government debt is not a burden if:
    - (a) The spending was for government investment activities that increased the nation's stock of productive assets that generated a rate-of-return in excess of the borrowing costs.
    - (b) The spending was for government investment activities that increased human capital that generated a rate-of-return (i.e., increased productivity) in excess of the borrowing costs.
  2. Government debt IS a burden if:
    - (a) It reduces national saving and crowds out more productive private investment.
    - (b) The spending was for government consumption activities.
    - (c) The spending was for government investment activities that have a rate-of-return below the borrowing costs.
    - (d) There are redistribution of wealth and income effects from (future) taxpayers to government bondholders.
    - (e) The debt is held by foreigners.
    - (f) There is debt intolerance, i.e., when the debt gets very large and fears of a debt repudiation increase.
    - (g) There are negative incentive effects to work and/or invest when taxes are raised, i.e., when the tax distortions are large
- Tax smoothing is a policy of keeping tax rates relatively stable even when tax revenues and government spending fluctuate with economic activity.
  - The rationale for tax smoothing is to minimize the distortions caused by high or volatile tax rates.
  - This also justifies budget deficits only when an increase in government spending is likely to be temporary rather than permanent.

## 23.3. Fiscal Policy in the Short-Run

### 23.3.1 Effects on Aggregate Demand

- In the short-run, expansionary fiscal policies increase aggregate demand and economic output through:
  1. an increase in government spending
  2. a reduction in tax rates
- Expenditure multiplier and tax multiplier
  1. The expenditure multiplier is the change in economic output for a given change in government purchases, i.e.:

$$\frac{\Delta Y}{\Delta G} \text{ and } \frac{1}{1 - mpc} \text{ in our model}$$

2. The tax multiplier is the change in economic output for a given change in tax revenues, i.e.:

$$\frac{\Delta Y}{\Delta T} \text{ and } -\frac{mpc}{1 - mpc} \text{ in our model}$$

Remarks:

1. Keynesian economists: the tax multiplier is always smaller in absolute value than the expenditure multiplier because:

- The initial change in spending from an increase in government purchases is a direct increase in spending.
- The initial change in spending from a decrease in taxes occurs through a change in disposable income that then causes a change in consumption and is an indirect increase in spending.

In our model:

$$\left| \frac{1}{1 - mpc} \right| > \left| - \frac{mpc}{1 - mpc} \right| \text{ because } mpc < 1$$

2. Some economists disagree on this conclusion and argue that the expenditure multiplier may be smaller than typically estimated and even smaller than the tax multiplier because:
  - An increase in government purchases will also increase the real interest rate and crowd out interest-sensitive spending on consumption, investment, and net exports.
  - Households and businesses may anticipate that larger government deficits will eventually lead to higher taxes so they may reduce their current spending in order to save more to pay for the anticipated (future) tax increase.

### 23.3.2. Effects on Aggregate Supply

- In the short-run expansionary fiscal policies can have effects on both aggregate demand and aggregate supply. Example of a cut in tax rates:
  - A payroll tax cut on the employees contribution would increase disposable income and increase aggregate demand.
  - A payroll tax cut on the employers contribution would act like a temporary positive supply shock, because it would lower the wage cost of production => positive temporary aggregate supply shock
- Supply-side economists (e.g. Arthur Laffer) emphasize that permanent cuts in tax rates, even ones that do not directly lower costs, such as income taxes, have an effect on aggregate demand but also on the long-run aggregate supply (by inducing more investment and work effort) => positive permanent aggregate supply shock

### 23.3.3 Some Additional Notes on Payroll Taxes and Supply-Side Effects

- Four different cases should be considered:
  1. *Temporary change with supply side effects:* a temporary change of payroll taxes on the employer side would shift the SRAS curve but would not have any true supply side effects because there has been no change in workers' incentives. Workers shouldn't change their long-run behavior due to temporary short-term changes. If the change in payroll taxes is on the employee side there is an AD effect but again there would not have any true supply side effects because there has been no permanent change in workers' incentives.
  2. *Temporary change without supply side effects:* if on the employer side, the SRAS curve would shift. If on the employee side, the AD curve would shift.
  3. *Permanent change with supply side effects:* if this is on the employer side the same as #1 above—the SRAS curve shifts because of a change in cost to the employer but there would be no change in workers' incentives so no change in the LRAS curve. If this is on the employee side there would be an AD effect, a LRAS effect, and a SRAS effect.
  4. *Permanent change without supply side effects:* If this is on the employer side only the SRAS curve shifts because of lower cost to the employer. If this is on the employee side there is an AD effect but no effect on either the LRAS curve or the SRAS curve.

