Long-Run Economic Growth: Sources and Policies

Chapter Summary

In the long run, a country will experience an increasing standard of living only if it experiences continuing technological change. This chapter looks at differences in economic growth rates over time and between countries. Because of diminishing returns to capital, sustained growth can only occur with technological change, which allows the economy to produce more output with the same quantities of inputs.

Until around the year 1300 A.D., most people survived with barely enough food. Living standards began to rise significantly only after the **Industrial Revolution** began in England in the 1700s with the application of mechanical power to the production of goods. The best measure of a country's standard of living is its level of real GDP per capita.

An **economic growth model** explains changes in real GDP per capita in the long run. **Labor productivity** is the quantity of goods and services that can be produced by one worker or by one hour of work. Economic growth depends on increases in labor productivity. **Technological change** is a change in the ability of a firm to produce a given level of output with a given quantity of inputs. There are three main sources of technological change: better machinery and equipment, increases in human capital, and better means of organizing and managing production. **Human capital** is the accumulated knowledge and skills that workers acquire from education and training or from their life experiences. **The per-worker production function** shows the relationship between capital per hour worked and output per hour worked, holding technology constant. *Diminishing returns to capital* means that increases in the quantity of capital per hour worked will result in diminishing increases in output per hour worked.

Technological change shifts up the per-worker production function, resulting in more output per hour worked at every level of capital per hour worked. The economic growth model stresses the importance of changes in capital per hour worked and technological change in explaining growth in output per hour worked. *New growth theory* is a model of long-run economic growth that emphasizes that technological change is influenced by how individuals and firms respond to economic incentives. One way governments can promote technological change is by granting **patents**, which are exclusive rights to a product for a period of 20 years from the date the product is invented.

The economic growth model predicts that poor countries will grow faster than rich countries, resulting in **catch-up**. In recent decades, some poor countries have grown faster than rich countries, but many have not. Some poor countries do not experience rapid growth for four main reasons: wars and revolutions, poor public education and health, failure to enforce the rule of law, and low rates of saving and investment. The **rule of law** refers to the ability of a government to enforce the laws of the country, particularly with respect to protecting private property and enforcing contracts. **Globalization** has aided

countries that have opened their economies to foreign trade and investment. **Foreign direct investment (FDI)** is the purchase or building by a corporation of a facility in a foreign country. **Foreign portfolio investment** is the purchase by an individual or firm of stock or bonds issued in another country.

Learning Objectives

When you finish this chapter, you should be able to:

1. **Define economic growth, calculate economic growth rates, and describe global trends in economic growth.** Until 1300 A.D. most people survived with barely enough to eat. Living standards began to rise significantly only after the **Industrial Revolution** began in England in the 1700s. The best measure of a country's standard of living is its level of real GDP per capita (real GDP per capita means the same thing as real GDP per person). Economic growth occurs when real GDP per capita increases, thereby increasing the country's standard of living.

2. **Use the economic growth model to explain why growth rates differ across countries**. **Labor productivity** is the quantity of goods and services that can be produced by one worker or by one hour of work. Economic growth depends on increases in labor productivity. Labor productivity will increase if there is an increase in the amount of capital available to each worker and if there is a change in technology. There are three main sources of change in technology:

   ▪ better machinery and equipment,
   ▪ increases in **human capital** (accumulated knowledge and skills), and
   ▪ better means of organizing and managing production.

   To sum up, we can say: An economy will have a higher standard of living the more capital it has per hour worked, the more human capital its workers have, the better its capital, and the better the job its business managers do in organizing production. The **per-worker production function** shows the relationship between capital per hour worked and output per hour worked, holding technology constant. Diminishing returns to capital mean that increases in the quantity of capital per hour worked will result in diminishing increases in output per hour worked. Technological change shifts up the per-worker production function, resulting in more output per hour worked at every level of capital per hour worked. The economic growth model stresses the importance of changes in capital per hour worked and technological change in explaining growth in output per hour worked. New growth theory, as first developed by Paul Romer, is a model of long-run economic growth that emphasizes the way technological change is influenced by economic incentives, and so is determined by the working of the market system. To Joseph Schumpeter, the entrepreneur is central to the "creative destruction" by which the standard of living increases as qualitatively better products replace existing products.

3. **Discuss fluctuations in productivity growth in the United States.** Productivity in the United States grew rapidly from the end of World War II until the mid 1970s. Growth then slowed down for 20 years before increasing again after 1995. Economists continue to debate the reasons for the growth slowdown of the mid-1970s to mid-1990s. Possible explanations for the productivity slowdown are: measurement problems, high oil prices, and a decline in labor quality. Because Western Europe and Japan experienced a productivity slowdown at the same time as the United States, explanations that focus on factors affecting only the United States are unlikely to be correct. Some economists argue that the faster growth in productivity beginning in the mid-1990s reflects the development of a New Economy based on information technology. In the period since the mid-1990's, growth in the United States has been significantly higher than in other leading industrial nations. Many economists believe

that this is due to the greater flexibility in U.S. labor markets and the greater efficiency of the U.S. financial system.

4. **Explain economic catch-up and discuss why many poor countries have not experienced rapid economic growth.** The economic growth model predicts that poor countries will grow faster than rich countries, resulting in **catch-up**. In recent decades, some poor countries have grown faster than rich countries, but many have not. Four main reasons have been offered to explain why some poor countries do not experience rapid growth:

   ▪ wars and revolutions,
   ▪ poor public education and health,
   ▪ failure to enforce the rule of law, and
   ▪ low rates of saving and investment.

   Globalization has aided countries that have opened their economies to foreign trade and investment.

5. **Discuss government policies that foster economic growth.** Governments can attempt to increase economic growth through policies that enhance property rights and the rule of law, improve health and education, subsidize research and development, and provide incentives for saving and investment. Whether continued economic growth is desirable is a normative question that cannot be settled by economic analysis.

Chapter Review

Chapter Opener: MySpace Meets the Chinese Economic Miracle (pages 308-309)

MySpace.com has been expanding rapidly into international markets, including China. To protect its investment and to maintain the legality of its operations in China, MySpace has had to search for a Chinese partner to deal with the government regulation of the internet in China. China is not a democracy and the Chinese government still intervenes in the economy in sometimes arbitrary ways. China's lack of a well-established rule of law may make it difficult for the country to sustain the high levels of entrepreneurial activity that have been the key to its recent rapid growth.

📖 Helpful Study Hint

Read *An Inside Look* at the end of the chapter for a news article from *The Economist* on why Europe's economy has been unable to grow at rates similar to those of the United States. The article cites lack of innovation as the key reason.

