

model captures the important economic relationships for the matter at hand. Because no single model can answer all questions, macroeconomists use different models to look at different issues.

3. A key feature of a macroeconomic model is whether it assumes that prices are flexible or sticky. According to most macroeconomists, models with flexible prices describe the economy in the long run, whereas models with sticky prices offer a better description of the economy in the short run.
4. Microeconomics is the study of how firms and individuals make decisions and how these decisionmakers interact. Because macroeconomic events arise from many microeconomic interactions, all macroeconomic models must be consistent with microeconomic foundations, even if those foundations are only implicit.

## KEY CONCEPTS

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Macroeconomics	Recession	Exogenous variables
Real GDP	Depression	Market clearing
Inflation and deflation	Models	Flexible and sticky prices
Unemployment	Endogenous variables	Microeconomics

## QUESTIONS FOR REVIEW

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1. Explain the difference between macroeconomics and microeconomics. How are these two fields related?
2. Why do economists build models?
3. What is a market-clearing model? When is it appropriate to assume that markets clear?

## PROBLEMS AND APPLICATIONS

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1. What macroeconomic issues have been in the news lately?
2. What do you think are the defining characteristics of a science? Does the study of the economy have these characteristics? Do you think macroeconomics should be called a science? Why or why not?
3. Use the model of supply and demand to explain how a fall in the price of frozen yogurt would affect the price of ice cream and the quantity of ice cream sold. In your explanation, identify the exogenous and endogenous variables.
4. How often does the price you pay for a haircut change? What does your answer imply about the usefulness of market-clearing models for analyzing the market for haircuts?

which is the ratio of nominal GDP to real GDP, the CPI measures the overall level of prices.

- The labor-force participation rate shows the fraction of adults who are working or want to work. The unemployment rate shows what fraction of those who would like to work do not have a job.

## KEY CONCEPTS

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Gross domestic product (GDP)	GDP deflator	Net exports
National income accounting	National income accounts identity	Consumer price index (CPI)
Stocks and flows	Consumption	Labor force
Value added	Investment	Unemployment rate
Imputed value	Government purchases	Labor-force participation rate
Nominal versus real GDP		

## QUESTIONS FOR REVIEW

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- List the two things that GDP measures. How can GDP measure two things at once?
- What does the consumer price index measure?
- List the three categories used by the Bureau of Labor Statistics to classify everyone in the economy. How does the Bureau compute the unemployment rate?
- Describe the two ways the Bureau of Labor Statistics measures total employment.

## PROBLEMS AND APPLICATIONS

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- Look at the newspapers for the past few days. What new economic statistics have been released? How do you interpret these statistics?
- A farmer grows a bushel of wheat and sells it to a miller for \$1.00. The miller turns the wheat into flour and then sells the flour to a baker for \$3.00. The baker uses the flour to make bread and sells the bread to an engineer for \$6.00. The engineer eats the bread. What is the value added by each person? What is GDP?
- Suppose a woman marries her butler. After they are married, her husband continues to wait on her as before, and she continues to support him as before (but as a husband rather than as an employee). How does the marriage affect GDP? How should it affect GDP?
- Place each of the following transactions in one of the four components of expenditure:
  - consumption, investment, government purchases, and net exports.
  - Boeing sells an airplane to the Air Force.
  - Boeing sells an airplane to American Airlines.
  - Boeing sells an airplane to Air France.
  - Boeing sells an airplane to Amelia Earhart.
  - Boeing builds an airplane to be sold next year.
- Find data on GDP and its components, and compute the percentage of GDP for the following components for 1950, 1980, and the most recent year available.
  - Personal consumption expenditures
  - Gross private domestic investment
  - Government purchases
  - Net exports

- e. National defense purchases
- f. State and local purchases
- g. Imports

Do you see any stable relationships in the data? Do you see any trends? (*Hint: A good place to look for data is the statistical appendices of the *Economic Report of the President*, which is written each year by the Council of Economic Advisers. Alternatively, you can go to [www.bea.gov](http://www.bea.gov), which is the Web site of the Bureau of Economic Analysis.*)

6. Consider an economy that produces and consumes bread and automobiles. In the following table are data for two different years.

Good	Year 2000		Year 2010	
	Quantity	Price	Quantity	Price
Automobiles	100	\$50,000	120	\$60,000
Bread	500,000	\$10	400,000	\$20

- a. Using the year 2000 as the base year, compute the following statistics for each year: nominal GDP, real GDP, the implicit price deflator for GDP, and a fixed-weight price index such as the CPI.
  - b. How much have prices risen between 2000 and 2010? Compare the answers given by the Laspeyres and Paasche price indexes. Explain the difference.
  - c. Suppose you are a senator writing a bill to index Social Security and federal pensions. That is, your bill will adjust these benefits to offset changes in the cost of living. Will you use the GDP deflator or the CPI? Why?
7. Abby consumes only apples. In year 1, red apples cost \$1 each, green apples cost \$2 each, and Abby buys 10 red apples. In year 2, red apples cost \$2, green apples cost \$1, and Abby buys 10 green apples.
- a. Compute a consumer price index for apples for each year. Assume that year 1 is the base year in which the consumer basket is fixed. How does your index change from year 1 to year 2?
  - b. Compute Abby's nominal spending on apples in each year. How does it change from year 1 to year 2?
  - c. Using year 1 as the base year, compute Abby's real spending on apples in each year. How does it change from year 1 to year 2?
  - d. Defining the implicit price deflator as nominal spending divided by real spending, compute the deflator for each year. How does the deflator change from year 1 to year 2?
  - e. Suppose that Abby is equally happy eating red or green apples. How much has the true cost of living increased for Abby? Compare this answer to your answers to parts (a) and (d). What does this example tell you about Laspeyres and Paasche price indexes?
8. Consider how each of the following events is likely to affect real GDP. Do you think the change in real GDP reflects a similar change in economic well-being?
- a. A hurricane in Florida forces Disney World to shut down for a month.
  - b. The discovery of a new, easy-to-grow strain of wheat increases farm harvests.
  - c. Increased hostility between unions and management sparks a rash of strikes.
  - d. Firms throughout the economy experience falling demand, causing them to lay off workers.
  - e. Congress passes new environmental laws that prohibit firms from using production methods that emit large quantities of pollution.
  - f. More high-school students drop out of school to take jobs mowing lawns.
  - g. Fathers around the country reduce their work-weeks to spend more time with their children.
9. In a speech that Senator Robert Kennedy gave when he was running for president in 1968, he said the following about GDP:

[It] does not allow for the health of our children, the quality of their education, or the joy of their play. It does not include the beauty of our poetry or the strength of our marriages, the intelligence of our public debate or the integrity of our public officials. It measures neither our courage, nor our wisdom, nor our devotion to our country. It measures everything, in short, except that which makes life worthwhile, and it can tell us everything about America except why we are proud that we are Americans.

Was Robert Kennedy right? If so, why do we care about GDP?

## QUESTIONS FOR REVIEW

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1. What determines the amount of output an economy produces?
2. Explain how a competitive, profit-maximizing firm decides how much of each factor of production to demand.
3. What is the role of constant returns to scale in the distribution of income?
4. Write down a Cobb–Douglas production function for which capital earns one-fourth of total income.
5. What determines consumption and investment?
6. Explain the difference between government purchases and transfer payments. Give two examples of each.
7. What makes the demand for the economy's output of goods and services equal the supply?
8. Explain what happens to consumption, investment, and the interest rate when the government increases taxes.

## PROBLEMS AND APPLICATIONS

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1. Use the neoclassical theory of distribution to predict the impact on the real wage and the real rental price of capital of each of the following events:
  - a. A wave of immigration increases the labor force.
  - b. An earthquake destroys some of the capital stock.
  - c. A technological advance improves the production function.
2. If a 10-percent increase in both capital and labor causes output to increase by less than 10 percent, the production function is said to exhibit *decreasing returns to scale*. If it causes output to increase by more than 10 percent, the production function is said to exhibit *increasing returns to scale*. Why might a production function exhibit decreasing or increasing returns to scale?
3. Suppose that an economy's production function is Cobb–Douglas with parameter  $\alpha = 0.3$ .
  - a. What fractions of income do capital and labor receive?
  - b. Suppose that immigration increases the labor force by 10 percent. What happens to total output (in percent)? The rental price of capital? The real wage?
  - c. Suppose that a gift of capital from abroad raises the capital stock by 10 percent. What happens to total output (in percent)? The rental price of capital? The real wage?
  - d. Suppose that a technological advance raises the value of the parameter  $A$  by 10 percent. What happens to total output (in percent)? The rental price of capital? The real wage?
4. Figure 3-5 shows that in U.S. data, labor's share of total income is approximately a constant over time. Table 3-1 shows that the trend in the real wage closely tracks the trend in labor productivity. How are these facts related? Could the first fact be true without the second also being true?
5. According to the neoclassical theory of distribution, the real wage earned by any worker equals that worker's marginal productivity. Let's use this insight to examine the incomes of two groups of workers: farmers and barbers.
  - a. Over the past century, the productivity of farmers has risen substantially because of technological progress. According to the neoclassical theory, what should have happened to their real wage?
  - b. In what units is the real wage discussed in part (a) measured?
  - c. Over the same period, the productivity of barbers has remained constant. What should have happened to their real wage?
  - d. In what units is the real wage in part (c) measured?
  - e. Suppose workers can move freely between being farmers and being barbers. What does this mobility imply for the wages of farmers and barbers?

- f. What do your previous answers imply for the price of haircuts relative to the price of food?
- g. Who benefits from technological progress in farming—farmers or barbers?
6. (This problem requires the use of calculus.) Consider a Cobb–Douglas production function with three inputs.  $K$  is capital (the number of machines),  $L$  is labor (the number of workers), and  $H$  is human capital (the number of college degrees among the workers). The production function is
- $$Y = K^{1/3}L^{1/3}H^{1/3}.$$
- a. Derive an expression for the marginal product of labor. How does an increase in the amount of human capital affect the marginal product of labor?
- b. Derive an expression for the marginal product of human capital. How does an increase in the amount of human capital affect the marginal product of human capital?
- c. What is the income share paid to labor? What is the income share paid to human capital? In the national income accounts of this economy, what share of total income do you think workers would appear to receive? (*Hint*: Consider where the return to human capital shows up.)
- d. An unskilled worker earns the marginal product of labor, whereas a skilled worker earns the marginal product of labor plus the marginal product of human capital. Using your answers to parts (a) and (b), find the ratio of the skilled wage to the unskilled wage. How does an increase in the amount of human capital affect this ratio? Explain.
- e. Some people advocate government funding of college scholarships as a way of creating a more egalitarian society. Others argue that scholarships help only those who are able to go to college. Do your answers to the preceding questions shed light on this debate?
7. The government raises taxes by \$100 billion. If the marginal propensity to consume is 0.6, what happens to the following? Do they rise or fall? By what amounts?
- Public saving.
  - Private saving.

- National saving.
  - Investment.
8. Suppose that an increase in consumer confidence raises consumers' expectations about their future income and thus increases the amount they want to consume today. This might be interpreted as an upward shift in the consumption function. How does this shift affect investment and the interest rate?
9. Consider an economy described by the following equations:

$$Y = C + I + G$$

$$Y = 5,000$$

$$G = 1,000$$

$$T = 1,000$$

$$C = 250 + 0.75(Y - T)$$

$$I = 1,000 - 50r.$$

- In this economy, compute private saving, public saving, and national saving.
  - Find the equilibrium interest rate.
  - Now suppose that  $G$  rises to 1,250. Compute private saving, public saving, and national saving.
  - Find the new equilibrium interest rate.
10. Suppose that the government increases taxes and government purchases by equal amounts. What happens to the interest rate and investment in response to this balanced-budget change? Does your answer depend on the marginal propensity to consume?
11. When the government subsidizes investment, such as with an investment tax credit, the subsidy often applies to only some types of investment. This question asks you to consider the effect of such a change. Suppose there are two types of investment in the economy: business investment and residential investment. And suppose that the government institutes an investment tax credit only for business investment.
- How does this policy affect the demand curve for business investment? The demand curve for residential investment?
  - Draw the economy's supply and demand for loanable funds. How does this policy affect the supply and demand for loanable funds? What happens to the equilibrium interest rate?

