Answers to Textbook Questions and Problems

CHAPTER 1   The Science of Macroeconomics

Questions for Review

1. *Microeconomics* is the study of how individual firms and households make decisions, and how they interact with one another. Microeconomic models of firms and households are based on principles of optimization—firms and households do the best they can given the constraints they face. For example, households choose which goods to purchase in order to maximize their utility, whereas firms decide how much to produce in order to maximize profits. In contrast, *macroeconomics* is the study of the economy as a whole; it focuses on issues such as how total output, total employment, and the overall price level are determined. These economy-wide variables are based on the interaction of many households and many firms; therefore, microeconomics forms the basis for macroeconomics.

2. Economists build models as a means of summarizing the relationships among economic variables. Models are useful because they abstract from the many details in the economy and allow one to focus on the most important economic connections.

3. A market-clearing model is one in which prices adjust to equilibrate supply and demand. Market-clearing models are useful in situations where prices are flexible. Yet in many situations, flexible prices may not be a realistic assumption. For example, labor contracts often set wages for up to three years. Or, firms such as magazine publishers change their prices only every three to four years. Most macroeconomists believe that price flexibility is a reasonable assumption for studying long-run issues. Over the long run, prices respond to changes in demand or supply, even though in the short run they may be slow to adjust.

Problems and Applications

1. Monetary policy in the United States and the European Union has been a big topic of conversation in early 2015. The EU embarked upon a quantitative easing policy in March 2015 in an attempt to stimulate growth and prevent deflation. There has been some concern that the inflation rate in Europe will turn negative. In the United States, there is continued discussion and speculation concerning when the Federal Reserve might choose to increase the target federal funds rate. Also in the United States, the unemployment rate has declined to about 5.5 percent and this suggests that wages may begin to increase. The Federal Reserve will be watching for wage and price increases as they decide when to increase interest rates.

2. Many philosophers of science believe that the defining characteristic of a science is the use of the scientific method of inquiry to establish stable relationships. Scientists examine data, often provided by controlled experiments, to support or disprove a hypothesis. Economists are more limited in their use of experiments. They cannot conduct controlled experiments on the economy; they must rely on the natural course of developments in the economy to collect data. To the extent that economists use the scientific method of inquiry, that is, developing hypotheses and testing them, economics has the characteristics of a science.

3. We can use a simple variant of the supply-and-demand model for pizza to answer this question. Assume that the quantity of ice cream demanded depends not only on the price of ice cream and income, but also on the price of frozen yogurt:

$$Q^d = D(P_{IC}, P_{FY}, Y).$$

We expect that demand for ice cream rises when the price of frozen yogurt rises, because ice cream and frozen yogurt are substitutes. That is, when the price of frozen yogurt goes up, I consume less of it and, instead, fulfill more of my frozen dessert urges through the consumption of ice cream.

The next part of the model is the supply function for ice cream, $Q^s = S(P_{IC})$. Finally, in equilibrium, supply must equal demand, so that $Q^s = Q^d$. Y and P_{FY} are the exogenous variables, and Q and P_{IC} are the endogenous variables. Figure 1-1 uses this model to show that a fall in the price of frozen yogurt results in an inward shift of the demand curve for ice cream. The new equilibrium has a lower price and quantity of ice cream.

Figure 1-1

Quantity of ice cream
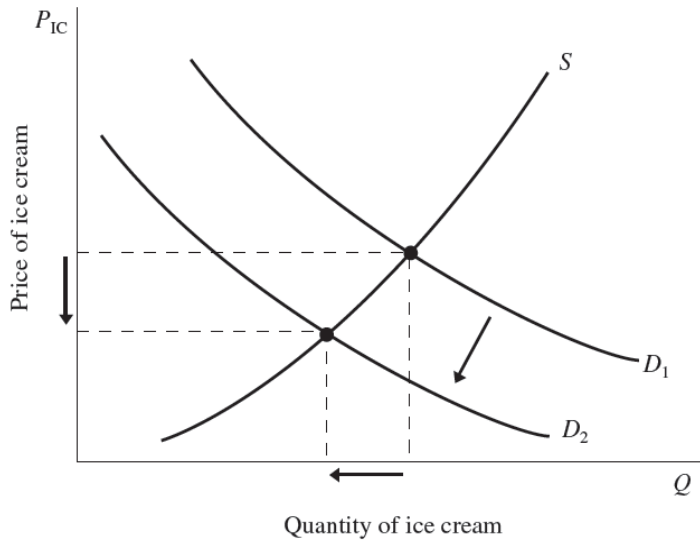
4. The price of haircuts changes rather infrequently. From casual observation, hairstylists tend to charge the same price over a one- or two-year period irrespective of the demand for haircuts or the supply of cutters. A market-clearing model for analyzing the market for haircuts has the unrealistic assumption of flexible prices. Such an assumption is unrealistic in the short run when we observe that prices are inflexible. Over the long run, however, the price of haircuts does tend to adjust; a market-clearing model is therefore appropriate.