Would you be better off without China? *Economics in YOUR Life!* at the start of this chapter poses this question. Keep the question in mind as you read the chapter. The authors will answer the question at the end of the chapter.

10.1 Economic Growth Over Time and Around the World (pages 310–314)

Learning Objective 1   Define economic growth, calculate growth rates, and describe global trends in economic growth.

There was not any significant economic growth in the world until the Industrial Revolution, which started in England around the year 1750. Estimates suggest that growth averaged about 0.2 percent per year in the 500 years before the Industrial Revolution and averaged about 1.3 percent per year in the 100 years after the Industrial Revolution. The Industrial Revolution probably started in England because of political changes that gave entrepreneurs the incentive to invest in the important technological inventions of the time, such as the steam engine.

The rate of economic growth is important because increasing growth rates allow for higher standards of living, which bring not only larger selections of goods but also health and education. Over long periods of time, small differences in economic growth rates have large effects, because compounding magnifies the effects of even slightly higher economic growth rates.

We can divide the world's countries into two groups, higher income countries, sometimes called industrial countries and poorer countries, sometimes called developing countries. In 2006, per capita GDP ranged from $68,000 in Luxembourg to only $600 in Somalia.

📖 Helpful Study Hint

You have probably read about the Industrial Revolution in some of your other classes. Read ***Making the Connection: Why Did the Industrial Revolution Begin in England?*** For an economic perspective on the reasons the revolution took root in England rather than in another country, such as China or India.

As a result of the Glorious Revolution of 1668, the British Parliament, rather than the king, controlled the British government. The British court system was also independent of the king. As a result, the British government was able to credibly commit to upholding private property rights, protecting wealth, and eliminating arbitrary increases in taxes. These institutional changes gave entrepreneurs the incentive to make the investments necessary to use the important technological developments of the second half of the eighteenth century—particularly the spinning jenny and the water frame, which were used in the production of cotton textiles, and the steam engine, which was used in mining and in the manufacture of textiles and other products.

You probably own many items that are stamped with "Made in China." So, you may be surprised to learn that the standard of living in China has not kept pace with that of Japan. Why not? For an answer, read ***Making the Connection: The Benefits of an Earlier Start: Standards of Living in China and Japan***. During the time period 1950-1978, the economic growth rate in Japan was large compared to the economic growth rate in China. More recently, in the 1996-2006 time

period, the growth rate pattern has reversed with China growing at an average annual rate of 9.1 percent, while the growth rate for Japan has been 2.1 percent. Despite China's stronger growth rate, China has still not caught up with Japan. Japanese real GDP per capita is four times the amount in China, and Japan has longer life expectancy, lower infant mortality rate, and higher percentages of the population with access to treated water and improved sanitation.

When economists talk about growth rates over periods of more than one year, they are talking about *average* annual growth rates, not total percentage changes. Read ***Don't Let This Happen To You: Don't Confuse the Average Annual Percentage Change with the Total Percentage Change***. Between 1950 and 2006, real GDP per capita in the United States increased by a total of 224 percent, but the average increase per year was 2.1 percent.

Extra Solved Problem 10-1

Chapter 10 of the textbook includes two Solved Problems. Here is an extra Solved Problem to help you build your skills solving economic problems:

Economic Growth Rates

Supports Learning Objective 1: Define economic growth, calculate economic growth rates, and describe global trends in economic growth.

The table below has data on per capita real GDP for three Western European countries (in U.S. Dollars):

Year	France	Spain	United Kingdom
2000	$27,522	$22,599	$27,946
2001	27,835	23,045	28,494
2002	27,922	23,221	28,978
2003	28,032	23,549	29,634
2004	28,539	23,925	30,458
2005	28,855	24,349	30,853
2006	29,253	24,948	31,618

For each of these countries, calculate the average growth rate over this time period.

SOLVING THE PROBLEM

Step 1:   Review the chapter material.
This problem is about computing economic growth rates, so you may want to review the section "Economic Growth Over Time and Around the World," which begins on page 310 in the textbook.

Step 2: **Calculate average growth rate.**
The total growth rates for the whole period from 2000 to 2006 would be computed as:

$$\text{Growth rate } = \frac{\text{Per capita GDP in 2006} - \text{Per capita GDP in 2000}}{\text{Per capita GDP in 2000}} \times 100$$

But we are interested in the average annual growth rate, which means we have to compute the growth each year and then average the values we obtain. For instance, to compute the average growth rate for the year 2001, we need to compute the percentage change in per capita GDP from 2000 to 2001:

$$\text{Growth rate in 2001 } = \frac{\text{Per capita GDP in 2001} - \text{Per capita GDP in 2000}}{\text{Per capita GDP in 2000}} \times 100$$

For France, this value is:

$$\text{Growth rate in 2001 } = \left(\frac{\$27,835 - \$27,522}{\$27,522} \right) \times 100 = 1.14\%.$$

The values for each country and each year are in the table below. The average annual growth rates are the averages of the growth rates for these years. For instance, for Spain the average annual growth rate is:

$$\frac{1.97\% + 0.76\% + 1.41\% + 1.60\% + 1.77\% + 2.46\%}{6} = 1.66\%.$$

Year	France		Spain		United Kingdom	
	GDP per capita	Growth rate	GDP per capita	Growth rate	GDP per capita	Growth rate
2000	$27,522	–	$22,599	–	$27,946	-
2001	27,835	1.14%	23,045	1.97%	28,494	1.96%
2002	27,922	0.31	23,221	0.76	28,978	1.70
2003	28,032	0.39	23,549	1.41	29,634	2.26
2004	28,539	1.81	23,925	1.60	30,458	2.78
2005	28,855	1.11	24,349	1.77	30,853	1.30
2006	29,253	1.38	24,948	2.46	31,618	2.48
Average annual growth rate		1.02%		1.66%		2.08%

10.2 What Determines How Fast Economies Grow? (pages 315–321)

Learning Objective 2 Use the economic growth model to explain why growth rates differ across countries.

An **economic growth model** explains growth rates in real GDP per capita. Growth requires that the average worker produce more goods per time period. By definition, this means **labor productivity** increases over time. Labor productivity grows with increases in the quantity of capital per worker and with **technological change.** Technological change occurs through better machinery and equipment, increases in human capital, and better means of organizing production. The **per-worker production function** exhibits diminishing returns to capital as long as technology does not change. Diminishing returns to capital are illustrated in textbook Figure 10-3.