- c. Compare the old and the new equilibria. How does this policy affect the total quantity of investment? The quantity of business investment? The quantity of residential investment?
12. If consumption depended on the interest rate, how would that affect the conclusions reached in this chapter about the effects of fiscal policy?
13. Macroeconomic data do not show a strong correlation between investment and interest rates. Let's examine why this might be so. Use our model in which the interest rate adjusts to equilibrate the supply of loanable funds (which is upward sloping) and the demand for loanable funds (which is downward sloping).
- a. Suppose the demand for loanable funds was stable but the supply fluctuated from year to year. What might cause these fluctuations in supply? In this case, what correlation between investment and interest rates would you find?
- b. Suppose the supply of loanable funds was stable but the demand fluctuated from year to year. What might cause these fluctuations in demand? In this case, what correlation between investment and interest rates would you find now?
- c. Suppose that both supply and demand in this market fluctuated over time. If you were to construct a scatterplot of investment and the interest rate, what would you find?
- d. Which of the above three cases seems most empirically realistic to you?

## KEY CONCEPTS

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Inflation	Central bank	Seigniorage
Hyperinflation	Federal Reserve	Nominal and real interest rates
Money	Open-market operations	Fisher equation and Fisher effect
Store of value	Currency	<i>Ex ante</i> and <i>ex post</i> real interest rates
Unit of account	Demand deposits	Shoeleather costs
Medium of exchange	Quantity equation	Menu costs
Fiat money	Transactions velocity of money	Real and nominal variables
Commodity money	Income velocity of money	Classical dichotomy
Gold standard	Real money balances	Monetary neutrality
Money supply	Money demand function	
Monetary policy	Quantity theory of money	

## QUESTIONS FOR REVIEW

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- Describe the functions of money.
- What is fiat money? What is commodity money?
- Who controls the money supply and how?
- Write the quantity equation and explain it.
- What does the assumption of constant velocity imply?
- Who pays the inflation tax?
- If inflation rises from 6 to 8 percent, what happens to real and nominal interest rates according to the Fisher effect?
- List all the costs of inflation you can think of, and rank them according to how important you think they are.
- Explain the roles of monetary and fiscal policy in causing and ending hyperinflations.
- Define the terms “real variable” and “nominal variable,” and give an example of each.

## PROBLEMS AND APPLICATIONS

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- What are the three functions of money? Which of the functions do the following items satisfy? Which do they not satisfy?
  - A credit card
  - A painting by Rembrandt
  - A subway token
- In the country of Wiknam, the velocity of money is constant. Real GDP grows by 5 percent per year, the money stock grows by 14 percent per year, and the nominal interest rate is 11 percent. What is the real interest rate?
- A newspaper article once reported that the U.S. economy was experiencing a low rate of inflation. It said that “low inflation has a downside: 45 million recipients of Social Security and other benefits will see their checks go up by just 2.8 percent next year.”
  - Why does inflation affect the increase in Social Security and other benefits?
  - Is this effect a cost of inflation, as the article suggests? Why or why not?
- Suppose a country has a money demand function  $(M/P)^d = kY$ , where  $k$  is a constant parameter.

The money supply grows by 12 per year, and real income grows by 4 percent per year.

- a. What is the average inflation rate?
  - b. How would inflation be different if real income growth were higher? Explain.
  - c. Suppose, instead of a constant money demand function, the velocity of money in this economy was growing steadily because of financial innovation. How would that affect the inflation rate? Explain.
5. Suppose you are advising a small country (such as Bermuda) on whether to print its own money or to use the money of its larger neighbor (such as the United States). What are the costs and benefits of a national money? Does the relative political stability of the two countries have any role in this decision?
  6. During World War II, both Germany and England had plans for a paper weapon: they each printed the other's currency, with the intention of dropping large quantities by airplane. Why might this have been an effective weapon?
  7. Suppose that the money demand function takes the form
 
$$(M/P)^d = L(i, Y) = Y/(5i)$$
    - a. If output grows at rate  $g$ , at what rate will the demand for real balances grow (assuming constant nominal interest rates)?
    - b. What is the velocity of money in this economy?
    - c. If inflation and nominal interest rates are constant, at what rate, if any, will velocity grow?
  - d. How will a permanent (once-and-for-all) increase in the level of interest rates affect the level of velocity? How will it affect the subsequent growth rate of velocity?
8. Calvin Coolidge once said that "inflation is repudiation." What might he have meant by this? Do you agree? Why or why not? Does it matter whether the inflation is expected or unexpected?
  9. Some economic historians have noted that during the period of the gold standard, gold discoveries were most likely to occur after a long deflation. (The discoveries of 1896 are an example.) Why might this be true?
  10. Suppose that consumption depends on the level of real money balances (on the grounds that real money balances are part of wealth). Show that if real money balances depend on the nominal interest rate, then an increase in the rate of money growth affects consumption, investment, and the real interest rate. Does the nominal interest rate adjust more than one-for-one or less than one-for-one to expected inflation?
 

This deviation from the classical dichotomy and the Fisher effect is called the *Mundell–Tobin effect*. How might you decide whether the Mundell–Tobin effect is important in practice?
  11. Use the Internet to identify a country that has had high inflation over the past year and another country that has had low inflation. (*Hint*: One useful Web site is <http://www.economist.com/markets/indicators/>.) For these two countries, find the rate of money growth and the current level of the nominal interest rate. Relate your findings to the theories presented in this chapter.

where  $Ep_{t+1}$  is the expected price level. Equation A8 states that real money balances depend on expected inflation. By following steps similar to those above, we can show that

$$p_t = \left( \frac{1}{1 + \gamma} \right) \left[ m_t + \left( \frac{\gamma}{1 + \gamma} \right) Em_{t+1} + \left( \frac{\gamma}{1 + \gamma} \right)^2 Em_{t+2} + \left( \frac{\gamma}{1 + \gamma} \right)^3 Em_{t+3} + \dots \right]. \quad (\text{A9})$$

Equation A9 states that the price level depends on the current money supply and expected future money supplies.

Some economists use this model to argue that *credibility* is important for ending hyperinflation. Because the price level depends on both current and expected future money, inflation depends on both current and expected future money growth. Therefore, to end high inflation, both money growth and expected money growth must fall. Expectations, in turn, depend on credibility—the perception that the central bank is committed to a new, more stable policy.

How can a central bank achieve credibility in the midst of hyperinflation? Credibility is often achieved by removing the underlying cause of the hyperinflation—the need for seigniorage. Thus, a credible fiscal reform is often necessary for a credible change in monetary policy. This fiscal reform might take the form of reducing government spending and making the central bank more independent from the government. Reduced spending decreases the need for seigniorage, while increased independence allows the central bank to resist government demands for seigniorage.

## MORE PROBLEMS AND APPLICATIONS

1. In the Cagan model, if the money supply is expected to grow at some constant rate  $\mu$  (so that  $Em_{t+s} = m_t + s\mu$ ), then Equation A9 can be shown to imply that  $p_t = m_t + \gamma\mu$ .
  - a. Interpret this result.
  - b. What happens to the price level  $p_t$  when the money supply  $m_t$  changes, holding the money growth rate  $\mu$  constant?
  - c. What happens to the price level  $p_t$  when the money growth rate  $\mu$  changes, holding the current money supply  $m_t$  constant?
  - d. If a central bank is about to reduce the rate of money growth  $\mu$  but wants to hold the price level  $p_t$  constant, what should it do with  $m_t$ ? Can you see any practical problems that might arise in following such a policy?
  - e. How do your previous answers change in the special case where money demand does not depend on the expected rate of inflation (so that  $\gamma = 0$ )?

## QUESTIONS FOR REVIEW

1. What are the net capital outflow and the trade balance? Explain how they are related.
2. Define the nominal exchange rate and the real exchange rate.
3. If a small open economy cuts defense spending, what happens to saving, investment, the trade balance, the interest rate, and the exchange rate?
4. If a small open economy bans the import of Japanese DVD players, what happens to saving, investment, the trade balance, the interest rate, and the exchange rate?
5. If Japan has low inflation and Mexico has high inflation, what will happen to the exchange rate between the Japanese yen and the Mexican peso?

## PROBLEMS AND APPLICATIONS

1. Use the model of the small open economy to predict what would happen to the trade balance, the real exchange rate, and the nominal exchange rate in response to each of the following events.
  - a. A fall in consumer confidence about the future induces consumers to spend less and save more.
  - b. The introduction of a stylish line of Toyotas makes some consumers prefer foreign cars over domestic cars.
  - c. The introduction of automatic teller machines reduces the demand for money.
2. Consider an economy described by the following equations:
 
$$Y = C + I + G + NX,$$

$$Y = 5,000,$$

$$G = 1,000,$$

$$T = 1,000,$$

$$C = 250 + 0.75(Y - T),$$

$$I = 1,000 - 50r,$$

$$NX = 500 - 500\epsilon,$$

$$r = r^* = 5.$$
  - a. In this economy, solve for national saving, investment, the trade balance, and the equilibrium exchange rate.
  - b. Suppose now that  $G$  rises to 1,250. Solve for national saving, investment, the trade balance, and the equilibrium exchange rate. Explain what you find.
  - c. Now suppose that the world interest rate rises from 5 to 10 percent. ( $G$  is again 1,000.) Solve for national saving, investment, the trade balance, and the equilibrium exchange rate. Explain what you find.
3. The country of Leverett is a small open economy. Suddenly, a change in world fashions makes the exports of Leverett unpopular.
  - a. What happens in Leverett to saving, investment, net exports, the interest rate, and the exchange rate?
  - b. The citizens of Leverett like to travel abroad. How will this change in the exchange rate affect them?
  - c. The fiscal policymakers of Leverett want to adjust taxes to maintain the exchange rate at its previous level. What should they do? If they do this, what are the overall effects on saving, investment, net exports, and the interest rate?
4. In 2005, Federal Reserve Governor Ben Bernanke said in a speech: "Over the past decade a combination of diverse forces has created a significant increase in the global supply of saving—a global saving glut—which helps to explain both the increase in the U.S. current account deficit [a broad measure of the trade deficit] and the relatively low level of long-term real interest rates in the world today." Is this statement consistent with the models you have learned? Explain.
5. What will happen to the trade balance and the real exchange rate of a small open economy when government purchases increase, such as during a war? Does your answer depend on whether this is a local war or a world war?