Answers to Textbook Questions and Problems

CHAPTER 2   The Data of Macroeconomics

Questions for Review

1.   GDP measures the total income earned from the production of the new final goods and services in the
     economy, and it measures the total expenditures on the new final goods and services produced in the
     economy. GDP can measure two things at once because the total expenditures on the new final goods
     and services by the buyers must be equal to the income earned by the sellers of the new final goods and
     services. As the circular flow diagram in the text illustrates, these are alternative, equivalent ways of
     measuring the flow of dollars in the economy.

2.   The four components of GDP are consumption, investment, government purchases, and net exports.
     The consumption category of GDP consists of household expenditures on new final goods and services,
     such as the purchase of a new television. The investment category of GDP consists of business fixed
     investment, residential fixed investment, and inventory investment. When a business buys new
     equipment this counts as investment. Government purchases consists of purchases of new final goods
     and services by federal, state, and local governments, such as payments for new military equipment.
     Net exports measures the value of goods and services sold to other countries minus the value of goods
     and services foreigners sell us. When the U.S. sells corn to foreign countries, it counts in the net export
     category of GDP.

3.   The consumer price index (CPI) measures the overall level of prices in the economy. It tells us the
     price of a fixed basket of goods relative to the price of the same basket in the base year. The GDP
     deflator is the ratio of nominal GDP to real GDP in a given year. The GDP deflator measures the prices
     of all goods and services produced, whereas the CPI only measures prices of goods and services
     bought by consumers. The GDP deflator includes only domestically produced goods, whereas the CPI
     includes domestic and foreign goods bought by consumers. Finally, the CPI is a Laspeyres index that
     assigns fixed weights to the prices of different goods, whereas the GDP deflator is a Paasche index that
     assigns changing weights to the prices of different goods. In practice, the two price indices tend to
     move together and do not often diverge.

4.   The CPI measures the price of a fixed basket of goods relative to the price of the same basket in the
     base year. The PCE deflator is the ratio of nominal consumer spending to real consumer spending. The
     CPI and the PCE deflator are similar in that they both only include the prices of goods purchased by
     consumers, and they both include the price of imported goods as well as domestically produced goods.
     The two measures differ because the CPI measures the change in the price of a fixed basket whereas
     the goods measured by the PCE deflator change from year to year depending on what consumers are
     purchasing in that particular year.

5.   The Bureau of Labor Statistics (BLS) classifies each person into one of the following three categories:
     employed, unemployed, or not in the labor force. The unemployment rate, which is the percentage of
     the labor force that is unemployed, is computed as follows:

$$\text{Unemployment Rate} = \frac{\text{Number of Unemployed}}{\text{Labor Force}} \times 100.$$

     Note that the labor force is the number of people employed plus the number of people unemployed.

6.   Every month, the Bureau of Labor Statistics undertakes two surveys to measure employment. First, the
     BLS surveys about 60,000 households and thereby obtains an estimate of the share of people who say
     they are working. The BLS multiplies this share by an estimate of the population to estimate the
     number of people working. Second, the BLS surveys about 160,000 business establishments and asks
     how many people they employ. Each survey is imperfect; so the two measures of employment are not
     identical.