Increases in the capital-labor ratio, given the level of technology, will result in increases in output per worker. However, because of diminishing returns to capital, as the capital-labor ratio grows, the size of the increases in output per worker will get smaller. Long-term economic growth requires more than just growth in capital. It also needs technological change. Technological change shifts up the per-worker production function, resulting in more output with the same level of resources. Shifts in the per-worker production function are due to technological changes, as shown in Figure 10-4 in the textbook.

📖 Helpful Study Hint

Changes in capita per worker cause movements along a single per-worker production function, while changes in technology cause shifts in the per-worker production function. An upward shift in the production function means that the economy can produce more with the same level of capital per worker.

Over time, living standards can increase only if a country experiences continual technological change. Paul Romer, an economist at Stanford University, argues that technological change is influenced by economic incentives. Romer's approach is referred to as the **new growth theory**. In this theory, the accumulation of knowledge capital is a key determinant of economic growth because knowledge capital is subject to increasing returns. This is true because once discovered, knowledge becomes available to everyone. Government policy can help increase the accumulation of knowledge capital by protecting intellectual property rights with patents and copyrights, subsidizing research and development, and subsidizing education.

📖 Helpful Study Hint

From 1917-1991, the Soviet Union was a centrally planned economy. The government decided what goods to produce, how to produce them, and who would receive them. To learn the details of why that country's system failed, read ***Making the Connection: Why did the Soviet Union's Economy Fail?*** A crucial requirement for growth is implementing new technologies. In a centrally planned economy, the people in charge of running most businesses are government employees and not entrepreneurs or independent business people, as is the case in market

economies. Soviet managers had little incentive to adopt new ways of doing things. Their pay depended on producing the quantity of output specified in the government's economic plan, not on discovering new, better, and lower-cost ways to produce goods.

10.3 Economic Growth in the United States (pages 322–326)

Learning Objective 3   Discuss fluctuations in productivity growth in the United States.

Economic growth rates in the United States have varied over time. From 1950 to 1973, real GDP per hour worked grew at an annual rate of 2.6 percent. Growth then slowed to 1.3 percent per year during the period from 1973 until 1995. This slowdown in productivity growth is usually linked to measurement problems caused by the increase in the service sector of the economy and difficulties measuring increases in safety and environmental improvements, the rapid increase in oil prices, and the mismatch of worker skills with the increase in the number of jobs requiring greater technical training. Growth rates since 1995 have increased, partly due to the use of computers and information technology in the workplace. Growth rates in the United States have been faster than in other countries since 1995 probably because of the flexibility of U.S. labor markets and the greater efficiency of the U.S. financial system.

📖 Helpful Study Hint

Remember, as we saw in Chapter 9, the financial system is where the funds of savers are loaned to borrowers. This process allows loanable funds to flow from households to firms that use the funds for new investment projects.

Extra Solved Problem **10-3**

Chapter 10 of the textbook includes two Solved Problems. Here is an extra Solved Problem to help you build your skills solving economic problems:

Output and Productivity Growth Rates

Supports Learning Objective 3: Discuss fluctuations in productivity growth in the United States.

The Bureau of Labor Statistics collects data on U.S. productivity. The table below lists an index of total manufacturing output and an index of manufacturing output per hour worked, which is a measure of productivity in the manufacturing sector. The base year for both indexes is 1992 (in other words, the level of manufacturing output and manufacturing output per hour worked for 1992 are both set equal to 100). Consequently, a value of 128.6 (as in manufacturing output for 1997) indicates that the value of output in 1997 was 1.286 times the value of output in 1992, or that output has increased by 28.6 percent since1992. Calculate the average annual growth rate in output and in output per hour worked for this period from 1998 to 2006. Are the growth rates for the two indexes the same? If they are different, what are the implications of the difference?

Year	Index of manufacturing output	Index of manufacturing output per hour worked
1997	128.6	121.3
1998	135.2	127.9
1999	140.3	133.5
2000	144.2	138.9
2001	136.8	141.1
2002	135.9	150.8
2003	137.3	160.1
2004	139.7	163.5
2005	144.6	171.3
2006	151.7	178.2

SOLVING THE PROBLEM

Step 1: **Review the chapter material.**
This problem is about growth in productivity, so you may want to review the section "Economic Growth in the United States," which begins on page 322.

Step 2: **Calculate the growth rates.**
You can calculate the growth rates using the following equation:

$$\text{Growth rate in 1998} = \left(\frac{\text{Value in 1998} - \text{Value in 1997}}{\text{Value in 1997}} \right) \times 100.$$

Using this formula for both columns of data gives us:

Year	Index of manufacturing output	Growth rate of manufacturing output	Index of manufacturing output per hour worked	Growth rate of manufacturing output per hour worked
1997	128.6	–	121.3	–
1998	135.2	5.1%	127.9	5.4%
1999	140.3	3.8	133.5	4.4
2000	144.2	2.8	138.9	4.0
2001	136.8	−5.1	141.1	1.6
2002	135.9	−0.7	150.8	6.9
2003	137.3	1.0	160.1	6.2
2004	139.7	1.7	163.5	2.1
2005	144.6	3.5	171.3	4.8
2006	151.7	4.9	178.2	4.0
Average annual growth rate, 1998-2006		1.9%		4.4%

Step 3: **Discuss why the growth rates are different.**
The average annual growth rate in manufacturing output is 1.9%, while the average annual growth in manufacturing output per worker is 4.4%. How is it possible for output per hour worked to increase at a faster rate than total output? This can only happen if the number of hours worked in manufacturing has decreased during this period.

10.4 LEARNING OBJECTIVE

10.4 Why Isn't the Whole World Rich? (pages 327–334)

Learning Objective 4 Explain economic catch-up and discuss why many poor countries have not experienced rapid economic growth.

The economic growth model tells us that economies grow when the quantity of capital per hour worked increases and when technological change takes place. Growth in capital and technology will have their biggest payoffs in poorer economies. This suggests that poorer countries should grow faster than rich countries. The prediction that poorer countries should grow faster than rich countries is called **catch-up** or **convergence**. The growth data suggests that convergence applies to some, but not all, countries. Economists have suggested several reasons why a number of low income countries have not experienced rapid growth:

  ▪ A legal system that does not enforce contracts and protect property rights. In other words, some countries have failed to establish the "rule of law."
  ▪ Wars and revolutions.

- ▪ Poor public education and health.
- ▪ Low levels of saving and investment.

Globalization, the process of countries becoming more open to foreign trade and investment, can help poorer countries that have low levels of domestic saving and investment and that lack access to the latest technologies. Foreign direct investment (FDI) occurs when firms build or purchase facilities in foreign countries. This inflow of capital can help speed development. Foreign portfolio investment occurs when individuals buy stock or bonds issued in other countries. This access to new capital can also speed growth. The process of globalization can help countries deal with the problem of low saving and investment.