6. A case study in this chapter concludes that if poor nations offered better production efficiency and legal protections, the trade balance in rich nations such as the United States would move toward surplus. Let's consider why this might be the case.
  - a. If the world's poor nations offer better production efficiency and legal protection, what would happen to the investment demand function in those countries?
  - b. How would the change you describe in part (a) affect the demand for loanable funds in world financial markets?
  - c. How would the change you describe in part (b) affect the world interest rate?
  - d. How would the change you describe in part (c) affect the trade balance in rich nations?
7. The president is considering placing a tariff on the import of Japanese luxury cars. Discuss the economics and politics of such a policy. In particular, how would the policy affect the U.S. trade deficit? How would it affect the exchange rate? Who would be hurt by such a policy? Who would benefit?
8. Suppose China exports TVs and uses the yuan as its currency, whereas Russia exports vodka and uses the ruble. China has a stable money supply and slow, steady technological progress in TV production, while Russia has very rapid growth in the money supply and no technological progress in vodka production. Based on this information, what would you predict for the real exchange rate (measured as bottles of vodka per TV) and the nominal exchange rate (measured as rubles per yuan)? Explain your reasoning. (*Hint:* For the real exchange rate, think about the link between scarcity and relative prices.)
9. Suppose that some foreign countries begin to subsidize investment by instituting an investment tax credit.
  - a. What happens to world investment demand as a function of the world interest rate?
  - b. What happens to the world interest rate?
  - c. What happens to investment in our small open economy?
  - d. What happens to our trade balance?
  - e. What happens to our real exchange rate?
10. "Traveling in Mexico is much cheaper now than it was ten years ago," says a friend. "Ten years ago, a dollar bought 10 pesos; this year, a dollar buys 15 pesos." Is your friend right or wrong? Given that total inflation over this period was 25 percent in the United States and 100 percent in Mexico, has it become more or less expensive to travel in Mexico? Write your answer using a concrete example—such as an American hot dog versus a Mexican taco—that will convince your friend.
11. You read in a newspaper that the nominal interest rate is 12 percent per year in Canada and 8 percent per year in the United States. Suppose that the real interest rates are equalized in the two countries and that purchasing-power parity holds.
  - a. Using the Fisher equation (discussed in Chapter 4), what can you infer about expected inflation in Canada and in the United States?
  - b. What can you infer about the expected change in the exchange rate between the Canadian dollar and the U.S. dollar?
  - c. A friend proposes a get-rich-quick scheme: borrow from a U.S. bank at 8 percent, deposit the money in a Canadian bank at 12 percent, and make a 4 percent profit. What's wrong with this scheme?

MORE PROBLEMS AND APPLICATIONS

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1. If a war broke out abroad, it would affect the U.S. economy in many ways. Use the model of the large open economy to examine each of the following effects of such a war. What happens in the United States to saving, investment, the trade balance, the interest rate, and the exchange rate? (To keep things simple, consider each of the following effects separately.)
  - a. The U.S. government, fearing it may need to enter the war, increases its purchases of military equipment.
  - b. Other countries raise their demand for high-tech weapons, a major export of the United States.
  - c. The war makes U.S. firms uncertain about the future, and the firms delay some investment projects.
  - d. The war makes U.S. consumers uncertain about the future, and the consumers save more in response.
  - e. Americans become apprehensive about traveling abroad, so more of them spend their vacations in the United States.
  - f. Foreign investors seek a safe haven for their portfolios in the United States.
2. On September 21, 1995, "House Speaker Newt Gingrich threatened to send the United States into default on its debt for the first time in the nation's history, to force the Clinton Administration to balance the budget on Republican terms" (*New York Times*, September 22, 1995, p. A1). That same day, the interest rate on 30-year U.S. government bonds rose from 6.46 to 6.55 percent, and the dollar fell in value from 102.7 to 99.0 yen. Use the model of the large open economy to explain this event.

5. The unemployment rates among demographic groups differ substantially. In particular, the unemployment rates for younger workers are much higher than for older workers. This results from a difference in the rate of job separation rather than from a difference in the rate of job finding.
6. The natural rate of unemployment in the United States has exhibited long-term trends. In particular, it rose from the 1950s to the 1970s and then started drifting downward again in the 1990s and early 2000s. Various explanations of the trends have been proposed, including the changing demographic composition of the labor force, changes in the prevalence of sectoral shifts, and changes in the rate of productivity growth.
7. Individuals who have recently entered the labor force, including both new entrants and reentrants, make up about one-third of the unemployed. Transitions into and out of the labor force make unemployment statistics more difficult to interpret.
8. American and European labor markets exhibit some significant differences. In recent years, Europe has experienced significantly more unemployment than the United States. In addition, because of higher unemployment, shorter workweeks, more holidays, and earlier retirement, Europeans work fewer hours than Americans.

## KEY CONCEPTS

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Natural rate of unemployment	Unemployment insurance	Insiders versus outsiders
Frictional unemployment	Wage rigidity	Efficiency wages
Sectoral shift	Structural unemployment	Discouraged workers

## QUESTIONS FOR REVIEW

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1. What determines the natural rate of unemployment?
2. Describe the difference between frictional unemployment and structural unemployment.
3. Give three explanations the real wage may remain above the level that equilibrates labor supply and labor demand.
4. Is most unemployment long-term or short-term? Explain your answer.
5. How do economists explain the high natural rate of unemployment in the 1970s and 1980s? How do they explain the fall in the natural rate in the 1990s and early 2000s?

## PROBLEMS AND APPLICATIONS

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1. Answer the following questions about your own experience in the labor force:
  - a. When you or one of your friends is looking for a part-time job, how many weeks does it typically take? After you find a job, how many weeks does it typically last?
  - b. From your estimates, calculate (in a rate per week) your rate of job finding  $f$  and your rate of job separation  $s$ . (*Hint:* If  $f$  is the rate of job finding, then the average spell of unemployment is  $1/f$ )

- c. What is the natural rate of unemployment for the population you represent?
2. In this chapter we saw that the steady-state rate of unemployment is  $U/L = s/(s + f)$ . Suppose that the unemployment rate does not begin at this level. Show that unemployment will evolve over time and reach this steady state. (*Hint:* Express the change in the number of unemployed as a function of  $s$ ,  $f$ , and  $U$ . Then show that if unemployment is above the natural rate, unemployment falls, and if unemployment is below the natural rate, unemployment rises.)
  3. The residents of a certain dormitory have collected the following data: People who live in the dorm can be classified as either involved in a relationship or uninvolved. Among involved people, 10 percent experience a breakup of their relationship every month. Among uninvolved people, 5 percent will enter into a relationship every month. What is the steady-state fraction of residents who are uninvolved?
  4. Suppose that Congress passes legislation making it more difficult for firms to fire workers. (An example is a law requiring severance pay for fired workers.) If this legislation reduces the rate of job separation without affecting the rate of job finding, how would the natural rate of unemployment change? Do you think it is plausible that the legislation would not affect the rate of job finding? Why or why not?
  5. Consider an economy with the following Cobb–Douglas production function:
 
$$Y = K^{1/3}L^{2/3}.$$
 The economy has 1,000 units of capital and a labor force of 1,000 workers.
    - a. Derive the equation describing labor demand in this economy as a function of the real wage and the capital stock. (*Hint:* Review Chapter 3.)
    - b. If the real wage can adjust to equilibrate labor supply and labor demand, what is the real wage? In this equilibrium, what are employment, output, and the total amount earned by workers?
    - c. Now suppose that Congress, concerned about the welfare of the working class, passes a law requiring firms to pay workers a real wage of 1 unit of output. How does this wage compare to the equilibrium wage?
    - d. Congress cannot dictate how many workers firms hire at the mandated wage. Given this fact, what are the effects of this law? Specifically, what happens to employment, output, and the total amount earned by workers?
    - e. Will Congress succeed in its goal of helping the working class? Explain.
    - f. Do you think that this analysis provides a good way of thinking about a minimum-wage law? Why or why not?
  6. Suppose that a country experiences a reduction in productivity—that is, an adverse shock to the production function.
    - a. What happens to the labor demand curve?
    - b. How would this change in productivity affect the labor market—that is, employment, unemployment, and real wages—if the labor market was always in equilibrium?
    - c. How would this change in productivity affect the labor market if unions prevented real wages from falling?
  7. When workers' wages rise, their decision about how much time to spend working is affected in two conflicting ways—as you may have learned in courses in microeconomics. The *income effect* is the impulse to work less, because greater incomes mean workers can afford to consume more leisure. The *substitution effect* is the impulse to work more, because the reward for working an additional hour has risen (equivalently, the opportunity cost of leisure has gone up). Apply these concepts to Blanchard's hypothesis about American and European tastes for leisure. On which side of the Atlantic do income effects appear larger than substitution effects? On which side do the two effects approximately cancel? Do you think it is a reasonable hypothesis that tastes for leisure vary by geography? Why or why not?
  8. In any city at any time, some of the stock of usable office space is vacant. This vacant office space is unemployed capital. How would you explain this phenomenon? Is it a social problem?

## KEY CONCEPTS

Solow growth model

Steady state

Golden Rule level of capital

## QUESTIONS FOR REVIEW

1. In the Solow model, how does the saving rate affect the steady-state level of income? How does it affect the steady-state rate of growth?
2. Why might an economic policymaker choose the Golden Rule level of capital?
3. Might a policymaker choose a steady state with more capital than in the Golden Rule steady state? With less capital than in the Golden Rule steady state? Explain your answers.
4. In the Solow model, how does the rate of population growth affect the steady-state level of income? How does it affect the steady-state rate of growth?

## PROBLEMS AND APPLICATIONS

1. Country A and country B both have the production function
 
$$Y = F(K, L) = K^{1/2}L^{1/2}.$$
  - a. Does this production function have constant returns to scale? Explain.
  - b. What is the per-worker production function,  $y = f(k)$ ?
  - c. Assume that neither country experiences population growth or technological progress and that 5 percent of capital depreciates each year. Assume further that country A saves 10 percent of output each year and country B saves 20 percent of output each year. Using your answer from part (b) and the steady-state condition that investment equals depreciation, find the steady-state level of capital per worker for each country. Then find the steady-state levels of income per worker and consumption per worker.
  - d. Suppose that both countries start off with a capital stock per worker of 2. What are the levels of income per worker and consumption per worker? Remembering that the change in the capital stock is investment less depreciation, use a calculator or a computer spreadsheet to show how the capital stock per worker will evolve over time in both countries. For each year, calculate income per worker and consumption per worker. How many years will it be before the consumption in country B is higher than the consumption in country A?
2. In the discussion of German and Japanese postwar growth, the text describes what happens when part of the capital stock is destroyed in a war. By contrast, suppose that a war does not directly affect the capital stock, but that casualties reduce the labor force. Assume the economy was in a steady state before the war, the saving rate is unchanged, and the rate of population growth after the war returns to normal.
  - a. What is the immediate impact of the war on total output and on output per person?
  - b. What happens subsequently to output per worker in the postwar economy? Is the growth rate of output per worker after the war smaller or greater than normal?
3. Consider an economy described by the production function:  $Y = F(K, L) = K^{0.3}L^{0.7}$ .
  - a. What is the per-worker production function?
  - b. Assuming no population growth or technological progress, find the steady-state capital stock per worker, output per worker, and consumption per worker as a function of the saving rate and the depreciation rate.

- c. Assume that the depreciation rate is 10 percent per year. Make a table showing steady-state capital per worker, output per worker, and consumption per worker for saving rates of 0 percent, 10 percent, 20 percent, 30 percent, and so on. (You will need a calculator with an exponent key for this.) What saving rate maximizes output per worker? What saving rate maximizes consumption per worker?
- d. (Harder) Use calculus to find the marginal product of capital. Add to your table the marginal product of capital net of depreciation for each of the saving rates. What does your table show?
4. “Devoting a larger share of national output to investment would help restore rapid productivity growth and rising living standards.” Do you agree with this claim? Explain.
5. One view of the consumption function is that workers have high propensities to consume and capitalists have low propensities to consume. To explore the implications of this view, suppose that an economy consumes all wage income and saves all capital income. Show that if the factors of production earn their marginal product, this economy reaches the Golden Rule level of capital. (*Hint*: Begin with the identity that saving equals investment. Then use the steady-state condition that investment is just enough to keep up with depreciation and population growth and the fact that saving equals capital income in this economy.)
6. Many demographers predict that the United States will have zero population growth in the twenty-first century, in contrast to average population growth of about 1 percent per year in the twentieth century. Use the Solow model to forecast the effect of this slowdown in population growth on the growth of total output and the growth of output per person. Consider the effects both in the steady state and in the transition between steady states.
7. In the Solow model, population growth leads to steady-state growth in total output, but not in output per worker. Do you think this would still be true if the production function exhibited increasing or decreasing returns to scale? Explain. (For the definitions of increasing and decreasing returns to scale, see Chapter 3, “Problems and Applications,” Problem 2.)
8. Consider how unemployment would affect the Solow growth model. Suppose that output is produced according to the production function  $Y = K^\alpha [(1 - u)L]^{1-\alpha}$ , where  $K$  is capital,  $L$  is the labor force, and  $u$  is the natural rate of unemployment. The national saving rate is  $s$ , the labor force grows at rate  $n$ , and capital depreciates at rate  $\delta$ .
- a. Express output per worker ( $y = Y/L$ ) as a function of capital per worker ( $k = K/L$ ) and the natural rate of unemployment. Describe the steady state of this economy.
- b. Suppose that some change in government policy reduces the natural rate of unemployment. Describe how this change affects output both immediately and over time. Is the steady-state effect on output larger or smaller than the immediate effect? Explain.
9. Choose two countries that interest you—one rich and one poor. What is the income per person in each country? Find some data on country characteristics that might help explain the difference in income: investment rates, population growth rates, educational attainment, and so on. (*Hint*: The Web site of the World Bank, [www.worldbank.org](http://www.worldbank.org), is one place to find such data.) How might you figure out which of these factors is most responsible for the observed income difference?