Problems and Applications

1. From the main bea.gov Web page click on the interactive data tab at the top, select GDP, begin using the data, section 1, and then table 1.1.1. Real GDP grew at a rate of 2.2 percent in quarter 4 of 2014. When compared to growth rates of −2.1 percent, 4.6 percent, and 5 percent for the first three quarters of 2014, the rate of 2.2 percent was slightly below average. From the main *bls.gov* Web page select the data tools tab, then top picks. Check the box for the unemployment rate and retrieve the data. The unemployment rate in March 2015 was 5.5 percent, which was about equal to the natural rate of unemployment, or the long run average rate. From the main bls.gov page, select the economic releases tab, then inflation and prices. Access the report for the CPI. In February 2015, the inflation rate for all items was 0 percent, and if food and energy were excluded the rate was 1.7 percent. The inflation rate was below average and below the Federal Reserve's target of 2 percent.

2. Value added by each person is equal to the value of the good produced minus the amount the person paid for the materials needed to make the good. Therefore, the value added by the farmer is $1.00 ($1 − 0 = $1). The value added by the miller is $2: she sells the flour to the baker for $3 but paid $1 for the flour. The value added by the baker is $3: she sells the bread to the engineer for $6 but paid the miller $3 for the flour. GDP is the total value added, or $1 + $2 + $3 = $6. Note that GDP equals the value of the final good (the bread).

3. When a woman marries her butler, GDP falls by the amount of the butler's salary. This happens because GDP measures total income, and therefore GDP, falls by the amount of the butler's loss in salary. If GDP truly measures the value of all goods and services, then the marriage would not affect GDP since the total amount of economic activity is unchanged. Actual GDP, however, is an imperfect measure of economic activity because the value of some goods and services is left out. Once the butler's work becomes part of his household chores, his services are no longer counted in GDP. As this example illustrates, GDP does not include the value of any output produced in the home.

4. a. The airplane sold to the U.S. Air Force counts as government purchases because the Air Force is part of the government.
   b. The airplane sold to American Airlines counts as investment because it is a capital good sold to a private firm.
   c. The airplane sold to Air France counts as an export because it is sold to a foreigner.
   d. The airplane sold to Amelia Earhart counts as consumption because it is sold to a private individual.
   e. The airplane built to be sold next year counts as investment. In particular, the airplane is counted as inventory investment, which is where goods that are produced in one year and sold in another year are counted.

5. Data on parts (a) to (f) can be downloaded from the Bureau of Economic Analysis. Go to the bea.gov Website, click on the interactive data tab at the top, select GDP, begin using the data, section 1, and then table 1.1.5. Choose the "modify the data" option to select the years you in which you are interested. By dividing each component (a) to (f) by nominal GDP and multiplying by 100, we obtain the following percentages:

	1950	1980	2014
a. Personal consumption expenditures	64.0%	61.3%	68.5%
b. Gross private domestic investment	18.8%	18.5%	16.4%
c. Government consumption purchases	16.9%	20.6%	18.2%
d. Net exports	0.2%	–0.5%	3.1%
e. National defense purchases	7.6%	6.3%	4.4%
f. Imports	3.9%	10.3%	16.5%

(Note: The above data was downloaded April 3, 2015, from the BEA Web site.)

Among other things, we observe the following trends in the economy over the period 1950–2015:
   a. Personal consumption expenditures have been around two-thirds of GDP between 1980 and 2015.
   b. The share of GDP going to gross private domestic investment remained fairly steady.

c. The share going to government consumption purchases rose sharply from 1950 to 1980.
d. Net exports, which were positive in 1950, have been negative since that time.
e. The share going to national defense purchases has fallen.
f. Imports have grown rapidly relative to GDP.

6. a. GDP measures the value of the final goods and services produced, or $1,000,000.
   b. NNP is equal to GNP minus depreciation. In this example, GDP is equal to GNP because there are no foreign transactions. Therefore, NNP is equal to $875,000.
   c. National income is equal to NNP, or $875,000.
   d. Employee compensation is equal to $600,000.
   e. Proprietors' income measures the income of the owner, and is equal to 150,000.
   f. Corporate profit is equal to corporate taxes plus dividends plus retained earnings, or $275,000. Retained earnings is calculated as sales minus wages minus dividends minus depreciation minus corporate tax, or $75,000.
   g. Personal income is equal to employee compensation plus dividends, or $750,000.
   h. Disposable personal income is personal income minus taxes, or $550,000.