10.5 LEARNING OBJECTIVE

10.5 Growth Policies (pages 334–336)

Learning Objective 5 Discuss government policies that foster economic growth.

Governments can do many things to help promote long-run economic growth. Policies that help enforce property rights and reduce corruption will encourage investment and contribute to economic growth. Policies that support health and education lead to increases in productivity and higher levels of growth. Policies that encourage technological innovation, such as subsidizing research and development or encouraging direct foreign investment, will also increase growth. Policies that encourage saving generate more funds for financing investment and will also encourage growth.

Extra Solved Problem 10-5

Chapter 10 of the textbook includes two Solved Problems. Here is an extra Solved Problem to help you build your skills solving economic problems:

Investment Tax Credits

Supports Learning Objective 5: Discuss government policies that foster economic growth.

The government can increase the incentive for firms to acquire physical capital through investment tax credits. An investment tax credit allows firms to deduct from their taxes some fraction of the funds they have spent on investment goods. The reduction in the taxes that firms pay increases their after-tax profits, thereby increasing their incentive to invest in new factories, offices, and machines. There are two ways that an investment tax credit can affect growth in the economy. Use separate per-worker production function graphs to illustrate each way the investment tax credit can affect economic growth.

Step 1: **Review the chapter material.**
This problem is about government policies to foster economic growth, so you may want to review the section "Policies with Respect to Saving and Investment," which begins on page 336 in the textbook.

Step 2: **Draw two per-worker production function graphs to illustrate the effects of the investment tax credit.**
As firms increase investment spending as a result of the investment tax credit, the capital stock will also increase. If the new capital has the same technology as the existing capital

stock, then the level of technology will not change. In this case, the new capital will increase the ratio of capital to labor and cause a movement along the per-worker production function. You can illustrate this with the graph below as a movement from point A to point B.
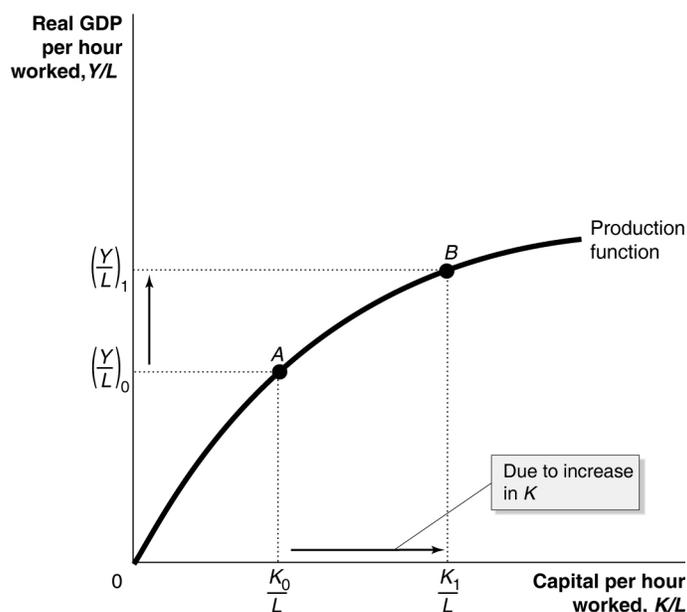
Notice that at point B, the increases in capital as a result of the new investment will result in more production as real GDP per hour worked increases.

If the new capital causes a change in the level of technology, then the new capital will also cause the production function to shift upward. So, the investment tax credit will cause both a movement along the per-worker production function and an upward shift as the level of technology changes. You can illustrate this with the graph below as a movement from point A to point B:
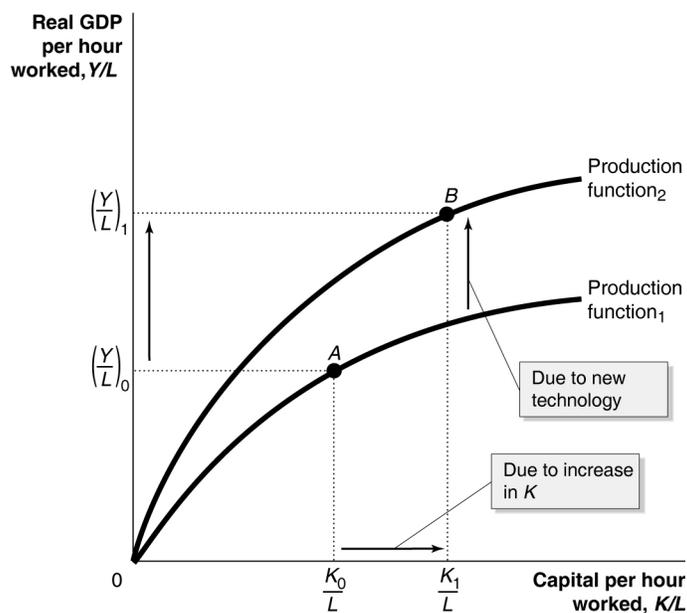
📖 Helpful Study Hint

You have probably read news stories or had class discussions about globalization. Read ***Making the Connection: Globalization and the Spread of Technology in Bangladesh***. Clothing manufacturing began in Bangladesh in 1980 when Noorul Quader started Desh Garments. To obtain critical training for his employees, Quader reached an agreement with Daewoo Corporation in South Korea. Under their agreement, Quader was responsible for running the Bangladesh clothing factory, while Daewoo would train 130 workers in the Daewoo plants in Korea. As a result of this training, shirt production rose from 43,000 shirts in 1980 to 2.3 million shirts by 1987.

📖 Helpful Study Hint

At the start of the chapter, the ***Economics in YOUR Life!*** feature asked if you would choose to live in a world with the Chinese economy very poor and growing slowly (as it was before 1978) or a world where the Chinese economy is growing very rapidly (as it is today). The rapid economic growth that has enabled Chinese firms to be competitive with firms in the United States has been a benefit to you as a consumer; you have lower-priced goods and better goods available to buy than you would if China had remained very poor.

Key Terms

Catch-up. The prediction that the level of GDP per capita (or income per capita) in poor countries will grow faster than in rich countries.

Economic growth model. A model that explains changes in real GDP per capita in the long run.

Foreign direct investment (FDI). The purchase or construction of a facility by a corporation in a foreign country.

Foreign portfolio investment. The purchase by an individual or firm of stock or bonds issued in another country.

Globalization. The process of countries becoming more open to foreign trade and investment.

Human capital. The accumulated knowledge and skills that workers acquire from education and training or from their life experiences.

Industrial Revolution. The application of mechanical power to the production of goods, beginning in England around 1750.

