CHAPTER 17

Economic Growth and the New Economy

THE WORLD'S CAPITALIST countries experienced impressive growth of real GDP and real GDP per capita during the last half of the twentieth century. In the United States, real GDP increased by 450 percent between 1950 and 2000, while population increased by only 80 percent. In 2000 the value of goods and services available to the average U.S. resident was three times greater than that of 50 years earlier. This expansion of real output—this **economic growth**—greatly increased material abundance and lifted the standard of living of most Americans. ■ In Chapter 8 we explained how economic growth is measured, briefly looked at economic growth in the United States, and compared growth rates among the major nations. In this chapter we want to explore economic growth in considerably more depth.

Ingredients of Growth

There are six main ingredients in economic growth. We can group them as supply, demand, and efficiency factors.

Supply Factors

Four of the ingredients of economic growth relate to the physical ability of the economy to expand. They are:

- Increases in the quantity and quality of natural resources.
- Increases in the quantity and quality of human resources.
- Increases in the supply (or stock) of capital goods.
- Improvements in technology.

These **supply factors**—changes in the physical and technical agents of production—enable an economy to expand its potential GDP.

Demand Factor

The fifth ingredient of economic growth is the **demand factor:**

- To achieve the higher production potential created by the supply factors, households, businesses, and government must *purchase* the economy's expanding output of goods and services.

When that occurs, there will be no unplanned increases in inventories and resources will remain fully employed. Economic growth requires increases in total spending to realize the output gains made available by increased production capacity.

Efficiency Factor

The sixth ingredient of economic growth is the **efficiency factor:**

- To reach its production potential, an economy must achieve economic efficiency as well as full employment.

The economy must use its resources in the least costly way (productive efficiency) to produce the specific mix of goods and services that maximizes people's well-being (allocative efficiency). The ability to expand production, together with the full use of available resources, is not sufficient for achieving maximum possible growth. Also required is the efficient use of those resources.

The supply, demand, and efficiency factors in economic growth are related. Unemployment caused by insufficient total spending (the demand factor) may lower the rate of new capital accumulation (a supply factor) and delay expenditures on research (also a supply factor). Conversely, low spending on investment (a supply factor) may cause insufficient spending (the demand factor) and unemployment. Widespread inefficiency in the use of resources (the efficiency factor) may translate into higher costs of goods and services and thus lower profits, which in turn may slow innovation and reduce the accumulation of capital (supply factors). Economic growth is a dynamic process in which the supply, demand, and efficiency factors all interact.

Production Possibilities Analysis

To put the six factors underlying economic growth in proper perspective, let's first use the production possibilities analysis introduced in Chapter 2.

Growth and Production Possibilities

Recall that a curve like *AB* in Figure 17.1 is a production possibilities curve. It indicates the various *maximum* combinations of products an economy can produce with its fixed quantity and quality of natural, human, and capital resources and its stock of technological knowledge. An improvement in any of the supply factors will push the production possibilities curve outward, as from *AB* to *CD*.

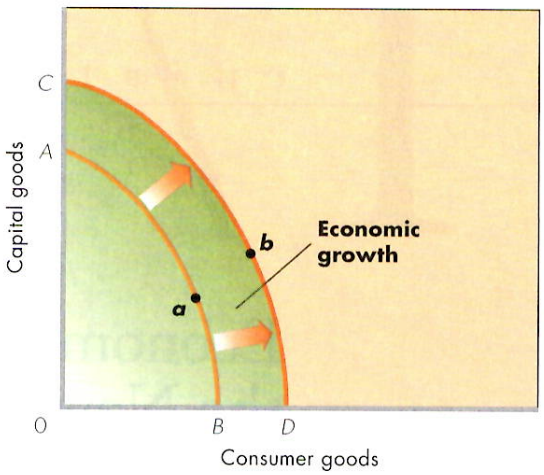

Figure 17.1

Economic growth and the production possibilities curve. Economic growth is made possible by the four supply factors that shift the production possibilities curve outward, as from *AB* to *CD*. Economic growth is realized when the demand factor and the efficiency factor move the economy from point *a* to *b*.