7. a. i. Nominal GDP is the total value of goods and services measured at current prices. Therefore,

$$\text{Nominal GDP}_{2010} = \left(P^{2010}_{hotdogs} \times Q^{2010}_{hotdogs}\right) + \left(P^{2010}_{burgers} \times Q^{2010}_{burgers}\right)$$
$$= (\$2 \times 200) + (\$3 \times 200)$$
$$= \$400 + \$600$$
$$= \$1,000.$$

$$\text{Nominal GDP}_{2015} = \left(P^{2015}_{hotdogs} \times Q^{2015}_{hotdogs}\right) + \left(P^{2015}_{burgers} \times Q^{2015}_{burgers}\right)$$
$$= (\$4 \times 250) + (\$4 \times 500)$$
$$= \$1,000 + \$2,000$$
$$= \$3,000.$$

ii. Real GDP is the total value of goods and services measured at constant prices. Therefore, to calculate real GDP in 2015 (with base year 2010), multiply the quantities purchased in the year 2015 by the 2010 prices:

$$\text{Real GDP}_{2015} = \left(P^{2010}_{hotdogs} \times Q^{2015}_{hotdogs}\right) + \left(P^{2010}_{burgers} \times Q^{2015}_{burgers}\right)$$
$$= (\$2 \times 250) + (\$3 \times 500)$$
$$= \$500 + \$1,500$$
$$= \$2,000.$$

Real GDP for 2010 is calculated by multiplying the quantities in 2010 by the prices in 2010. Since the base year is 2010, real GDP$_{2010}$ equals nominal GDP$_{2010}$, which is $10,00. Hence, real GDP increased between 2010 and 2015.

iii. The implicit price deflator for GDP compares the current prices of all goods and services produced to the prices of the same goods and services in a base year. It is calculated as follows:

$$\text{Implicit Price Deflator}_{2015} = \frac{\textbf{Nominal GDP}_{2010}}{\textbf{Real GDP}_{2010}} = 1$$

Using the values for Nominal GDP$_{2015}$ and real GDP$_{2015}$ calculated above:

$$\text{Implicit Price Deflator}_{2015} = \frac{\$3,000}{\$2,000}$$

$$= 1.50.$$

This calculation reveals that prices of the goods produced in the year 2015 increased by 50 percent compared to the prices that the goods in the economy sold for in 2010. (Because 2010 is the base year, the value for the implicit price deflator for the year 2010 is 1.0 because nominal and real GDP are the same for the base year.)

iv. The consumer price index (CPI) measures the level of prices in the economy. The CPI is called a fixed-weight index because it uses a fixed basket of goods over time to weight prices. If the base year is 2010, the CPI in 2015 is measuring the cost of the basket in 2015 relative to the cost in 2010. The CPI_{2015} is calculated as follows:

$$CPI_{2015} = \frac{(P_{hotdogs}^{2015} \times Q_{hotdogs}^{2010}) + (P_{burgers}^{2015} \times Q_{burgers}^{2010})}{(P_{hotdogs}^{2010} \times Q_{hotdogs}^{2010}) + (P_{burgers}^{2010} \times Q_{burgers}^{2010})}$$

$$= \frac{\$16,000,000}{\$10,000,000}$$

$$= 1.6.$$

This calculation shows that the price of goods purchased in 2015 increased by 60 percent compared to the prices these goods would have sold for in 2010. The CPI for 2010, the base year, equals 1.0.

b. The implicit price deflator is a Paasche index because it is computed with a changing basket of goods; the CPI is a Laspeyres index because it is computed with a fixed basket of goods. From (7.a.iii), the implicit price deflator for the year 2015 is 1.50, which indicates that prices rose by 50 percent from what they were in the year 2010. From (7.a.iv.), the CPI for the year 2015 is 1.6, which indicates that prices rose by 60 percent from what they were in the year 2010.

If prices of all goods rose by, for example, 50 percent, then one could say unambiguously that the price level rose by 50 percent. Yet, in our example, relative prices have changed. The price of hot dogs rose by 1020 percent; the price of hamburgers rose by 33.33 percent, making hamburgers relatively less expensive.