## 23.4. Budget Deficits and Inflation

- Monetizing the debt occurs when a central bank issues newly created money to finance the government deficit. (the central bank is basically printing money)
- Seignorage is the revenue the government receives by issuing currency. It is an inflation tax because the resulting higher inflation lowers the real value of the outstanding money supply. From the quantity theory of money the seignorage  $\frac{\Delta M}{P}$  is:

$$\begin{aligned}\pi &\approx \frac{\Delta M}{M} \\ \Delta M &\approx \pi \times M \\ \frac{\Delta M}{P} &\approx \pi \times \frac{M}{P}\end{aligned}$$

- In the short-run, expansionary fiscal policies lead to higher inflation. The increase in inflation is even higher if the deficit is financed by increasing the money supply. In the long-run, inflation will not rise if the central bank maintains an inflation target

## 23.5. Budget Deficits and Ricardian Equivalence

- (Complete) Ricardian equivalence implies that changes in taxes or government spending have no effect on spending and national saving.
  1. It assumes that households recognize that a tax cut today that creates a larger budget deficit will have to be paid for by higher taxes in the future.
  2. Because expected future (disposable) income will be lower, consumers will not change their spending today in response to the tax cut.
- Ricardian equivalence will hold only if consumers:
  1. Are very forward looking,
  2. Are not subject to borrowing constraints, and
  3. Care a lot about their children's' and grandchildren's' inheritance.
- Ricardian equivalence will not hold if consumers:
  1. Are myopic,
  2. Are subject to borrowing constraints, or
  3. Do not care a lot about their children's' and grandchildren's' inheritance.

## Exercises

1. In which case would you most likely expect inflation to accelerate when the government is running a sustained budget deficit?
  - (a) When the deficit is caused by lowering tax rates.
  - (b) When the deficit is financed by borrowing from the public.
  - (c) When the deficit is financed by increasing the money supply.
  - (d) When the deficit is caused by increasing government purchases
2. The primary effect of tax smoothing is to:
  - (a) Reduce income inequality.
  - (b) Keep the tax wedge from shrinking.
  - (c) Avoid fluctuations in the government deficit-to-GDP ratio.
  - (d) Shift the debt burden from current taxpayers onto future taxpayers.
3. Suppose government purchases are permanently increased by ten percent with no change in tax rates. In the long run, the resulting deficit will disappear:
  - (a) Only if the government debt is sold to foreigners.
  - (b) Only if economic growth raises tax revenue by ten percent.
  - (c) Unless the money is spent entirely on government consumption.
  - (d) Only if government spending is brought back down to the original level.
4. The phenomenon of crowding-out suggests that the positive impact of budget deficits on economic activity is reduced by:
  - (a) An increase in national saving.
  - (b) The interest rate effects associated with federal deficits.
  - (c) The increase in government spending on inefficient projects.
  - (d) The impact produced by government spending on the environment.
5. According to supply-side theory, if the economy begins with a balanced budget, a cut in tax rates will tend to cause:
  - (a) A budget deficit.
  - (b) A budget surplus.
  - (c) No change in the federal government budget.
  - (d) A decrease in aggregate supply and an increase in aggregate demand.
6. The theory of Ricardian Equivalence states that any fall in government saving will be offset by an equivalent rise in private saving. So, according to Ricardian Equivalence, a large reduction in tax rates would lead to:
  - (a) No shift of the IS curve.
  - (b) A leftward shift of the IS curve.
  - (c) A rightward shift of the IS curve.
  - (d) An indeterminate shift of the IS curve.

7. According to Ricardian equivalence, the key consequence of an increase in the budget deficit that arises from a reduction in taxes is:
  - (a) An increase in inflation.
  - (b) A decrease in private investment.
  - (c) An increase in the supply of money.
  - (d) An increase in the public's holding of government bonds.
8. Monetizing the debt occurs whenever:
  - (a) Government securities are issued.
  - (b) Government securities are sold by the central bank.
  - (c) Tax revenues fall short of government expenditures.
  - (d) Government securities are bought by the central bank.
9. Seignorage is also known as an inflation tax because:
  - (a) Money balances lose value in real terms.
  - (b) Inflation can be caused by rising energy costs.
  - (c) Budget deficits increase in the size of the national debt.
  - (d) Higher interest rates can crowd-out investment spending.