Labor productivity. The quantity of goods and services that can be produced by one worker or by one hour of work.

New growth theory. A model of long-run economic growth that emphasizes that technological change is influenced by economic incentives, and so is determined by the working of the market system.

Patent. The exclusive right to a product for a period of 20 years from the date the product was invented.

Per-worker production function. The relationship between real GDP, or output, per hour worked and capital per hour worked, holding the level of technology constant.

Property rights. The rights individuals or firms have to the exclusive use of their property, including the right to buy or sell it.

Rule of law. The ability of a government to enforce the laws of the country, particularly with respect to protecting private property and enforcing contracts.

Technological change. Change in the quantity of output that a firm can produce from a given quantity of inputs.

Self-Test

(Answers are provided at the end of the Self-Test.)

Multiple-Choice Questions

1. What is the best measure we have of a country's standard of living?
    a. the unemployment rate
    b. nominal GDP per capita
    c. real GDP per capita
    d. the inflation rate

2. Which of the following marks the beginning of significant economic growth in the world economy?
    a. the victory of Mao Zedong and the Communist Party in China in 1949
    b. the American Revolution of 1776
    c. the Industrial Revolution in England
    d. the Bolshevik Revolution

3. Which of these institutional changes gave entrepreneurs the incentive to make the investments necessary for technological development in the second half of the eighteenth century in England?
    a. upholding private property rights
    b. protecting wealth
    c. eliminating arbitrary increases in taxes
    d. all of the above

4. The process known as *compounding* does which of the following?
    a. It minimizes the differences in interest rates or growth rates over short periods of time.
    b. It magnifies even small differences in interest rates or growth rates over long periods of time.
    c. It highlights the social characteristics necessary for economic growth to occur.
    d. It magnifies the importance of the effect of inflation on increases in the standard of living of the typical person.

5. In the 1980s and 1990s, a small group of countries experienced high rates of growth. These countries
   are sometimes referred to as the *newly industrializing countries*. Where are they located?
   a. in East Asia
   b. in Africa
   c. in Latin America
   d. in Western Europe

6. What is the economic growth model?
   a. a model that explains trends in labor productivity
   b. a model that explains changes in real GDP per capita in the long run
   c. a model that explains how the interaction of inflation and unemployment accounts for most
      economic growth
   d. a model that explains why economic fluctuations and the business cycle occur

7. Which of the following are the two key factors that determine labor productivity?
   a. economic growth and real GDP per capita
   b. the amount of land and capital available in a country
   c. government policies that promote household consumption
   d. the quantity of capital per hour worked and the level of technology

8. Better machinery and equipment, increases in human capital, and better means of organizing and
   managing production are the three main sources of
   a. rising unemployment.
   b. increases in capital per hour worked.
   c. technological change.
   d. increases in inflation.

9. The accumulated knowledge and skills that workers acquire from education, training, and their life
   experiences are called
   a. labor productivity.
   b. technical knowledge.
   c. physical capital.
   d. human capital.

10. What is the name given to the relationship between real GDP per hour worked and capital per hour
    worked, holding the level of technology constant?
    a. the output growth function
    b. the capital-labor function
    c. the per-worker production function
    d. the production possibilities frontier

11. Along the per-worker production function, what happens to real GDP per hour worked as capital per
    hour worked increases?
    a. Real GDP per hour worked increases at an increasing rate.
    b. Real GDP per hour worked increases at a decreasing rate.
    c. Real GDP per hour worked decreases at an increasing rate.
    d. Real GDP per hour worked decreases at a decreasing rate.

12. The law of diminishing returns states that as we add more of one input to a fixed quantity of another input, output increases by smaller additional amounts. In the case of the per-worker production function, which input is the fixed input, and which one is the variable input?
    a.   Capital is the fixed input and labor is the variable input.
    b.   Capital is the variable input and labor is the fixed input.
    c.   Capital is the variable input and real GDP is the fixed input.
    d.   Real GDP is the variable input and capital is the fixed input.

13. The *per-worker production function* exhibits
    a.   diminishing returns to labor.
    b.   diminishing returns to capital.
    c.   diminishing returns to real GDP per capita.
    d.   all of the above

14. The per-worker production function
    a.   shows that equal increases in capital per worker cause equal increases in output per hour worked.
    b.   shifts up with increases in labor hours worked.
    c.   shifts up with increases in technology.
    d.   shifts up with increases in capital at a given level of technology.

15. A movement along the per-worker production function is *not* caused by
    a.   an increase in technology.
    b.   an increase in capital at a given level of technology.
    c.   an increase in hours worked per worker.
    d.   an increase in the number of workers.

16. What is the impact of technological change on the per-worker production function?
    a.   As technological change occurs, the economy moves from one point to another along the per-worker production function.
    b.   Technological change shifts the per-worker production function up.
    c.   Technological change does not affect the per-worker production function.
    d.   Technological change may or may not affect the per worker production function depending on how it affects the quantity of capital per worker.

17. In the long run, a country will experience an increasing standard of living only if
    a.   the country's labor force increases.
    b.   the country's capital stock increases.
    c.   the country experiences continuing technological change.
    d.   all of the above

18. In which economies is there a greater incentive for technological change?
    a.   in centrally planned economies
    b.   in market economies
    c.   in countries with high inflation rates
    d.   in countries that lack patent laws

19. Which of the following is known as the *new growth theory*?
    a. a growth model that focuses on growth in the ratio of capital to labor as the key factor in explaining long-run growth in real GDP per capita
    b. the economic growth model that was first developed in the 1950s by Robert Solow, an economist at MIT and winner of the Nobel Prize in Economics
    c. a model of long-run economic growth that emphasizes that technological change is influenced by economic incentives
    d. a model of long-run economic growth that emphasizes that increases in technology are difficult to explain

20. When are additions of knowledge capital subject to diminishing returns?
    a. when they are made at the firm level
    b. when they apply to the economy as a whole
    c. when those additions don't contribute to economic growth
    d. when the additions are due to improved education for workers

21. Which of the following is *not* a government policy that will increase the accumulation of knowledge capital?
    a. encouraging the growth of labor unions
    b. subsidizing research and development
    c. protecting intellectual property with patents and copyrights
    d. subsidizing education

22. Which of the following is nonrival and nonexcludable?
    a. labor hired by a firm
    b. a prescription drug purchased by a consumer
    c. the use of physical capital
    d. the use of knowledge capital that is not protected by a patent or copyright

23. In which case are firms more likely to try to be *free riders*?
    a. in using physical capital owned by other firms
    b. in using labor hired by other firms
    c. in using the research and development of other firms
    d. in paying taxes