As the discrepancy between the CPI and the implicit price deflator illustrates, the change in the price level depends on how the goods' prices are weighted. The CPI weights the price of goods by the quantities purchased in the year 2010. The implicit price deflator weights the price of goods by the quantities purchased in the year 2015. Since the quantity of the two goods was the same in 2010, the CPI is placing equal weight on the two price changes. In 2015, the quantity of hamburgers was twice as large as hot dogs, so there is twice as much weight placed on the hamburger price relative to the hot dog price. For this reason, the CPI shows a larger inflation rate – more weight is placed on the good with the larger price increase.

8. a. The consumer price index uses the consumption bundle in year 1 to figure out how much weight to put on the price of a given good:

$$CPI^2 = \frac{(\$2 \times 10) + (\$1 \times 0)}{(\$1 \times 10) + (\$2 \times 0)}$$

$$= \frac{(P_{red}^2 \times Q_{red}^1) + (P_{green}^2 \times Q_{green}^1)}{(P_{red}^1 \times Q_{red}^1) + (P_{green}^1 \times Q_{green}^1)}$$

$$= 2.$$

According to the CPI, prices have doubled.

b. Nominal spending is the total value of output produced in each year. In year 1 and year 2, Abby buys 10 apples for $1 each, so her nominal spending remains constant at $10. For example,

$$\text{Nominal Spending}_2 = \left(P^2_{red} \times Q^2_{red}\right) + \left(P^2_{green} \times Q^2_{green}\right)$$
$$= (\$2 \times 0) + (\$1 \times 10)$$
$$= \$10.$$

c. Real spending is the total value of output produced in each year valued at the prices prevailing in year 1. In year 1, the base year, her real spending equals her nominal spending of $10. In year 2, she consumes 10 green apples that are each valued at their year 1 price of $2, so her real spending is $20. That is,

$$\text{Real Spending}_2 = \left(P^1_{red} \times Q^2_{red}\right) + \left(P^1_{green} \times Q^2_{green}\right)$$
$$= (\$1 \times 0) + (\$2 \times 10)$$
$$= \$20.$$

Hence, Abby's real spending rises from $10 to $20.

d. The implicit price deflator is calculated by dividing Abby's nominal spending in year 2 by her real spending that year:

$$\text{Implicit Price Deflator}_2 = \frac{\text{Nominal Spending}_2}{\text{Real Spending}_2}$$
$$= \frac{\$10}{\$20}$$
$$= 0.5.$$

Thus, the implicit price deflator suggests that prices have fallen by half. The reason for this is that the deflator estimates how much Abby values her apples using prices prevailing in year 1. From this perspective green apples appear very valuable. In year 2, when Abby consumes 10 green apples, it appears that her consumption has increased because the deflator values green apples more highly than red apples. The only way she could still be spending $10 on a higher consumption bundle is if the price of the good she was consuming fell.

e. If Abby thinks of red apples and green apples as perfect substitutes, then the cost of living in this economy has not changed—in either year it costs $10 to consume 10 apples. According to the CPI, however, the cost of living has doubled. This is because the CPI only takes into account the fact that the red apple price has doubled; the CPI ignores the fall in the price of green apples because they were not in the consumption bundle in year 1. In contrast to the CPI, the implicit price deflator estimates the cost of living has been cut in half. Thus, the CPI, a Laspeyres index, overstates the increase in the cost of living and the deflator, a Paasche index, understates it.

9. a. The labor force includes full time workers, part time workers, those who run their own business, and those who do not have a job but are looking for a job. The labor force consists of 70 people. The working age population consists of the labor force plus those not in the labor force. The 10 discouraged workers and the 10 retired people are not in the labor force, but assuming they are capable of working, they are part of the adult population. The adult population consists of 90 people, so the labor force participation rate is equal to 70/90 or 77.8 percent.

b. The number of unemployed workers is equal to 10, so the unemployment rate is 10/70 or 14.3 percent.

c. The household survey estimates total employment by asking a sample of households about their employment status. The household survey would report 60 people employed. The establishment survey estimates total employment by asking a sample of businesses to report how many workers they are employing. In this case the establishment survey would report 55 people employed. The 5 people with 2 jobs would be counted twice, and the 10 people who run their own business would not be counted.