- Analytical Question #1 (Fall 2011). *AD—AS Model with Fiscal Policy.*

Suppose that the economy has an output gap of -\$1,000 billion, an unemployment rate of 9.0%, and a budget deficit of \$1,000 billion. Assume that Ricardian equivalence does not hold.

1. Based only on this information, use an AD—AS model diagram to clearly and accurately show each economy's initial equilibrium position. This diagram should be shown in BLACK.
2. Provide an economic explanation of what you have drawn in your diagram above.
3. Now suppose that the government increases government purchases by \$250 billion. On your diagram above, clearly and accurately show what happens to economic output and inflation. These changes should be drawn in RED.
4. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.
5. Subsequently, i.e., in the following year, worries about the budget deficit cause the government to increase tax revenues by \$250 billion. On your diagram above, clearly and accurately show what happens to economic output and inflation. These changes should be drawn in BLUE.
6. Provide an economic explanation of what you have drawn in your diagram above. Be sure to discuss what happens to economic output and inflation and explain why these changes take place.
7. Provide an economic explanation of what has happened to the magnitude of the output gap and the budget deficit after both the increase in government purchases and the increase in tax revenues.
8. Explain how your answers above would be different if complete Ricardian equivalence held.

- Analytical question #2 (Fall 2012). *The AD - AS Model with Supply Side Economic Effects and Ricardian Equivalence.*

Suppose an economy is characterized by (1) sticky wages and prices, (2) substantial supply side economic effects, and (3) complete Ricardian equivalence. This economy is initially below its potential output level.

1. Based only on this information, use an AD - AS model diagram to clearly and accurately show the economy's current (1) economic output and (2) inflation. This diagram should be drawn in BLACK.

2. In Year 1, a political impasse leads to a significant permanent increase in marginal tax rates as well as a sharp permanent decline in government consumption purchases. Meanwhile, the central bank enacts a discretionary monetary policy easing but, because of a long effectiveness lag, it does not have any effect on economic output until Year 2. Incorporating only this new information, clearly and accurately show on your diagram above the Year 1 effects, if any, of these events on (1) economic output and (2) inflation, knowing that the unemployment rate rose. These effects should be drawn in RED.
3. Provide an economic explanation of what you have shown in your diagram above. Discuss what, if anything, happens in Year 1 to (1) economic output and (2) inflation. Be sure to explain why these effects take place and what causes them.
4. On your diagram above, clearly and accurately show what Year 2 effects, if any, there are on (1) economic output and (2) inflation, knowing that the unemployment rate rose. These effects should be drawn in BLUE.
5. Provide an economic explanation of what you have shown in your diagram above. Discuss what, if anything, happens in Year 2 to (1) economic output and (2) inflation. Be sure to explain why these effects take place and what causes them.
6. On your diagram above, clearly and accurately show the economy's final general equilibrium (1) economic output and (2) inflation. These should be drawn in GREEN.

## SECTION 24: The Role of Expectations in Macroeconomic Policy

### 24.1. Adaptive and Rational Expectations

- Adaptive expectations vs. Rational expectations:
  1. Adaptive expectations are formed from past experiences only.
    - Consequently, changes in expectations will occur slowly over time.
  2. Rational expectations are formed from both past experiences and predictions about the future
    - Consequently, changes in expectations can occur very quickly when new information becomes available.
    - Rational expectations will be identical to optimal forecasts, i.e., the best guess of the future, using all available information (but they will not always be perfectly accurate!)
- There are 3 important implications of rational expectations for macroeconomic policy analysis:
  1. Expectations that are rational will use all available information.
  2. Only new information will cause rational expectations to change.
  3. If there is a change in the way a variable moves, the way in which expectations of this variable are formed will change as well.