24. How can government policy help increase the accumulation of knowledge capital and bring it closer to the optimal level?
    a. by protecting intellectual property with patents and copyrights
    b. by subsidizing research and development
    c. by subsidizing education
    d. all of the above

25. According to Joseph Schumpeter, which of the following provides the most important incentive for bringing the factors of production together to start new firms and to introduce new goods and services?
    a. the accumulation of knowledge capital
    b. government policies that help to increase the accumulation of physical capital
    c. the profits entrepreneurs hope to earn
    d. the existence of export markets

26. Which of the following periods in U.S. economic history had the slowest growth rate, as measured by the average annual increase in real GDP per hour worked?
    a. 1900-1950
    b. 1950-1973
    c. 1973-1995
    d. 1995-2004

27. Which of the following are explanations that have been offered for the productivity slowdown of the mid-1970s to mid-1990s?
    a. measurement problems
    b. high oil prices
    c. a decline in labor quality
    d. all of the above

28. According to economists, a major factor in the faster growth in productivity beginning in the mid-1990s was
    a. the fact that services, such as haircuts and financial advice, became a larger fraction of GDP and goods.
    b. oil price increases.
    c. the increasing skill and training of workers.
    d. the development of a "new economy" based on information technology.

29. Why has productivity growth in the United States over the last ten years been more rapid than in the other industrialized countries?
    a. because of the greater flexibility of U.S. labor markets and the greater efficiency of the U.S. financial system
    b. because the U.S. government has more restrictive regulations that make the labor and output markets more efficient
    c. because the opportunity cost of being unemployed is lower in the United States than in these other countries
    d. all of the above

30. In comparing growth rates across countries, the economic growth model predicts that
    a. richer countries will grow faster than poorer countries.
    b. poorer countries will grow faster than richer countries.
    c. richer and poorer countries will have the same growth rates.
    d. there is no consistent relationship between the level of per capita GDP and economic growth.

31. In the United States, what is a key source of funds for start-up firms bringing new technologies to market?
    a. loans from commercial banks and other financial institutions
    b. the sale of stock
    c. the sale of bonds
    d. funding from venture capital firms

32. Catch-up, or convergence, is the prediction that the level of GDP per capita (or income per person) in poor countries will
    a. grow faster than in rich countries.
    b. grow slower than in rich countries.
    c. grow at the same pace as the growth in rich countries.
    d. grow at the same rate as the growth rate of capital per hour worked.

33. Which of the following statements about catch-up is correct?
    a. The lower-income industrial countries have been catching up to the higher-income industrial countries.
    b. The developing countries as a group have been catching up to the industrial countries as a group.
    c. both a. and b.
    d. neither a. nor b.

34. Along the downward-sloping catch-up line, a country near the top of the line is
    a. a rich country growing slowly.
    b. a rich country growing rapidly.
    c. a poor country growing rapidly.
    d. a poor country growing slowly.

35. Why do many low-income countries have low growth rates?
    a. because of the failure of governments to enforce the rule of law
    b. because of wars and revolutions
    c. because of poor public education and health
    d. All of the above are reasons why some low-income countries have low growth rates.

36. Which countries grow faster?
    a. countries that have a strong rule of law, such as the Czech Republic, Tunisia, and Israel
    b. countries that have a weak rule of law, such as Haiti, Congo, and Albania
    c. countries that rely on a common law system rather than on a civil law system
    d. None of the above. There is no relationship between the rule of law and economic growth.

37. In the vicious cycle of poverty
    a. households have low incomes.
    b. households save very little.
    c. few funds are available for businesses to borrow.
    d. all of the above

38. What is the name given to the purchase or building of a facility by a corporation in a foreign country?
    a. foreign portfolio investment
    b. foreign diversification investment
    c. foreign financial investment
    d. foreign direct investment

39. Which countries have experienced faster economic growth?
    a. countries that have been generally more open to foreign trade and investment
    b. countries that have relied less on foreign trade and more on their own internal sources of saving and investment
    c. countries that focused on job preservation
    d. countries that avoided globalization

40. The migration of highly educated and successful individuals from developing countries to high-income countries is called
    a. the human portfolio drain.
    b. the brain drain.
    c. the intelligent exodus.
    d. the intellectual outsourcing.

41. One of the lessons from the economic growth model presented in this chapter is that
    a. technological change is more important than increases in physical capital in explaining long-run growth.
    b. technological change is less important than increases in physical capital in explaining long-run growth.
    c. technological change is equally important to increases in physical capital in explaining long-run growth.
    d. technological change is only possible in countries that have already attained a high level of real GDP per capita.

42. Investment tax credits allow
    a. firms to deduct from their taxes some fraction of the funds they have spent on investment.
    b. households to save for retirement by placing funds in 401(k) or 403(b) plans or in Individual Retirement Accounts (IRAs).
    c. firms to deduct from their taxes part of the wages they pay workers.
    d. the government to raise a larger amount of revenue from households.

43. As a generalization, who is opposed to economic growth?
    a. very few people, because economic growth is good for everyone, regardless of income
    b. some people who think that, at least in the high-income countries, further economic growth is not desirable
    c. many people who think that economic growth in low-income countries is undesirable
    d. most politicians in developing countries

44. Which of the following are assertions made by opponents of globalization?
    a. Globalization has undermined the distinctive cultures of many countries.
    b. Globalization has contributed to the avoidance of safety and environmental regulations by multinational firms in low-income countries that they are required to follow in the high-income countries.
    c. Economic growth and globalization may be contributing to global warming, deforestation, and other environmental problems.
    d. all of the above

Short Answer Questions

1. Why do small differences in growth rates among countries matter?

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2. Explain the effect on the per-worker production function of an increase in capital per hour worked. Now explain the effect of technological change.

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3. What happened to the economy of the Soviet Union? What does the experience of the Soviet economy teach us about the nature of long-run economic growth?

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4. What is "catch-up"? Why would we expect catch-up to occur? Has it occurred?

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5. The "brain drain" refers to highly-educated and successful individuals leaving developing countries for high-income countries, such as the United States. How does the brain drain affect growth rates in the developing countries that experience it?