6. Modern theories of endogenous growth attempt to explain the rate of technological progress, which the Solow model takes as exogenous. These models try to explain the decisions that determine the creation of knowledge through research and development.

## KEY CONCEPTS

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Efficiency of labor

Labor-augmenting technological progress

Endogenous growth theory

## QUESTIONS FOR REVIEW

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1. In the Solow model, what determines the steady-state rate of growth of income per worker?
2. In the steady state of the Solow model, at what rate does output per person grow? At what rate does capital per person grow? How does this compare with the U.S. experience?
3. What data would you need to determine whether an economy has more or less capital than in the Golden Rule steady state?
4. How can policymakers influence a nation's saving rate?
5. What has happened to the rate of productivity growth over the past 50 years? How might you explain this phenomenon?
6. How does endogenous growth theory explain persistent growth without the assumption of exogenous technological progress? How does this differ from the Solow model?

## PROBLEMS AND APPLICATIONS

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1. An economy described by the Solow growth model has the following production function:

$$y = \sqrt{k}.$$

- a. Solve for the steady-state value of  $y$  as a function of  $s$ ,  $n$ ,  $g$ , and  $\delta$ .
  - b. A developed country has a saving rate of 28 percent and a population growth rate of 1 percent per year. A less developed country has a saving rate of 10 percent and a population growth rate of 4 percent per year. In both countries,  $g = 0.02$  and  $\delta = 0.04$ . Find the steady-state value of  $y$  for each country.
  - c. What policies might the less developed country pursue to raise its level of income?
2. In the United States, the capital share of GDP is about 30 percent, the average growth in output is about 3 percent per year, the depreciation rate is about 4 percent per year, and the capital-output ratio is about 2.5. Suppose that the production function is Cobb-Douglas, so that the capital share in output is constant, and that the United States has been in a steady state. (For a discussion of the Cobb-Douglas production function, see Chapter 3.)
- a. What must the saving rate be in the initial steady state? [*Hint:* Use the steady-state relationship,  $sy = (\delta + n + g)k$ .]
  - b. What is the marginal product of capital in the initial steady state?
  - c. Suppose that public policy raises the saving rate so that the economy reaches the Golden Rule level of capital. What will the marginal product of capital be at the Golden Rule steady state? Compare the marginal product at the Golden Rule steady state to the marginal product in the initial steady state. Explain.
  - d. What will the capital-output ratio be at the Golden Rule steady state? (*Hint:* For the Cobb-Douglas production function, the capital-output ratio is related to the marginal product of capital.)

- e. What must the saving rate be to reach the Golden Rule steady state?
3. Prove each of the following statements about the steady state of the Solow model with population growth and technological progress.
- The capital–output ratio is constant.
  - Capital and labor each earn a constant share of an economy’s income. [*Hint*: Recall the definition  $MPK = f(k + 1) - f(k)$ .]
  - Total capital income and total labor income both grow at the rate of population growth plus the rate of technological progress,  $n + g$ .
  - The real rental price of capital is constant, and the real wage grows at the rate of technological progress  $g$ . (*Hint*: The real rental price of capital equals total capital income divided by the capital stock, and the real wage equals total labor income divided by the labor force.)
4. Two countries, Richland and Poorland, are described by the Solow growth model. They have the same Cobb–Douglas production function,  $F(K, L) = A K^\alpha L^{1-\alpha}$ , but with different quantities of capital and labor. Richland saves 32 percent of its income, while Poorland saves 10 percent. Richland has population growth of 1 percent per year, while Poorland has population growth of 3 percent. (The numbers in this problem are chosen to be approximately realistic descriptions of rich and poor nations.) Both nations have technological progress at a rate of 2 percent per year and depreciation at a rate of 5 percent per year.
- What is the per-worker production function  $f(k)$ ?
  - Solve for the ratio of Richland’s steady-state income per worker to Poorland’s. (*Hint*: The parameter  $\alpha$  will play a role in your answer.)
  - If the Cobb–Douglas parameter  $\alpha$  takes the conventional value of about 1/3, how much higher should income per worker be in Richland compared to Poorland?
  - Income per worker in Richland is actually 16 times income per worker in Poorland. Can you explain this fact by changing the value of the parameter  $\alpha$ ? What must it be? Can you think of any way of justifying such a value for this parameter? How else might you explain the large difference in income between Richland and Poorland?
5. The amount of education the typical person receives varies substantially among countries. Suppose you were to compare a country with a highly educated labor force and a country with a less educated labor force. Assume that education affects only the level of the efficiency of labor. Also assume that the countries are otherwise the same: they have the same saving rate, the same depreciation rate, the same population growth rate, and the same rate of technological progress. Both countries are described by the Solow model and are in their steady states. What would you predict for the following variables?
- The rate of growth of total income.
  - The level of income per worker.
  - The real rental price of capital.
  - The real wage.
6. This question asks you to analyze in more detail the two-sector endogenous growth model presented in the text.
- Rewrite the production function for manufactured goods in terms of output per effective worker and capital per effective worker.
  - In this economy, what is break-even investment (the amount of investment needed to keep capital per effective worker constant)?
  - Write down the equation of motion for  $k$ , which shows  $\Delta k$  as saving minus break-even investment. Use this equation to draw a graph showing the determination of steady-state  $k$ . (*Hint*: This graph will look much like those we used to analyze the Solow model.)
  - In this economy, what is the steady-state growth rate of output per worker  $Y/L$ ? How do the saving rate  $s$  and the fraction of the labor force in universities  $u$  affect this steady-state growth rate?
  - Using your graph, show the impact of an increase in  $u$ . (*Hint*: This change affects both curves.) Describe both the immediate and the steady-state effects.
  - Based on your analysis, is an increase in  $u$  an unambiguously good thing for the economy? Explain.

get some training, and do other useful tasks that standard measures of output fail to include. If so, then output is underestimated in recessions, which would also make the measured Solow residual cyclical for reasons other than technology.

Thus, economists can interpret the cyclical behavior of the Solow residual in different ways. Some economists point to the low productivity in recessions as evidence for adverse technology shocks. Others believe that measured productivity is low in recessions because workers are not working as hard as usual and because more of their output is not measured. Unfortunately, there is no clear evidence on the importance of labor hoarding and the cyclical mismeasurement of output. Therefore, different interpretations of Figure 8-2 persist.<sup>20</sup>

## MORE PROBLEMS AND APPLICATIONS

1. In the economy of Solovia, the owners of capital get two-thirds of national income, and the workers receive one-third.
  - a. The men of Solovia stay at home performing household chores, while the women work in factories. If some of the men started working outside the home so that the labor force increased by 5 percent, what would happen to the measured output of the economy? Does labor productivity—defined as output per worker—increase, decrease, or stay the same? Does total factor productivity increase, decrease, or stay the same?
  - b. In year 1, the capital stock was 6, the labor input was 3, and output was 12. In year 2, the capital stock was 7, the labor input was 4, and output was 14. What happened to total factor productivity between the two years?
2. Labor productivity is defined as  $Y/L$ , the amount of output divided by the amount of labor input. Start with the growth-accounting equation and show that the growth in labor pro-

ductivity depends on growth in total factor productivity and growth in the capital-labor ratio. In particular, show that

$$\frac{\Delta(Y/L)}{Y/L} = \frac{\Delta A}{A} + \alpha \frac{\Delta(K/L)}{K/L}.$$

*Hint:* You may find the following mathematical trick helpful. If  $z = wx$ , then the growth rate of  $z$  is approximately the growth rate of  $w$  plus the growth rate of  $x$ . That is,

$$\Delta z/z \approx \Delta w/w + \Delta x/x.$$

3. Suppose an economy described by the Solow model is in a steady state with population growth  $n$  of 1.8 percent per year and technological progress  $g$  of 1.8 percent per year. Total output and total capital grow at 3.6 percent per year. Suppose further that the capital share of output is  $1/3$ . If you used the growth-accounting equation to divide output growth into three sources—capital, labor, and total factor productivity—how much would you attribute to each source? Compare your results to the figures we found for the United States in Table 8-3.

<sup>20</sup> To read more about this topic, see Edward C. Prescott, "Theory Ahead of Business Cycle Measurement," and Lawrence H. Summers, "Some Skeptical Observations on Real Business Cycle Theory," both in *Quarterly Review*, Federal Reserve Bank of Minneapolis (Fall 1986); N. Gregory Mankiw, "Real Business Cycles: A New Keynesian Perspective," *Journal of Economic Perspectives* 3 (Summer 1989): 79–90; Bennett T. McCallum, "Real Business Cycle Models," in R. Barro, ed., *Modern Business Cycle Theory* (Cambridge, MA: Harvard University Press, 1989), 16–50; and Charles I. Plosser, "Understanding Real Business Cycles," *Journal of Economic Perspectives* 3 (Summer 1989): 51–77.

## KEY CONCEPTS

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Okun's law	Aggregate supply	Supply shocks
Leading indicators	Shocks	Stabilization policy
Aggregate demand	Demand shocks	

## QUESTIONS FOR REVIEW

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- When real GDP declines during a recession, what typically happens to consumption, investment, and the unemployment rate?
- Give an example of a price that is sticky in the short run but flexible in the long run.
- Why does the aggregate demand curve slope downward?
- Explain the impact of an increase in the money supply in the short run and in the long run.
- Why is it easier for the Fed to deal with demand shocks than with supply shocks?

## PROBLEMS AND APPLICATIONS

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- An economy begins in long-run equilibrium, and then a change in government regulations allows banks to start paying interest on checking accounts. Recall that the money stock is the sum of currency and demand deposits, including checking accounts, so this regulatory change makes holding money more attractive.
  - How does this change affect the demand for money?
  - What happens to the velocity of money?
  - If the Fed keeps the money supply constant, what will happen to output and prices in the short run and in the long run?
  - If the goal of the Fed is to stabilize the price level, should the Fed keep the money supply constant in response to this regulatory change? If not, what should it do? Why?
  - If the goal of the Fed is to stabilize output, how would your answer to part (d) change?
- Suppose the Fed reduces the money supply by 5 percent.
  - What happens to the aggregate demand curve?
  - What happens to the level of output and the price level in the short run and in the long run?
  - According to Okun's law, what happens to unemployment in the short run and in the long run?
  - What happens to the real interest rate in the short run and in the long run? (*Hint:* Use the model of the real interest rate in Chapter 3 to see what happens when output changes.)
- Let's examine how the goals of the Fed influence its response to shocks. Suppose Fed A cares only about keeping the price level stable and Fed B cares only about keeping output and employment at their natural levels. Explain how each Fed would respond to the following.