### 24.2. Policy Conduct: Rules or Discretion?

- Rules vs. Discretion:
  1. When using discretion, policy makers have no commitment to future actions; instead they make what they believe at that moment to be the right policy choice for the current economic situation  
⇒focus on “best” short-term result, which is not always consistent with the “best” long-term result
    - Drawbacks:
      - (a) Time-inconsistency problem
    - Advantages:
      - (a) Especially in a time of crisis, being able to act flexibly using discretion can be the key to a successful monetary policy.
      - (b) Monetary policy is as much an art as it is a science; judgment still appears to be an essential element for effective monetary policy.
      - (c) Discretion allows policy makers to change policy settings when an economy undergoes structural changes
  2. When using rules, policy makers bind themselves to plans that specify exactly how policy will respond to a particular economic situation. Types of rules:
    - (a) Non-activist rules specify that a particular variable should behave in a specified manner: for example, a constant-money-growth-rate rule.
    - (b) Activist rules specify that monetary policy should react to the level of output as well as inflation: for example, the Taylor rule.⇒focus on achieving desirable long-run outcomes

- Drawbacks:
  - (a) Rules may be too rigid because they cannot foresee every contingency.
  - (b) Rules do not easily incorporate the use of judgment, especially of non-quantifiable data
  - (c) The “true” model of the economy cannot be known precisely so a policy rule based on a particular model will be wrong if the economic model from which the rule was derived is wrong.
  - (d) Even if the “true” economic model was known, structural changes in the economy would lead to changes in the sensitivities of the model.
- Advantages:
  - (a) Solve time-inconsistency problems
- Constrained Discretion
  - Allows monetary policy to operate within a clearly articulated framework in which the general objectives and tactics of the policy makers are committed to in advance but not their specific actions.
  - One way to achieve constrained discretion is to have the monetary authority credibly commit to a nominal anchor (inflation rate, money supply, exchange rate, etc.) that will allow it to achieve price stability. Benefits of a credible nominal anchor include:
    - a. overcome the time inconsistency problem by providing an expected constraint on discretionary policy.
    - b. anchor inflationary expectations, leading to smaller fluctuations in inflation.

### 24.3. Credibility and Shocks

- Aggregate Demand shocks:
  1. Monetary policy credibility has the benefit of stabilizing inflation in the short-run when faced with positive demand shocks.
  2. Monetary policy credibility has the benefit of stabilizing inflation in the short-run when faced with negative demand shocks.
- Short-Run Aggregate Supply Shocks:
  1. Monetary policy credibility has the benefit of better outcomes for both economic output and inflation in the short-run when faced with temporary positive aggregate supply shocks.
  2. Monetary policy credibility has the benefit of better outcomes for both economic output and inflation in the short-run when faced with temporary negative aggregate supply shocks.
- How can a central bank establish credibility?
  1. Inflation targeting
  2. Appoint inflation-phobic central bankers
  3. Increase central bank independence.
- Literature on central bank independence:
  - Bade and Parkin (1982) Alesina (1988) and Grilli, Masciandaro and Tabellini (1991) focused on OECD countries and found an inverse relationship between Central Bank Independence and inflation.

- Crowe and Meade (2007) study the evolution of central bank independence and compute an index for central bank independence using data from 2003. They find that Central Bank Independence has increased. Eighty five percent of the central banks in 2003 had a score above 0.4, compared with only 38 percent in the 1980s and average independence has risen from 0.3 in the 1980s to above 0.6 in 2003. They also break the sample in two groups, advanced and emerging economies, finding that both experienced an increase in Central Bank Independence but such increase is greater in developing countries, two thirds of the 15 central banks that are rated as highly independent, with scores above 0.8, are eastern European countries.

- Issues

1. the legal measures of central bank independence may not represent actual central bank independence. Cukierman, Webb and Neyapti (1992) use three indicators of actual independence: the rate of turnover of central bank governors, an index based on a questionnaire answered by specialists in 23 countries, and an aggregation of the legal index and the rate of turnover.
2. Can we really say that Central Bank independence "causes" low inflation or that countries which prefer (for whatever reason) low inflation choose to delegate monetary policy to independent Central Banks?

Posen (1993,1995) argues that Central Bank Independence really lead to a reduction of inflation in OECD countries only when it reflects an underlying agreement in society about lowering inflation or when groups that prefer low and stable inflation to other policies are predominant in society.