10. As Senator Robert Kennedy pointed out, GDP is an imperfect measure of economic performance or well-being. In addition to the left-out items that Kennedy cited, GDP also ignores the imputed rent on durable goods such as cars, refrigerators, and lawnmowers; many services and products produced as part of household activity, such as cooking and cleaning; and the value of goods produced and sold in illegal activities, such as the drug trade. These imperfections in the measurement of GDP do not necessarily reduce its usefulness. As long as these measurement problems stay constant over time, then GDP is useful in comparing economic activity from year to year. Moreover, a large GDP allows us to afford better medical care for our children, newer books for their education, and more toys for their play. Finally, countries with higher levels of GDP tend to have higher levels of life expectancy, better access to clean water and sanitation, and higher levels of education. GDP is therefore a useful measure for comparing the level of growth and development across countries.

11. a. Real GDP falls because Disney World does not produce any services while it is closed. This corresponds to a decrease in economic well-being because the income of workers and shareholders of Disney World falls (the income side of the national accounts), and people's consumption of Disney World falls (the expenditure side of the national accounts).

b. Real GDP rises because the original capital and labor in farm production now produce more wheat. This corresponds to an increase in the economic well-being of society, since people can now consume more wheat. (If people do not want to consume more wheat, then farmers and farmland can be shifted to producing other goods that society values.)

c. Real GDP falls because with fewer workers on the job, firms produce less. This accurately reflects a fall in economic well-being.

d. Real GDP falls because the firms that lay off workers produce less. This decreases economic well-being because workers' incomes fall (the income side), and there are fewer goods for people to buy (the expenditure side).

e. Real GDP is likely to fall, as firms shift toward production methods that produce fewer goods but emit less pollution. Economic well-being, however, may rise. The economy now produces less measured output but more clean air. Clean air is not traded in markets and, thus, does not show up in measured GDP, but is nevertheless a good that people value.

f. Real GDP rises because the high school students go from an activity in which they are not producing market goods and services to one in which they are. Economic well-being, however, may decrease. In ideal national accounts, attending school would show up as investment because it presumably increases the future productivity of the worker. Actual national accounts do not measure this type of investment. Note also that future GDP may be lower than it would be if the students stayed in school, since the future work force will be less educated.

g. Measured real GDP falls because fathers spend less time producing market goods and services. The actual production of goods and services need not have fallen because but unmeasured production of child-rearing services rises. The well-being of the average person may very well rise if we assume the fathers and the children enjoy the extra time they are spending together.

Answers to Textbook Questions and Problems

CHAPTER 3   National Income: Where It Comes From and Where It Goes

Questions for Review

1. The factors of production and the production technology determine the amount of output an economy can produce. The factors of production are the inputs used to produce goods and services: the most important factors are capital and labor. The production technology determines how much output can be produced from any given amounts of these inputs. An increase in one of the factors of production or an improvement in technology leads to an increase in the economy's output.

2. When a firm decides how much of a factor of production to hire or demand, it considers how this decision affects profits. For example, hiring an extra unit of labor increases output and therefore increases revenue; the firm compares this additional revenue to the additional cost from the higher wage bill. The additional revenue the firm receives depends on the marginal product of labor (MPL) and the price of the good produced (P). An additional unit of labor produces MPL units of additional output, which sells for P dollars per unit. Therefore, the additional revenue to the firm is $P \times MPL$. The cost of hiring the additional unit of labor is the wage W. Thus, this hiring decision has the following effect on profits:

$$\Delta\text{Profit} = \Delta\text{Revenue} - \Delta\text{Cost}$$

$$= (P \times MPL) - W.$$

If the additional revenue, $P \times MPL$, exceeds the cost (W) of hiring the additional unit of labor, then profit increases. The firm will hire labor until it is no longer profitable to do so—that is, until the MPL falls to the point where the change in profit is zero. In the equation above, the firm hires labor until $\Delta\text{Profit} = 0$, which is when $(P \times MPL) = W$.