- a. An exogenous decrease in the velocity of money.
  - b. An exogenous increase in the price of oil.
4. The official arbiter of when recessions begin and end is the National Bureau of Economic Research, a nonprofit economics research group. Go to the NBER's Web site

([www.nber.org](http://www.nber.org)) and find the latest turning point in the business cycle. When did it occur? Was this a switch from expansion to contraction or the other way around? List all the recessions (contractions) that have occurred during your lifetime and the dates when they began and ended.

## KEY CONCEPTS

IS-LM model	Keynesian cross	Tax multiplier
IS curve	Government-purchases multiplier	Theory of liquidity preference
LM curve		

## QUESTIONS FOR REVIEW

- Use the Keynesian cross to explain why fiscal policy has a multiplied effect on national income.
- Use the theory of liquidity preference to explain why an increase in the money supply lowers the interest rate. What does this explanation assume about the price level?
- Why does the IS curve slope downward?
- Why does the LM curve slope upward?

## PROBLEMS AND APPLICATIONS

- Use the Keynesian cross to predict the impact on equilibrium GDP of
  - An increase in government purchases.
  - An increase in taxes.
  - Equal-sized increases in both government purchases and taxes.
- In the Keynesian cross, assume that the consumption function is given by
 
$$C = 200 + 0.75(Y - T).$$
 Planned investment is 100; government purchases and taxes are both 100.
  - Graph planned expenditure as a function of income.
  - What is the equilibrium level of income?
  - If government purchases increase to 125, what is the new equilibrium income?
  - What level of government purchases is needed to achieve an income of 1,600?
- Although our development of the Keynesian cross in this chapter assumes that taxes are a fixed amount, in many countries (including the United States) taxes depend on income. Let's represent the tax system by writing tax revenue as
 
$$T = \bar{T} + tY,$$
 where  $\bar{T}$  and  $t$  are parameters of the tax code. The parameter  $t$  is the marginal tax rate: if income rises by \$1, taxes rise by  $t \times \$1$ .
  - How does this tax system change the way consumption responds to changes in GDP?
  - In the Keynesian cross, how does this tax system alter the government-purchases multiplier?
  - In the IS-LM model, how does this tax system alter the slope of the IS curve?
- Consider the impact of an increase in thriftiness in the Keynesian cross. Suppose the consumption function is
 
$$C = \bar{C} + c(Y - T),$$
 where  $\bar{C}$  is a parameter called *autonomous consumption* and  $c$  is the marginal propensity to consume.
  - What happens to equilibrium income when the society becomes more thrifty, as represented by a decline in  $\bar{C}$ ?
  - What happens to equilibrium saving?
  - Why do you suppose this result is called the *paradox of thrift*?
  - Does this paradox arise in the classical model of Chapter 3? Why or why not?

5. Suppose that the money demand function is

$$(M/P)^d = 1,000 - 100r,$$

where  $r$  is the interest rate in percent. The money supply  $M$  is 1,000 and the price level  $P$  is 2.

- a. Graph the supply and demand for real money balances.
- b. What is the equilibrium interest rate?
- c. Assume that the price level is fixed. What happens to the equilibrium interest rate if the supply of money is raised from 1,000 to 1,200?
- d. If the Fed wishes to raise the interest rate to 7 percent, what money supply should it set?

4. Expansionary fiscal policy—an increase in government purchases or a decrease in taxes—shifts the *IS* curve to the right. This shift in the *IS* curve increases the interest rate and income. The increase in income represents a rightward shift in the aggregate demand curve. Similarly, contractionary fiscal policy shifts the *IS* curve to the left, lowers the interest rate and income, and shifts the aggregate demand curve to the left.
5. Expansionary monetary policy shifts the *LM* curve downward. This shift in the *LM* curve lowers the interest rate and raises income. The increase in income represents a rightward shift of the aggregate demand curve. Similarly, contractionary monetary policy shifts the *LM* curve upward, raises the interest rate, lowers income, and shifts the aggregate demand curve to the left.

## KEY CONCEPTS

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Monetary transmission mechanism

Pigou effect

Debt-deflation theory

## QUESTIONS FOR REVIEW

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1. Explain why the aggregate demand curve slopes downward.
2. What is the impact of an increase in taxes on the interest rate, income, consumption, and investment?
3. What is the impact of a decrease in the money supply on the interest rate, income, consumption, and investment?
4. Describe the possible effects of falling prices on equilibrium income.

## PROBLEMS AND APPLICATIONS

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1. According to the *IS–LM* model, what happens in the short run to the interest rate, income, consumption, and investment under the following circumstances?
  - a. The central bank increases the money supply.
  - b. The government increases government purchases.
  - c. The government increases taxes.
  - d. The government increases government purchases and taxes by equal amounts.
2. Use the *IS–LM* model to predict the effects of each of the following shocks on income, the interest rate, consumption, and investment. In each case, explain what the Fed should do to keep income at its initial level.
  - a. After the invention of a new high-speed computer chip, many firms decide to upgrade their computer systems.
  - b. A wave of credit-card fraud increases the frequency with which people make transactions in cash.
  - c. A best-seller titled *Retire Rich* convinces the public to increase the percentage of their income devoted to saving.
3. Consider the economy of Hicksonia.
  - a. The consumption function is given by
 
$$C = 200 + 0.75(Y - T).$$

The investment function is

$$I = 200 - 25r.$$

Government purchases and taxes are both 100. For this economy, graph the *IS* curve for  $r$  ranging from 0 to 8.

- b. The money demand function in Hicksonia is

$$(M/P)^d = Y - 100r.$$

The money supply  $M$  is 1,000 and the price level  $P$  is 2. For this economy, graph the *LM* curve for  $r$  ranging from 0 to 8.

- c. Find the equilibrium interest rate  $r$  and the equilibrium level of income  $Y$ .
- d. Suppose that government purchases are raised from 100 to 150. How much does the *IS* curve shift? What are the new equilibrium interest rate and level of income?
- e. Suppose instead that the money supply is raised from 1,000 to 1,200. How much does the *LM* curve shift? What are the new equilibrium interest rate and level of income?
- f. With the initial values for monetary and fiscal policy, suppose that the price level rises from 2 to 4. What happens? What are the new equilibrium interest rate and level of income?
- g. Derive and graph an equation for the aggregate demand curve. What happens to this aggregate demand curve if fiscal or monetary policy changes, as in parts (d) and (e)?
4. Explain why each of the following statements is true. Discuss the impact of monetary and fiscal policy in each of these special cases.
- If investment does not depend on the interest rate, the *IS* curve is vertical.
  - If money demand does not depend on the interest rate, the *LM* curve is vertical.
  - If money demand does not depend on income, the *LM* curve is horizontal.
  - If money demand is extremely sensitive to the interest rate, the *LM* curve is horizontal.
5. Suppose that the government wants to raise investment but keep output constant. In the *IS-LM* model, what mix of monetary and fiscal policy will achieve this goal? In the early 1980s, the U.S. government cut taxes and ran a budget

deficit while the Fed pursued a tight monetary policy. What effect should this policy mix have?

6. Use the *IS-LM* diagram to describe the short-run and long-run effects of the following changes on national income, the interest rate, the price level, consumption, investment, and real money balances.
- An increase in the money supply.
  - An increase in government purchases.
  - An increase in taxes.
7. The Fed is considering two alternative monetary policies:
- holding the money supply constant and letting the interest rate adjust, or
  - adjusting the money supply to hold the interest rate constant.

In the *IS-LM* model, which policy will better stabilize output under the following conditions?

- All shocks to the economy arise from exogenous changes in the demand for goods and services.
  - All shocks to the economy arise from exogenous changes in the demand for money.
8. Suppose that the demand for real money balances depends on disposable income. That is, the money demand function is

$$M/P = L(r, Y - T).$$

Using the *IS-LM* model, discuss whether this change in the money demand function alters the following:

- The analysis of changes in government purchases.
- The analysis of changes in taxes.

9. This problem asks you to analyze the *IS-LM* model algebraically. Suppose consumption is a linear function of disposable income:

$$C(Y - T) = a + b(Y - T),$$

where  $a > 0$  and  $0 < b < 1$ . Suppose also that investment is a linear function of the interest rate:

$$I(r) = c - dr,$$

where  $c > 0$  and  $d > 0$ .

- Solve for  $Y$  as a function of  $r$ , the exogenous variables  $G$  and  $T$ , and the model's parameters  $a$ ,  $b$ ,  $c$ , and  $d$ .

- b. How does the slope of the *IS* curve depend on the parameter  $d$ , the interest rate sensitivity of investment? Refer to your answer to part (a), and explain the intuition.
- c. Which will cause a bigger horizontal shift in the *IS* curve, a \$100 tax cut or a \$100 increase in government spending? Refer to your answer to part (a), and explain the intuition.

Now suppose demand for real money balances is a linear function of income and the interest rate:

$$L(r, Y) = eY - fr,$$

where  $e > 0$  and  $f > 0$ .

- d. Solve for  $r$  as a function of  $Y$ ,  $M$ , and  $P$  and the parameters  $e$  and  $f$ .
- e. Using your answer to part (d), determine whether the *LM* curve is steeper for large or small values of  $f$ , and explain the intuition.
- f. How does the size of the shift in the *LM* curve resulting from a \$100 increase in  $M$  depend on
- i. the value of the parameter  $e$ , the income sensitivity of money demand?
- ii. the value of the parameter  $f$ , the interest sensitivity of money demand?
- g. Use your answers to parts (a) and (d) to derive an expression for the aggregate demand curve. Your expression should show  $Y$  as a function of  $P$ ; of exogenous policy variables  $M$ ,  $G$ , and  $T$ ; and of the model's parameters. This expression should not contain  $r$ .
- h. Use your answer to part (g) to prove that the aggregate demand curve has a negative slope.
- i. Use your answer to part (g) to prove that increases in  $G$  and  $M$ , and decreases in  $T$ , shift the aggregate demand curve to the right. How does this result change if the parameter  $f$ , the interest sensitivity of money demand, equals zero?

3. In the Mundell–Fleming model with floating exchange rates, explain what happens to aggregate income, the exchange rate, and the trade balance when a quota on imported cars is removed. What would happen if exchange rates were fixed rather than floating?
4. What are the advantages of floating exchange rates and fixed exchange rates?
5. Describe the impossible trinity.

## PROBLEMS AND APPLICATIONS

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1. Use the Mundell–Fleming model to predict what would happen to aggregate income, the exchange rate, and the trade balance under both floating and fixed exchange rates in response to each of the following shocks.
  - a. A fall in consumer confidence about the future induces consumers to spend less and save more.
  - b. The introduction of a stylish line of Toyotas makes some consumers prefer foreign cars over domestic cars.
  - c. The introduction of automatic teller machines reduces the demand for money.
2. A small open economy with a floating exchange rate is in recession with balanced trade. If policymakers want to reach full employment while maintaining balanced trade, what combination of monetary and fiscal policy should they choose?
3. The Mundell–Fleming model takes the world interest rate  $r^*$  as an exogenous variable. Let's consider what happens when this variable changes.
  - a. What might cause the world interest rate to rise?
  - b. In the Mundell–Fleming model with a floating exchange rate, what happens to aggregate income, the exchange rate, and the trade balance when the world interest rate rises?
  - c. In the Mundell–Fleming model with a fixed exchange rate, what happens to aggregate income, the exchange rate, and the trade balance when the world interest rate rises?
4. Business executives and policymakers are often concerned about the competitiveness of American industry (the ability of U.S. industries to sell their goods profitably in world markets).
  - a. How would a change in the nominal exchange rate affect competitiveness in the short run when prices are sticky?
  - b. Suppose you wanted to make domestic industries more competitive but did not want to alter aggregate income. According to the Mundell–Fleming model, what combination of monetary and fiscal policies should you pursue?
5. Suppose that higher income implies higher imports and thus lower net exports. That is, the net exports function is
 
$$NX = NX(e, Y).$$
 Examine the effects in a small open economy of a fiscal expansion on income and the trade balance under the following.
  - a. A floating exchange rate.
  - b. A fixed exchange rate.
 How does your answer compare to the results in Table 12-1?
6. Suppose that money demand depends on disposable income, so that the equation for the money market becomes
 
$$M/P = L(r, Y - T).$$
 Analyze the impact of a tax cut in a small open economy on the exchange rate and income under both floating and fixed exchange rates.
7. Suppose that the price level relevant for money demand includes the price of imported goods and that the price of imported goods depends on the exchange rate. That is, the money market is described by
 
$$M/P = L(r, Y),$$
 where
 
$$P = \lambda P_d + (1 - \lambda)P_f/e.$$
 The parameter  $\lambda$  is the share of domestic goods in the price index  $P$ . Assume that the price of

domestic goods  $P_d$  and the price of foreign goods measured in foreign currency  $P_f$  are fixed.