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True/False Questions

T F 1.   Over time, economic growth rates have not significantly changed.
T F 2.   The Industrial Revolution began in Japan during the seventeenth century.
T F 3.   Small differences in growth rates cause significant differences in living standards in the long run.
T F 4.   The standard of living in China is currently significantly higher than the standard of living in Japan.
T F 5.   In New Zealand, real GDP per capita grew from $9,664 in 1950 to $18,815 in 2000. This is an average annual growth rate of 95 percent.
T F 6.   Human capital is the accumulated knowledge and skills that workers acquire from education, training, and life experiences.
T F 7.   An increase in capital per hour worked will shift up the per-worker production function.
T F 8.   Diminishing returns to capital mean that as we add more capital to a fixed amount of labor, increases in output will become smaller and smaller.
T F 9.   In the long run, a country will experience rising living standards only if it experiences continuing technological change.
T F 10. Paul Romer argues that knowledge capital is subject to increasing returns, unlike physical capital.
T F 11. A patent gives its owner the exclusive right to produce a good for two years.
T F 12. During the years 1973 to 1995, labor productivity increased at a much slower rate than during the period immediately before or immediately after.
T F 13. The catch-up hypothesis suggests that countries with lower levels of real GDP per capita will grow more slowly than countries with higher levels of real GDP per capita.
T F 14. Countries that fail to protect property rights grow at slower rates than countries that succeed in protecting property rights.
T F 15. In the 1990s, there was no difference between the growth rates of more globalized and less globalized countries.

Answers to the Self-Test

Multiple-Choice Questions

| Question	Answer	Comment
1	c	Real GDP per capita is the best measure we have of a country's standard of living, because GDP measures a country's total income. Economic growth occurs when real GDP per capita increases.
2	c	Significant economic growth did not begin until the Industrial Revolution, which started in England around the year 1750.
3	d	Upholding private property rights, protecting wealth, and eliminating arbitrary increases in taxes were the institutional changes that gave entrepreneurs the incentive to make the investments necessary to use the important technological developments of the second half of the eighteenth century. Most economists accept the idea that economic growth is not likely to occur unless a country's government provides the right type of institutional framework.

4	b	Compounding magnifies even small differences in interest rates or growth rates over long periods of time. The important point to keep in mind is that in the long run, small differences in economic growth rates result in big differences in living standards.
5	a	In the 1980s and 1990s, a small group of countries, mostly East Asian countries such as South Korea, Taiwan, and Singapore, experienced high rates of growth and are sometimes referred to as the *newly industrializing countries*.
6	b	An economic growth model is a model that explains changes in real GDP per capita in the long run.
7	d	Economists believe two key factors determine labor productivity: the quantity of capital per hour worked and the level of technology. Therefore, the economic growth model will focus on technological change and changes over time in the quantity of capital per hour worked in explaining changes in real GDP per capita.
8	c	Among the sources of technological change are: better machinery and equipment, increases in human capital, and better means of organizing and managing production.
9	d	Human capital is the accumulated knowledge and skills that workers acquire from education, training, and their life experiences. As workers increase their human capital through education or on-the-job training, their productivity will also increase. The more educated workers are, the greater their human capital.
10	c	The per-worker production function is the relationship between real GDP (output) per hour worked and capital per hour worked, holding the level of technology constant. Using the per-worker production function, we explored the effects of increases in the amount of capital per hour worked and technological change on economic growth.
11	b	Holding technology constant, equal increases in the amount of capital per hour worked lead to diminishing increases in output per hour worked.
12	b	As it applies to the per-worker production function, the *law of diminishing returns* states that as we add more of one input—in this case, capital—to a fixed quantity of another input—in this case, labor—output increases by smaller additional amounts.
13	b	An increase in capital per hour worked increases real GDP per hour worked, but each additional increase in capital per hour worked results in progressively smaller increases in output per hour worked.
14	c	In a per worker production function, changes in capital and labor cause movements along the curve, while changes in technology cause the curve to shift.
15	a	In a per worker production function, changes in capital and labor cause movements along the curve, while changes in technology cause the curve to shift.
16	b	Technological change shifts the per-worker production function up and allows an economy to produce more real GDP per hour worked with the same quantity of capital per hour worked.
17	c	Because of diminishing returns to capital, continuing increases in real GDP per hour worked will only occur if there is technological change. Remember that a country will experience increases in its standard of living only if it experiences increases in real GDP per hour worked. Therefore, we can draw the following important conclusion: *In the long run, a country will experience an increasing standard of living only if it experiences continuing technological change.*
18	b	The drive for profit provides an incentive for technological change that centrally planned economies are unable to duplicate. In market economies, decisions on which investments to make and which technologies to adopt are made by entrepreneurs and managers with their own money on the line.
19	c	The *new growth theory* is a model of long-run economic growth that emphasizes that technological change is influenced by economic incentives, and, so is determined by the working of the market system.

20   a   We have seen that accumulation of physical capital is subject to diminishing returns: increases in capital per hour worked lead to increases in real GDP per hour worked, but at a decreasing rate. Paul Romer argues that the same is true of knowledge capital, at the firm level. As firms add to their stock of knowledge capital, they will increase their output, but at a decreasing rate. At the level of the economy, however, Romer argues that knowledge capital is subject to increasing returns. This is true because, once discovered, knowledge becomes available to everyone.

21   a   Labor unions do not have a role in the accumulation of knowledge capital and government policy.

22   d   The use of physical capital is rival because if one firm uses it, other firms can't, and excludable because the firm that owns the capital can keep other firms from using it. The use of knowledge capital is nonrival because one firm's use of this knowledge does not interfere with another firm's use of it. Knowledge capital is also nonexcludable because once something like a chemical formula becomes known, it becomes widely available for other firms to use.

23   c   Because knowledge capital is nonrival and nonexcludable, firms will attempt to *free-ride* on the research and development of other firms. Firms free-ride when they benefit from the results of research and development they did not pay for. (Patent law and other legal restrictions on the use of intellectual property can discourage this free riding.)

24   d   All of the above are ways the government can help to increase the accumulation of knowledge capital.

25   c   The profits an entrepreneur hopes to earn provide the incentive for bringing the factors of production—labor, capital, and raw materials—together to start new firms and to introduce new goods and services.

26   c   The growth rate in the United States increased from 1800 through the mid-1970s. Then for more than 20 years, growth slowed before increasing again in the mid-1990s.

27   d   Several explanations—including measurement problems, high oil prices, and a decline in labor quality—have been offered for the productivity slowdown of the mid-1970s to mid-1990s, but none of the explanations is completely satisfying.

28   d   Information technology industries, such as computers, semiconductors, cell phones, computer programming, and computer software, have accounted for as much as one-third of the growth in real GDP in recent years.

29   a   Many economists believe that productivity growth in the United States has been more rapid for two reasons: the greater flexibility of U.S. labor markets and the greater efficiency of the U.S. financial system.

30   b   Because the return to increasing capital and adopting new technologies is generally greater in poor countries than in rich countries, all else being equal, poor countries should grow faster than rich countries.