## Exercises

1. Rational expectations:
  - (a) Are formed from both past experiences and predictions about the future and are always perfectly accurate
  - (b) Are formed only from predictions about the future and are perfectly accurate
  - (c) Are formed from both past experiences and predictions about the future and are not necessarily accurate
  - (d) Are formed only from past experiences and are not necessarily perfectly accurate
2. Activist rules specify that:
  - (a) A particular variable should behave in a specified manner
  - (b) Monetary policy should react to the level of output as well as inflation
  - (c) Monetary policy should be focusing on achieving short-term outcomes
  - (d) Policy can change depending on the particular economic situation
3. The immediate objective of a nominal anchor is to reduce the variability of:
  - (a) Actual inflation.
  - (b) Economic output.
  - (c) Expected inflation.
  - (d) Aggregate supply shocks.
  - (e) Aggregate demand shocks.
4. While facing positive aggregate demand shocks, monetary policy credibility has the benefit of:
  - (a) Stabilizing inflation in both the short-run and the long-run
  - (b) Stabilizing output in the short-run but not in the long-run
  - (c) Stabilizing inflation in the short-run but not in the long-run
  - (d) Stabilizing output in both the short-run and the long-run
5. If the public believes that the central bank's commitment to a nominal anchor is credible, then the effect of a negative aggregate demand shock is for:
  - (a) The short-run aggregate supply curve to shift up.
  - (b) The short-run aggregate supply curve to shift down.
  - (c) The short-run aggregate supply curve to not shift.
  - (d) The short-run aggregate supply curve to become flatter.
  - (e) The short-run aggregate supply curve to become steeper.
6. Inflation targeting makes more sense than unemployment targeting because:
  - (a) Monetary policies affect inflation but not unemployment.
  - (b) Expected unemployment is not a key determinant of the unemployment rate.
  - (c) Most voters and most politicians are more concerned about inflation than unemployment.
  - (d) A commitment to avoid high inflation is inherently more credible than a commitment to avoid high unemployment.

7. Which of these policies is the best example of constrained discretion?
- The annual federal budget deficit shall not exceed three percent of the GDP.
  - Macroeconomic policies shall promote rapid economic growth and low inflation.
  - Macroeconomic policies shall aim to keep inflation—on average over each five-year interval—within a range of two percent to four percent.
  - The growth rate of the money supply, with appropriate adjustments for changes in the velocity of money, shall be between two percent and five percent.
8. Which of the following is NOT an aspect of inflation targeting?
- Increased transparency of monetary policy.
  - Increased accountability of the central bank.
  - An institutional commitment to a dual mandate.
  - The public announcement of medium-term numerical inflation targets.

• Analytical question (Spring 2012). *AD—AS Model and Central Bank Credibility.*

Suppose that the U.S. and Germany have identical aggregate demand and short-run aggregate supply curves. In 1973 both countries were in general equilibrium, were characterized by sticky wages and prices, and were at their central bank's announced inflation target.

- Based only on this information, use an AD—AS diagram for the U.S. (on the left) and an AD—AS diagram for Germany (on the right) to clearly and accurately show the both economy's initial (1) economic output and (2) inflation. These diagrams should be drawn in BLACK.
- In 1974, OPEC sharply increased the price of crude oil, generating identical shocks in both countries. Germans had extreme confidence that the Bundesbank, Germany's central bank, would maintain its inflation target under all circumstances. Americans had no confidence that the Federal Reserve, the U.S.'s central bank, would maintain its inflation target but rather believed that the Fed was more concerned about unemployment. Consequently, expected inflation in 1974 also increased. Neither central bank changed its autonomous monetary policy. Incorporating only this new information, clearly and accurately show in your diagrams above what effects this would have on (1) economic output and (2) inflation. These effects should be drawn in RED.
- Provide an economic explanation of what you have shown in your diagrams above. Discuss what happens to (1) economic output and (2) inflation for each country. Be sure to explain why these effects take place.
- In 1975 there were no additional exogenous shocks to either economy. Germans kept their extreme confidence that the Bundesbank would maintain its inflation target under all circumstances. Americans kept their lack of confidence that the Federal Reserve would maintain its inflation target and continued to believe that the Fed was more concerned about unemployment. Consequently, in the U.S., expected inflation in 1975 was greater than actual inflation was in 1974. Neither central bank changed its autonomous monetary policy. Incorporating only this new information, clearly and accurately show in your diagrams above what effects this would have on (1) economic output and (2) inflation. These effects should be drawn in BLUE.
- Provide an economic explanation of what you have shown in your diagrams above. Discuss what happens to (1) economic output and (2) inflation for each country. Be sure to explain why these effects take place.