- a. Suppose that we graph the  $LM^*$  curve for given values of  $P_d$  and  $P_f$  (instead of the usual  $P$ ). Is this  $LM^*$  curve still vertical? Explain.
  - b. What is the effect of expansionary fiscal policy under floating exchange rates in this model? Explain. Contrast with the standard Mundell–Fleming model.
  - c. Suppose that political instability increases the country risk premium and, thereby, the interest rate. What is the effect on the exchange rate, the price level, and aggregate income in this model? Contrast with the standard Mundell–Fleming model.
8. Use the Mundell–Fleming model to answer the following questions about the state of California (a small open economy).
    - a. What kind of exchange-rate system does California have with its major trading partners (Alabama, Alaska, Arizona, . . .)?
    - b. If California suffers from a recession, should the state government use monetary or fiscal policy to stimulate employment? Explain. (*Note:* For this question, assume that the state government can print dollar bills.)
    - c. If California prohibited the import of wines from the state of Washington, what would happen to income, the exchange rate, and the trade balance? Consider both the short-run and the long-run impacts.

We can now see that the monetary transmission mechanism works through two channels in a large open economy. As in a closed economy, a monetary expansion lowers the interest rate, which stimulates investment. As in a small open economy, a monetary expansion causes the currency to depreciate in the market for foreign exchange, which stimulates net exports. Both effects result in a higher level of aggregate income.

## A Rule of Thumb

This model of the large open economy describes well the U.S. economy today. Yet it is somewhat more complicated and cumbersome than the model of the closed economy we studied in Chapters 10 and 11 and the model of the small open economy we developed in this chapter. Fortunately, there is a useful rule of thumb to help you determine how policies influence a large open economy without remembering all the details of the model: *The large open economy is an average of the closed economy and the small open economy. To find how any policy will affect any variable, find the answer in the two extreme cases and take an average.*

For example, how does a monetary contraction affect the interest rate and investment in the short run? In a closed economy, the interest rate rises, and investment falls. In a small open economy, neither the interest rate nor investment changes. The effect in the large open economy is an average of these two cases: a monetary contraction raises the interest rate and reduces investment, but only somewhat. The fall in the net capital outflow mitigates the rise in the interest rate and the fall in investment that would occur in a closed economy. But unlike in a small open economy, the international flow of capital is not so strong as to negate fully these effects.

This rule of thumb makes the simple models all the more valuable. Although they do not describe perfectly the world in which we live, they do provide a useful guide to the effects of economic policy.

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## MORE PROBLEMS AND APPLICATIONS

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1. Imagine that you run the central bank in a large open economy. Your goal is to stabilize income, and you adjust the money supply accordingly. Under your policy, what happens to the money supply, the interest rate, the exchange rate, and the trade balance in response to each of the following shocks?
  - a. The president raises taxes to reduce the budget deficit.
  - b. The president restricts the import of Japanese cars.
2. Over the past several decades, investors around the world have become more willing to take advantage of opportunities in other countries. Because of this increasing sophistication, economies are more open today than in the past. Consider how this development affects the ability of monetary policy to influence the economy.
  - a. If investors become more willing to substitute foreign and domestic assets, what happens to the slope of the  $CF$  function?

- b. If the  $CF$  function changes in this way, what happens to the slope of the  $IS$  curve?
  - c. How does this change in the  $IS$  curve affect the Fed's ability to control the interest rate?
  - d. How does this change in the  $IS$  curve affect the Fed's ability to control national income?
3. Suppose that policymakers in a large open economy want to raise the level of investment without changing aggregate income or the exchange rate.
- a. Is there any combination of domestic monetary and fiscal policies that would achieve this goal?
  - b. Is there any combination of domestic monetary, fiscal, and trade policies that would achieve this goal?
  - c. Is there any combination of monetary and fiscal policies at home and abroad that would achieve this goal?
4. Suppose that a large open economy has a fixed exchange rate.
- a. Describe what happens in response to a fiscal contraction, such as a tax increase. Compare your answer to the case of a small open economy.
  - b. Describe what happens if the central bank expands the money supply by buying bonds from the public. Compare your answer to the case of a small open economy.

## KEY CONCEPTS

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Sticky-price model	Demand-pull inflation	Natural-rate hypothesis
Imperfect-information model	Cost-push inflation	Hysteresis
Phillips curve	Sacrifice ratio	
Adaptive expectations	Rational expectations	

## QUESTIONS FOR REVIEW

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1. Explain the two theories of aggregate supply. On what market imperfection does each theory rely? What do the theories have in common?
2. How is the Phillips curve related to aggregate supply?
3. Why might inflation be inertial?
4. Explain the differences between demand-pull inflation and cost-push inflation.
5. Under what circumstances might it be possible to reduce inflation without causing a recession?
6. Explain two ways in which a recession might raise the natural rate of unemployment.

## PROBLEMS AND APPLICATIONS

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1. In the sticky-price model, describe the aggregate supply curve in the following special cases. How do these cases compare to the short-run aggregate supply curve we discussed in Chapter 9?
  - a. No firms have flexible prices ( $s = 1$ ).
  - b. The desired price does not depend on aggregate output ( $a = 0$ ).
2. Suppose that an economy has the Phillips curve
 
$$\pi = \pi_{-1} - 0.5(\mu - 0.06).$$
  - a. What is the natural rate of unemployment?
  - b. Graph the short-run and long-run relationships between inflation and unemployment.
  - c. How much cyclical unemployment is necessary to reduce inflation by 5 percentage points? Using Okun's law, compute the sacrifice ratio.
  - d. Inflation is running at 10 percent. The Fed wants to reduce it to 5 percent. Give two scenarios that will achieve that goal.
3. According to the rational-expectations approach, if everyone believes that policymakers are committed to reducing inflation, the cost of reducing inflation—the sacrifice ratio—will be lower than if the public is skeptical about the policymakers' intentions. Why might this be true? How might credibility be achieved?
4. Suppose that the economy is initially at a long-run equilibrium. Then the Fed increases the money supply.
  - a. Assuming any resulting inflation to be unexpected, explain any changes in GDP, unemployment, and inflation that are caused by the monetary expansion. Explain your conclusions using three diagrams: one for the *IS-LM* model, one for the *AD-AS* model, and one for the Phillips curve.
  - b. Assuming instead that any resulting inflation is expected, explain any changes in GDP, unemployment, and inflation that are caused by the monetary expansion. Once again, explain your conclusions using three

diagrams: one for the *IS-LM* model, one for the *AD-AS* model, and one for the Phillips curve.

5. Assume that people have rational expectations and that the economy is described by the sticky-price model. Explain why each of the following propositions is true.
  - a. Only unanticipated changes in the money supply affect real GDP. Changes in the money supply that were anticipated when prices were set do not have any real effects.
  - b. If the Fed chooses the money supply at the same time as people are setting prices, so that everyone has the same information about the state of the economy, then monetary policy cannot be used systematically to stabilize output. Hence, a policy of keeping the money supply constant will have the same real effects as a policy of adjusting the money supply in response to the state of the economy. (This is called the *policy irrelevance proposition*.)
  - c. If the Fed sets the money supply well after people have set prices, so that the Fed has collected more information about the state of the economy, then monetary policy can be used systematically to stabilize output.

6. Suppose that an economy has the Phillips curve

$$\pi = \pi_{-1} - 0.5(u - u^n),$$

and that the natural rate of unemployment is given by an average of the past two years' unemployment:

$$u^n = 0.5(u_{-1} + u_{-2}).$$

- a. Why might the natural rate of unemployment depend on recent unemployment (as is assumed in the preceding equation)?
- b. Suppose that the Fed follows a policy to reduce permanently the inflation rate by

1 percentage point. What effect will that policy have on the unemployment rate over time?

- c. What is the sacrifice ratio in this economy? Explain.
  - d. What do these equations imply about the short-run and long-run tradeoffs between inflation and unemployment?
7. Some economists believe that taxes have an important effect on the labor supply. They argue that higher taxes cause people to want to work less and that lower taxes cause them to want to work more. Consider how this effect alters the macroeconomic analysis of tax changes.
    - a. If this view is correct, how does a tax cut affect the natural level of output?
    - b. How does a tax cut affect the aggregate demand curve? The long-run aggregate supply curve? The short-run aggregate supply curve?
    - c. What is the short-run impact of a tax cut on output and the price level? How does your answer differ from the case without the labor-supply effect?
    - d. What is the long-run impact of a tax cut on output and the price level? How does your answer differ from the case without the labor-supply effect?

8. Economist Alan Blinder, whom Bill Clinton appointed to be vice chairman of the Federal Reserve, once wrote the following:

The costs that attend the low and moderate inflation rates experienced in the United States and in other industrial countries appear to be quite modest—more like a bad cold than a cancer on society. . . . As rational individuals, we do not volunteer for a lobotomy to cure a head cold. Yet, as a collectivity, we routinely prescribe the economic equivalent of lobotomy (high unemployment) as a cure for the inflationary cold.<sup>13</sup>

<sup>13</sup> Alan Blinder, *Hard Heads, Soft Hearts: Tough-Minded Economics for a Just Society* (Reading, Mass.: Addison-Wesley, 1987), 5.

What do you think Blinder meant by this? What are the policy implications of the viewpoint Blinder is advocating? Do you agree? Why or why not?

9. Go to the Web site of the Bureau of Labor Statistics ([www.bls.gov](http://www.bls.gov)). For each of the past five years, find the inflation rate as measured by the consumer price index for all items (sometimes

called *headline inflation*) and as measured by the CPI excluding food and energy (sometimes called *core inflation*). Compare these two measures of inflation. Why might they be different? What might the difference tell you about shifts in the aggregate supply curve and in the short-run Phillips curve?

Keynesian special case (which occurs when  $\alpha$  equals infinity, so the price level is completely fixed).

2. *Closed or Open?* You decide whether you want a closed economy (which occurs when the capital flow  $CF$  always equals zero) or an open economy (which allows  $CF$  to differ from zero).
3. *Small or Large?* If you want an open economy, you decide whether you want a small one (in which  $CF$  is infinitely elastic at the world interest rate  $r^*$ ) or a large one (in which the domestic interest rate is not pinned down by the world rate).
4. *Floating or Fixed?* If you are examining a small open economy, you decide whether the exchange rate is floating (in which case the central bank sets the money supply) or fixed (in which case the central bank allows the money supply to adjust).
5. *Fixed velocity?* If you are considering a closed economy with the Keynesian assumption of fixed prices, you decide whether you want to focus on the special case in which velocity is exogenously fixed.

By making this series of modeling decisions, you move from the more complete and complex model to a simpler, more narrowly focused special case that is easier to understand and use.