31   d   Many firms that start to bring new technologies to market obtain funds from *venture capital firms*. Venture capital firms raise funds from institutional investors, such as pension funds, and from wealthy individuals, to invest in startup firms. The owners of venture capital firms closely examine the business plans of startup firms, looking for those that appear most likely to succeed.

32   a   The economic growth model predicts that poor countries will grow faster than rich countries. If this prediction is correct, we should observe poor countries catching up to the rich countries in levels of GDP per capita (or income per person).

33   a   The lower-income *industrial* countries have been catching up to the higher-income industrial countries. But the developing countries as a group have not been catching up to the industrial countries as a group.

34   c   According to the economic growth model, countries that start with lower levels of GDP per capita should grow faster (points near the top of the line) than countries that start with higher levels of GDP per capita (points near the bottom of the line).

35   d   Why are many low-income countries not growing? There is no one answer, but most economists point to four key factors: failure to enforce the rule of law; wars and revolutions; poor public education and health; and low rates of saving and investment.

36   a   The *rule of law* refers to the ability of a government to enforce the laws of the country, particularly with respect to protecting private property and enforcing contracts. The 20 developing countries that have the strongest rule of law, such as the Czech Republic, Tunisia, and Israel, grew more than six times faster during the 1990s than the 20 developing countries that have the weakest rule of law, such as Haiti, Congo, and Albania.

37   d   The low savings rates in developing countries contribute to a *vicious cycle* of poverty. Because households have low incomes, they save very little. Because households save very little, few funds are available for businesses to borrow. Lacking funds, businesses do not invest in the new factories, machinery, and equipment needed for economic growth. Because the economy does not grow, household incomes remain low, as do their savings, and so on.

38   d   Foreign direct investment (FDI) occurs when corporations build or purchase facilities in foreign countries. When an individual or firm buys stock or bonds issued in another country, they are engaging in foreign portfolio investment.

39   a   As Figure 10-11 depicts, countries that were more open to foreign trade and investment grew more than six times faster during the 1980s and 1990s than countries that were less open.

40   b   The rising incomes that result from economic growth can help developing countries deal with the brain drain. The *brain drain* refers to highly educated and successful individuals leaving developing countries for high-income countries.

41   a   One of the lessons from the economic growth model is that technological change is more important than increases in capital in explaining long-run growth. For low-income countries, access to existing technologies is of paramount importance.

42   a   Investment tax credits allow firms to deduct from their taxes some fraction of the funds they have spent on investment.

43   b   It seems undeniable that increasing the growth rates of very low-income countries would help relieve the daily suffering that many people in these countries must endure. But some people are unconvinced that, at least in the high-income countries, further economic growth is not desirable.

44   d   Some people believe that globalization has undermined the distinctive cultures of many countries, as imports of food, clothing, movies, and other goods displace domestically produced goods. We have seen that allowing foreign direct investment is an important way in which low-income countries can gain access to the latest technology. Some people, however, see multinational firms that locate in low-income countries as paying very low wages, and as failing to follow the same safety and environmental regulations they are required to follow in the high-income countries.

Short Answer Responses

1. Due to the effects of compounding, small differences in growth rates when maintained for many years can lead to very large differences in real GDP per capita. The standard of living in the United States and other high-income countries is much higher than the standard of living in developing countries because the high-income countries have experienced higher growth rates than the developing countries.

2. Using the graph below, an increase in the capital stock will cause a movement along the per-worker production function. This is a movement from point A to point B. A technological change will allow the economy to produce more with the same amount of inputs (same amount of capital per hour worked). This is a shift in the per-worker production function and a movement from point B to point C.
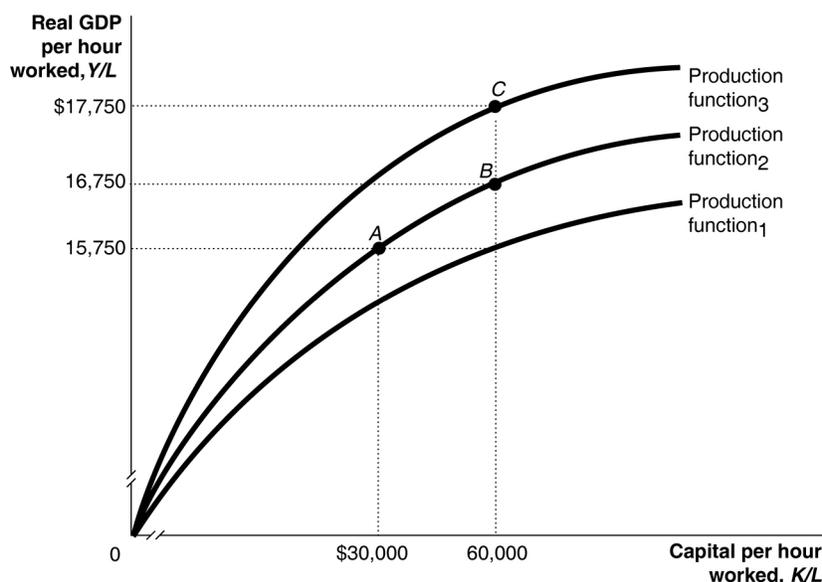
3. The Soviet economy eventually experienced very low growth rates. Although the Soviet Union was successful in increasing levels of capital per hour worked, it was unsuccessful in implementing continuing technological change. The experience of the Soviet economy shows that because of diminishing returns to capital, economic growth will persist in the long run only if an economy experiences technological change.

4. Catch-up—also known as convergence—is the prediction of the economic growth model that poor countries will grow faster than rich countries. The profitability of using additional capital or better technology is generally greater in a developing country than in a high-income country. Therefore, we would expect that developing countries would experience more rapid growth in capital per hour worked and would adopt the best technology, which would cause them to experience rapid rates of economic growth and to catch-up with the high-income countries. Among the countries that currently have high incomes, catch-up has occurred. But the developing countries as a group are not catching up with the high-income countries as a group.

5. The brain drain will cause a country to lose those individuals who can help implement and create technological change. Slower technological change means smaller upward shifts in the per-worker production function and slower rates of economic growth.

True/False Answers

1. F See textbook Figure 10-1.
2. F The Industrial Revolution began in England during the eighteenth century.
3. T
4. F See the *Making the Connection* on page 313 of the textbook.
5. F 95 percent is the total percentage change rather than the average annual growth rate.
6. T
7. F An increase in capital per hour worked results in a movement along the per-worker production function.
8. T
9. T
10. T
11. F The life of a patent is 20 years.
12. T
13. F Catch-up holds that countries with lower levels of real GDP per capita will have faster growth rates.
14. T
15. F More globalized countries grew much faster than less globalized countries. See textbook Figure 10-11.