This condition can be rewritten as:

$$MPL = W/P.$$

Therefore, a competitive profit-maximizing firm hires labor until the marginal product of labor equals the real wage. The same logic applies to the firm's decision regarding how much capital to hire: the firm will hire capital until the marginal product of capital equals the real rental price.

3. A production function has constant returns to scale if an equal percentage increase in all factors of production causes an increase in output of the same percentage. For example, if a firm increases its use of capital and labor by 50 percent, and output increases by 50 percent, then the production function has constant returns to scale.

    If the production function has constant returns to scale, then total income (or equivalently, total output) in an economy of competitive profit-maximizing firms is divided between the return to labor, $MPL \times L$, and the return to capital, $MPK \times K$. That is, under constant returns to scale, economic profit is zero.

4. A Cobb–Douglas production function has the form $F(K,L) = AK^\alpha L^{1-\alpha}$. The text showed that the parameter α gives capital's share of income. So if capital earns one-fourth of total income, then $\alpha = 0.25$. Hence, $F(K,L) = AK^{0.25}L^{0.75}$.

5. Consumption depends positively on disposable income—i.e. the amount of income after all taxes have been paid. Higher disposable income means higher consumption.

    The quantity of investment goods demanded depends negatively on the real interest rate. For an investment to be profitable, its return must be greater than its cost. Because the real interest rate measures the cost of funds, a higher real interest rate makes it more costly to invest, so the demand for investment goods falls.

6. Government purchases are a measure of the value of goods and services purchased directly by the government. For example, the government buys missiles and tanks, builds roads, and provides services such as air traffic control. All of these activities are part of GDP. Transfer payments are government payments to individuals that are not in exchange for goods or services. They are the opposite of taxes: taxes reduce household disposable income, whereas transfer payments increase it. Examples of transfer payments include Social Security payments to the elderly, unemployment insurance, and veterans' benefits.

7. Consumption, investment, and government purchases determine demand for the economy's output, whereas the factors of production and the production function determine the supply of output. The real interest rate adjusts to ensure that the demand for the economy's goods equals the supply. At the equilibrium interest rate, the demand for goods and services equals the supply.

8. When the government increases taxes, disposable income falls, and therefore consumption falls as well. The decrease in consumption equals the amount that taxes increase multiplied by the marginal propensity to consume (*MPC*). The higher the *MPC* is, the greater is the negative effect of the tax increase on consumption. Because output is fixed by the factors of production and the production technology, and government purchases have not changed, the decrease in consumption must be offset by an increase in investment. For investment to rise, the real interest rate must fall. Therefore, a tax increase leads to a decrease in consumption, an increase in investment, and a fall in the real interest rate.

Problems and Applications

1. a. According to the neoclassical theory of distribution, the real wage equals the marginal product of labor. Because of diminishing returns to labor, an increase in the labor force causes the marginal product of labor to fall. Hence, the real wage falls.
   Given a Cobb–Douglas production function, the increase in the labor force will increase the marginal product of capital and will increase the real rental price of capital. With more workers, the capital will be used more intensively and will be more productive.

   b. The real rental price equals the marginal product of capital. If an earthquake destroys some of the capital stock (yet miraculously does not kill anyone and lower the labor force), the marginal product of capital rises and, hence, the real rental price rises.
   Given a Cobb–Douglas production function, the decrease in the capital stock will decrease the marginal product of labor and will decrease the real wage. With less capital, each worker becomes less productive.

   c. If a technological advance improves the production function, this is likely to increase the marginal products of both capital and labor. Hence, the real wage and the real rental price both increase.

   d. High inflation that doubles the nominal wage and the price level will have no impact on the real wage. Similarly, high inflation that doubles the nominal rental price of capital and the price level will have no impact on the real rental price of capital.

2. a. To find the amount of output produced, substitute the given values for labor and land into the production function:
$$Y = 100^{0.5}100^{0.5} = 100.$$

   b. According to the text, the formulas for the marginal product of labor and the marginal product of capital (land) are:

$$MPL = (1 - \alpha)AK^{\alpha}L^{-\alpha}.$$

$$MPK = \alpha AK^{\alpha-1}L^{1-\alpha}.$$