When thinking about the real world, it is important to keep in mind all the models and their simplifying assumptions. Each of these models provides insight into some facet of the economy.

## MORE PROBLEMS AND APPLICATIONS

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1. Let's consider some more special cases of this large model. Starting with the large model, what extra assumptions would you need to yield each of the following models?
  - a. The model of the classical large open economy in the appendix to Chapter 5.
  - b. The Keynesian cross in the first half of Chapter 10.
  - c. The  $IS-LM$  model for the large open economy in the appendix to Chapter 12.

3. The dynamic  $AD-AS$  model can be used to determine the immediate impact on the economy of any shock and can also be used to trace out the effects of the shock over time.
4. Because the parameters of the monetary-policy rule influence the slope of the dynamic aggregate demand curve, they determine whether a supply shock has a greater effect on output or inflation. When choosing the parameters for monetary policy, a central bank faces a tradeoff between output variability and inflation variability.
5. The dynamic  $AD-AS$  model typically assumes that the central bank responds to a 1-percentage-point increase in inflation by increasing the nominal interest rate by more than 1 percentage point, so the real interest rate rises as well. If the central bank responds less vigorously to inflation, the economy becomes unstable. A shock can send inflation spiraling out of control.

## KEY CONCEPTS

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Taylor rule

Taylor principle

## QUESTIONS FOR REVIEW

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1. On a carefully labeled graph, draw the dynamic aggregate supply curve. Explain why it has the slope it has.
2. On a carefully labeled graph, draw the dynamic aggregate demand curve. Explain why it has the slope it has.
3. A central bank has a new head, who decides to raise the target inflation rate from 2 to 3 percent. Using a graph of the dynamic  $AD-AS$  model, show the effect of this change. What happens to the nominal interest rate immediately upon the change in policy and in the long run? Explain.
4. A central bank has a new head, who decides to increase the response of interest rates to inflation. How does this change in policy alter the response of the economy to a supply shock? Give both a graphical answer and a more intuitive economic explanation.

## PROBLEMS AND APPLICATIONS

---

1. Derive the long-run equilibrium for the dynamic  $AD-AS$  model. Assume there are no shocks to demand or supply ( $\epsilon_t = v_t = 0$ ) and inflation has stabilized ( $\pi_t = \pi_{t-1}$ ), and then use the five equations to derive the value of each variable in the model. Be sure to show each step you follow.

2. Suppose the monetary-policy rule has the wrong natural rate of interest. That is, the central bank follows this rule:

$$i_t = \pi_t + \rho' + \theta_\pi(\pi_t - \pi_t^*) + \theta_Y(Y_t - \bar{Y}_t)$$

where  $\rho'$  does not equal  $\rho$ , the natural rate of interest in the equation for goods demand. The rest of the dynamic *AD-AS* model is the same as in the chapter. Solve for the long-run equilibrium under this policy rule. Explain in words the intuition behind your solution.

3. "If a central bank wants to achieve lower nominal interest rates, it has to raise the nominal interest rate." Explain in what way this statement makes sense.
4. The *sacrifice ratio* is the accumulated loss in output that results when the central bank lowers its target for inflation by 1 percentage point. For the parameters used in the text simulation, what is the implied sacrifice ratio? Explain.
5. The text analyzes the case of a temporary shock to the demand for goods and services. Suppose, however, that  $\epsilon_t$  were to increase permanently. What would happen to the economy over time? In particular, would the inflation rate return to its target in the long run? Why or why not? (*Hint*: It might be helpful to solve for the long-run equilibrium without the assumption that  $\epsilon_t$  equals zero.) How might the central bank alter its policy rule to deal with this issue?
6. Suppose a central bank does not satisfy the Taylor principle; that is,  $\theta_\pi$  is less than zero. Use a graph to analyze the impact of a supply shock. Does this analysis contradict or reinforce the Taylor principle as a guideline for the design of monetary policy?
7. The text assumes that the natural rate of interest  $\rho$  is a constant parameter. Suppose instead that it varies over time, so now it has to be written as  $\rho_t$ .
- How would this change affect the equations for dynamic aggregate demand and dynamic aggregate supply?
  - How would a shock to  $\rho_t$  affect output, inflation, the nominal interest rate, and the real interest rate?

- Can you see any practical difficulties that a central bank might face if  $\rho_t$  varied over time?
8. Suppose that people's expectations of inflation are subject to random shocks. That is, instead of being merely adaptive, expected inflation in period  $t$ , as seen in period  $t - 1$ , is  $E_{t-1}\pi_t = \pi_{t-1} + \eta_{t-1}$ , where  $\eta_{t-1}$  is a random shock. This shock is normally zero, but it deviates from zero when some event beyond past inflation causes expected inflation to change. Similarly,  $E_t\pi_{t+1} = \pi_t + \eta_t$ .
- Derive the two equations for dynamic aggregate demand and dynamic aggregate supply in this slightly more general model.
  - Suppose that the economy experiences an *inflation scare*. That is, in period  $t$ , for some reason people come to believe that inflation in period  $t + 1$  is going to be higher, so  $\eta_t$  is greater than zero (for this period only). What happens to the *DAD* and *DAS* curves in period  $t$ ? What happens to output, inflation, and nominal and real interest rates in that period? Explain.
  - What happens to the *DAD* and *DAS* curves in period  $t + 1$ ? What happens to output, inflation, and nominal and real interest rates in that period? Explain.
  - What happens to the economy in subsequent periods?
  - In what sense are inflation scares self-fulfilling?
9. Use the dynamic *AD-AS* model to solve for inflation as a function of only lagged inflation and the supply and demand shocks. (Assume target inflation is a constant.)
- According to the equation you have derived, does inflation return to its target after a shock? Explain. (*Hint*: Look at the coefficient on lagged inflation.)
  - Suppose the central bank does not respond to changes in output but only to changes in inflation, so that  $\theta_Y = 0$ . How, if at all, would this fact change your answer to part (a)?

- c. Suppose the central bank does not respond to changes in inflation but only to changes in output, so that  $\theta_\pi = 0$ . How, if at all, would this fact change your answer to part (a)?
- d. Suppose the central bank does not follow the Taylor principle but instead raises the

nominal interest rate only 0.8 percentage point for each percentage-point increase in inflation. In this case, what is  $\theta_\pi$ ? How does a shock to demand or supply influence the path of inflation?

[T]he ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed, the world is ruled by little else. Practical men, who believe themselves to be quite exempt from intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back.

This is as true today as it was when Keynes wrote it in 1936—except now that academic scribbler is often Keynes himself.

## Summary

1. Advocates of active policy view the economy as subject to frequent shocks that will lead to unnecessary fluctuations in output and employment unless monetary or fiscal policy responds. Many believe that economic policy has been successful in stabilizing the economy.
2. Advocates of passive policy argue that because monetary and fiscal policies work with long and variable lags, attempts to stabilize the economy are likely to end up being destabilizing. In addition, they believe that our present understanding of the economy is too limited to be useful in formulating successful stabilization policy and that inept policy is a frequent source of economic fluctuations.
3. Advocates of discretionary policy argue that discretion gives more flexibility to policymakers in responding to various unforeseen situations.
4. Advocates of policy rules argue that the political process cannot be trusted. They believe that politicians make frequent mistakes in conducting economic policy and sometimes use economic policy for their own political ends. In addition, advocates of policy rules argue that a commitment to a fixed policy rule is necessary to solve the problem of time inconsistency.

## KEY CONCEPTS

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Inside and outside lags

Political business cycle

Monetarists

Automatic stabilizers

Time inconsistency

Inflation targeting

Lucas critique

## QUESTIONS FOR REVIEW

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1. What are the inside lag and the outside lag? Which has the longer inside lag—monetary or fiscal policy? Which has the longer outside lag? Why?
2. Why would more accurate economic forecasting make it easier for policymakers to stabilize the economy? Describe two ways economists try to forecast developments in the economy.

3. Describe the Lucas critique.
4. How does a person's interpretation of macroeconomic history affect his view of macroeconomic policy?
5. What is meant by the "time inconsistency" of economic policy? Why might policymakers be tempted to renege on an announcement they made earlier? In this situation, what is the advantage of a policy rule?
6. List three policy rules that the Fed might follow. Which of these would you advocate? Why?

## PROBLEMS AND APPLICATIONS

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1. Suppose that the tradeoff between unemployment and inflation is determined by the Phillips curve:
 
$$u = u^n - \alpha(\pi - E\pi),$$
 where  $u$  denotes the unemployment rate,  $u^n$  the natural rate,  $\pi$  the rate of inflation, and  $E\pi$  the expected rate of inflation. In addition, suppose that the Democratic Party always follows a policy of high money growth and the Republican Party always follows a policy of low money growth. What "political business cycle" pattern of inflation and unemployment would you predict under the following conditions?
  - a. Every four years, one of the parties takes control based on a random flip of a coin. (*Hint:* What will expected inflation be prior to the election?)
  - b. The two parties take turns.
2. When cities pass laws limiting the rent landlords can charge on apartments, the laws usually apply to existing buildings and exempt any buildings not yet built. Advocates of rent control argue that this exemption ensures that rent control does not discourage the construction of new housing. Evaluate this argument in light of the time-inconsistency problem.
3. Go to the Web site of the Federal Reserve ([www.federalreserve.gov](http://www.federalreserve.gov)). Find and read a press release, segment of congressional testimony, or report about recent monetary policy. What does it say? What is the Fed doing? Why? What do you think about the Fed's recent policy decisions?

game against private decisionmakers who have rational expectations. Unless it is committed to a fixed rule of zero inflation, the Fed cannot get private agents to expect zero inflation.

Suppose, for example, that the Fed simply announces that it will follow a zero-inflation policy. Such an announcement by itself cannot be credible. After private agents have formed their expectations of inflation, the Fed has the incentive to renege on its announcement in order to decrease unemployment. [As we have just seen, once expectations are determined, the Fed's optimal policy is to set inflation at  $\pi = \alpha/(2\gamma)$ , regardless of  $E\pi$ .] Private agents understand the incentive to renege and therefore do not believe the announcement in the first place.

This theory of monetary policy has an important corollary. Under one circumstance, the Fed with discretion achieves the same outcome as the Fed committed to a fixed rule of zero inflation. If the Fed dislikes inflation much more than it dislikes unemployment (so that  $\gamma$  is very large), inflation under discretion is near zero, because the Fed has little incentive to inflate. This finding provides some guidance to those who have the job of appointing central bankers. An alternative to imposing a fixed rule is to appoint an individual with a fervent distaste for inflation. Perhaps this is why even liberal politicians (Jimmy Carter, Bill Clinton) who are more concerned about unemployment than inflation sometimes appoint conservative central bankers (Paul Volcker, Alan Greenspan) who are more concerned about inflation.

## MORE PROBLEMS AND APPLICATIONS

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1. In the 1970s in the United States, the inflation rate and the natural rate of unemployment both rose. Let's use this model of time inconsistency to examine this phenomenon. Assume that policy is discretionary.

- a. In the model as developed so far, what happens to the inflation rate when the natural rate of unemployment rises?
- b. Let's now change the model slightly by supposing that the Fed's loss function is quadratic in both inflation and unemployment.

That is,

$$L(u, \pi) = u^2 + \gamma\pi^2.$$

Follow steps similar to those in the text to solve for the inflation rate under discretionary policy.

- c. Now what happens to the inflation rate when the natural rate of unemployment rises?
- d. In 1979, President Jimmy Carter appointed the conservative central banker Paul Volcker to head the Federal Reserve. According to this model, what should have happened to inflation and unemployment?

to the future. The debate between the traditional and Ricardian views of government debt is ultimately a debate over how consumers behave. Are consumers rational or shortsighted? Do they face binding borrowing constraints? Are they economically linked to future generations through altruistic bequests? Economists' views of government debt hinge on their answers to these questions.

5. Most economists oppose a strict rule requiring a balanced budget. A budget deficit can sometimes be justified on the basis of short-run stabilization, tax smoothing, or intergenerational redistribution of the tax burden.
6. Government debt can potentially have other effects. Large government debt or budget deficits may encourage excessive monetary expansion and, therefore, lead to greater inflation. The possibility of running budget deficits may encourage politicians to unduly burden future generations when setting government spending and taxes. A high level of government debt may increase the risk of capital flight and diminish a nation's influence around the world. Economists differ in which of these effects they consider most important.

## KEY CONCEPTS

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Capital budgeting

Cyclically adjusted budget deficit

Ricardian equivalence

## QUESTIONS FOR REVIEW

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1. What was unusual about U.S. fiscal policy from 1980 to 1995?
2. Why do many economists project increasing budget deficits and government debt over the next several decades?
3. Describe four problems affecting measurement of the government budget deficit.
4. According to the traditional view of government debt, how does a debt-financed tax cut affect public saving, private saving, and national saving?
5. According to the Ricardian view of government debt, how does a debt-financed tax cut affect public saving, private saving, and national saving?
6. Do you find more credible the traditional or the Ricardian view of government debt? Why?
7. Give three reasons why a budget deficit might be a good policy choice.
8. Why might the level of government debt affect the government's incentives regarding money creation?

## PROBLEMS AND APPLICATIONS

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1. On April 1, 1996, Taco Bell, the fast-food chain, ran a full-page ad in the *New York Times* with this news: "In an effort to help the national debt, Taco Bell is pleased to announce that we have agreed to purchase the Liberty Bell, one of our country's most historic treasures. It will now be called the *Taco Liberty Bell* and will still be accessible to the American public for viewing. We hope our move will prompt other corporations to take similar action to do their part to reduce

the country's debt." Would such actions by U.S. corporations actually reduce the national debt as it is now measured? How would your answer change if the U.S. government adopted capital budgeting? Do you think these actions represent a true reduction in the government's indebtedness? Do you think Taco Bell was serious about this plan? (*Hint:* Note the date.)

2. Draft a letter to the senator described in Section 16-3, explaining and evaluating the Ricardian view of government debt.
3. The Social Security system levies a tax on workers and pays benefits to the elderly. Suppose that Congress increases both the tax and the benefits. For simplicity, assume that Congress announces that the increases will last for one year only.
  - a. How do you suppose this change would affect the economy? (*Hint:* Think about the marginal propensities to consume of the young and the old.)
  - b. Does your answer depend on whether generations are altruistically linked?
4. Some economists have proposed the rule that the cyclically adjusted budget deficit always be balanced. Compare this proposal to a strict balanced-budget rule. Which is preferable? What problems do you see with the rule requiring a balanced cyclically adjusted budget?
5. Using the library or the Internet, find some recent projections for the future path of the U.S. government debt as a percentage of GDP. What assumptions are made about government spending, taxes, and economic growth? Do you think these assumptions are reasonable? If the United States experiences a productivity slowdown, how will reality differ from this projection? (*Hint:* A good place to look is [www.cbo.gov](http://www.cbo.gov).)

## KEY CONCEPTS

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Marginal propensity to consume	Normal good	Permanent-income hypothesis
Average propensity to consume	Income effect	Permanent income
Intertemporal budget constraint	Substitution effect	Transitory income
Discounting	Borrowing constraint	Random walk
Indifference curves	Life-cycle hypothesis	
Marginal rate of substitution	Precautionary saving	

## QUESTIONS FOR REVIEW

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1. What were Keynes's three conjectures about the consumption function?
2. Describe the evidence that was consistent with Keynes's conjectures and the evidence that was inconsistent with them.
3. How do the life-cycle and permanent-income hypotheses resolve the seemingly contradictory pieces of evidence regarding consumption behavior?
4. Use Fisher's model of consumption to analyze an increase in second-period income. Compare the case in which the consumer faces a binding borrowing constraint and the case in which he does not.
5. Explain why changes in consumption are unpredictable if consumers obey the permanent-income hypothesis and have rational expectations.
6. Give an example in which someone might exhibit time-inconsistent preferences.

## PROBLEMS AND APPLICATIONS

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1. The chapter uses the Fisher model to discuss a change in the interest rate for a consumer who saves some of his first-period income. Suppose, instead, that the consumer is a borrower. How does that alter the analysis? Discuss the income and substitution effects on consumption in both periods.
2. Jack and Jill both obey the two-period Fisher model of consumption. Jack earns \$100 in the first period and \$100 in the second period. Jill earns nothing in the first period and \$210 in the second period. Both of them can borrow or lend at the interest rate  $r$ .
  - a. You observe both Jack and Jill consuming \$100 in the first period and \$100 in the second period. What is the interest rate  $r$ ?
  - b. Suppose the interest rate increases. What will happen to Jack's consumption in the first period? Is Jack better off or worse off than before the interest rate rise?
  - c. What will happen to Jill's consumption in the first period when the interest rate increases? Is Jill better off or worse off than before the interest rate increase?
3. The chapter analyzes Fisher's model for the case in which the consumer can save or borrow at an interest rate of  $r$  and for the case in which the consumer can save at this rate but cannot borrow at all. Consider now the intermediate case in which the consumer can save at rate  $r_s$  and borrow at rate  $r_b$ , where  $r_s < r_b$ .
  - a. What is the consumer's budget constraint in the case in which he consumes less than his income in period one?
  - b. What is the consumer's budget constraint in the case in which he consumes more than his income in period one?

- c. Graph the two budget constraints and shade the area that represents the combination of first-period and second-period consumption the consumer can choose.
  - d. Now add to your graph the consumer's indifference curves. Show three possible outcomes: one in which the consumer saves, one in which he borrows, and one in which he neither saves nor borrows.
  - e. What determines first-period consumption in each of the three cases?
4. Explain whether borrowing constraints increase or decrease the potency of fiscal policy to influence aggregate demand in each of the following two cases.
    - a. A temporary tax cut.
    - b. An announced future tax cut.
  5. In the discussion of the life-cycle hypothesis in the text, income is assumed to be constant during the period before retirement. For most people, however, income grows over their lifetimes. How does this growth in income influence the lifetime pattern of consumption and wealth accumulation shown in Figure 17-12 under the following conditions?
    - a. Consumers can borrow, so their wealth can be negative.
    - b. Consumers face borrowing constraints that prevent their wealth from falling below zero.Do you consider case (a) or case (b) to be more realistic? Why?
  6. Demographers predict that the fraction of the population that is elderly will increase over the next 20 years. What does the life-cycle model predict for the influence of this demographic change on the national saving rate?
  7. One study found that the elderly who do not have children dissave at about the same rate as the elderly who do have children. What might this finding imply about the reason the elderly do not dissave as much as the life-cycle model predicts?
  8. Consider two savings accounts that pay the same interest rate. One account lets you take your money out on demand. The second requires that you give 30-day advance notification before withdrawals. Which account would you prefer? Why? Can you imagine a person who might make the opposite choice? What do these choices say about the theory of the consumption function?

## QUESTIONS FOR REVIEW

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1. In the neoclassical model of business fixed investment, under what conditions will firms find it profitable to add to their capital stock?
2. What is Tobin's  $q$ , and what does it have to do with investment?
3. Explain why an increase in the interest rate reduces the amount of residential investment.
4. List four reasons firms might hold inventories.

## PROBLEMS AND APPLICATIONS

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1. Use the neoclassical model of investment to explain the impact of each of the following on the rental price of capital, the cost of capital, and investment.
  - a. Anti-inflationary monetary policy raises the real interest rate.
  - b. An earthquake destroys part of the capital stock.
  - c. Immigration of foreign workers increases the size of the labor force.
2. Suppose that the government levies a tax on oil companies equal to a proportion of the value of the company's oil reserves. (The government assures the firms that the tax is for one time only.) According to the neoclassical model, what effect will the tax have on business fixed investment by these firms? What if these firms face financing constraints?
3. The  $IS-LM$  model developed in Chapters 10 and 11 assumes that investment depends only on the interest rate. Yet our theories of investment suggest that investment might also depend on national income: higher income might induce firms to invest more.
  - a. Explain why investment might depend on national income.
  - b. Suppose that investment is determined by
 
$$I = \bar{I} + aY,$$
 where  $a$  is a constant between zero and one, which measures the influence of national income on investment. With investment set this way, what are the fiscal-policy multipliers in the Keynesian-cross model? Explain.
  - c. Suppose that investment depends on both income and the interest rate. That is, the investment function is
 
$$I = \bar{I} + aY - br,$$
 where  $a$  is a constant between zero and one that measures the influence of national income on investment and  $b$  is a constant greater than zero that measures the influence of the interest rate on investment. Use the  $IS-LM$  model to consider the short-run impact of an increase in government purchases on national income  $Y$ , the interest rate  $r$ , consumption  $C$ , and investment  $I$ . How might this investment function alter the conclusions implied by the basic  $IS-LM$  model?
4. When the stock market crashes, as it did in October 1929 and October 1987, what influence does it have on investment, consumption, and aggregate demand? Why? How should the Federal Reserve respond? Why?
5. It is an election year, and the economy is in a recession. The opposition candidate campaigns on a platform of passing an investment tax credit, which would be effective next year after she takes office. What impact does this campaign promise have on economic conditions during the current year?
6. The United States experienced a large increase in the number of births in the 1950s. People in this baby-boom generation reached adulthood and started forming their own households in the 1970s.
  - a. Use the model of residential investment to predict the impact of this event on housing prices and residential investment.
  - b. For the years 1970 and 1980, compute the real price of housing, measured as the residential investment deflator divided by the GDP deflator. What do you find? Is this finding consistent with the model? (*Hint:* A good source of data is the *Economic Report of the President*, which is published annually.)
7. U.S. tax laws encourage investment in housing (such as through the deductibility of mortgage interest for purposes of computing income) and discourage investment in business capital (such as through the corporate income tax). What are the long-run effects of this policy? (*Hint:* Think about the labor market.)

5. Portfolio theories of money demand stress the role of money as a store of value. They predict that the demand for money depends on the risk and return on money and alternative assets.
6. Transactions theories of money demand, such as the Baumol–Tobin model, stress the role of money as a medium of exchange. They predict that the demand for money depends positively on expenditure and negatively on the interest rate.
7. Financial innovation has led to the creation of assets with many of the attributes of money. These near moneys make the demand for money less stable, which complicates the conduct of monetary policy.

### KEY CONCEPTS

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Reserves	Money multiplier	Capital requirement
100-percent-reserve banking	High-powered money	Portfolio theories
Balance sheet	Open-market operations	Dominated asset
Fractional-reserve banking	Reserve requirements	Transactions theories
Financial intermediation	Discount rate	Baumol–Tobin model
Monetary base	Excess reserves	Near money
Reserve–deposit ratio	Bank capital	
Currency–deposit ratio	Leverage	

### QUESTIONS FOR REVIEW

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1. Explain how banks create money.
2. What are the three ways in which the Federal Reserve can influence the money supply?
3. Why might a banking crisis lead to a fall in the money supply?
4. Explain the difference between portfolio and transactions theories of money demand.
5. According to the Baumol–Tobin model, what determines how often people go to the bank? What does this decision have to do with money demand?
6. In what way does the existence of near money complicate the conduct of monetary policy? How has the Federal Reserve responded to this complication?

### PROBLEMS AND APPLICATIONS

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1. The money supply fell from 1929 to 1933 because both the currency–deposit ratio and the reserve–deposit ratio increased. Use the model of the money supply and the data in Table 19-1 to answer the following hypothetical questions about this episode.
  - a. What would have happened to the money supply if the currency–deposit ratio had risen but the reserve–deposit ratio had remained the same?