But the demand and efficiency factors remind us that the economy may not automatically attain its maximum production potential. The curve may shift outward but leave the economy behind at some level of operation such as *a* on *AB*. Because *a* is inside the new production possibilities curve *CD*, the economy has not achieved its growth potential. That potential will be realized only if (1) total spending increases enough to sustain full employment and (2) the additional resources that pushed the curve outward are employed efficiently so that they make the maximum possible dollar contribution to output.

An increase in total spending is needed to move the economy from point *a* to a point on *CD*. And for the economy to achieve the maximum increase in the monetary value of its output—its greatest growth of real GDP—that location on *CD* must be optimal. You will recall from Chapter 2 that this "best allocation" is determined by expanding production of each good until its marginal benefit equals its marginal cost. Here, we assume that this optimal combination of capital and consumer goods occurs at point *b*.

Example: The net increase in the size of the labor force in the United States in recent years has been roughly 2 million workers per year. That increment raises the economy's production capacity. But obtaining the extra output that these added workers could produce depends on their success in finding jobs. It also depends on whether or not the jobs are in firms and industries where the workers' talents are fully and optimally used. Society does not want new labor-force entrants to be unemployed. Nor does it want pediatricians working as plumbers or pediatricians producing services for which marginal costs exceed marginal benefits. **(Key Question 1)**

Labor and Productivity

Although demand and efficiency factors are important, discussions of economic growth focus primarily on supply factors. Society can increase its real output and income in two fundamental ways: (1) by increasing its inputs of resources, and (2) by raising the productivity of those inputs. Figure 17.2 focuses on the input of *labor* and provides a useful framework for discussing the role of supply factors in growth. A nation's real GDP in any year depends on the input of labor (measured in worker-hours) multiplied by **labor productivity** (measured as real output per worker per hour):

Real GDP = worker-hours × labor productivity

So, thought of this way, a nation's economic growth from one year to the next depends on its *increase* in labor inputs (if any) and its *increase* in labor productivity (if any).

Illustration: Assume that the hypothetical economy of Ziam has 10 workers in year 1, each working 2000 hours per year (50 weeks at 40 hours per week). The total input of labor therefore is 20,000 hours. If productivity (average real output per worker-hour) is $10, then real GDP in Ziam will be $200,000 (= 20,000 × $10). If worker-hours rise to 20,200 and labor productivity rises to $10.40, Ziam's real GDP will increase to $210,080 in year 2. Ziam's rate of economic growth will be about 5 percent [= ($210,080 − $200,000)/$200,000] for the year.

Worker-Hours What determines the number of hours worked each year? As shown in Figure 17.2, the hours of labor input depend on the size of the employed labor force and the length of the average workweek. Labor-force size depends on the size of the working-age population and the **labor-force participation rate**—the percentage of the working-age population actually in the labor force. The length of the average workweek is governed by legal and institutional considerations and by collective bargaining.

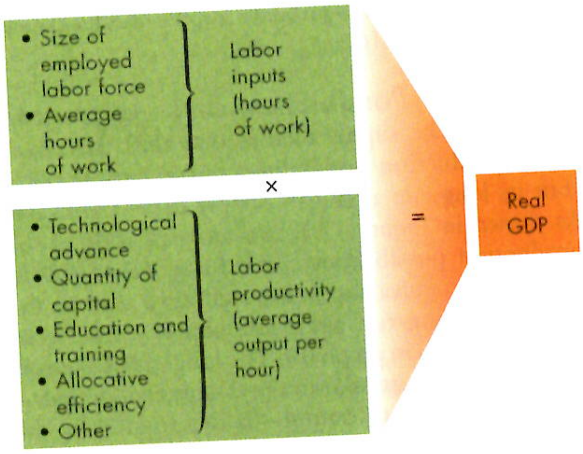

Figure 17.2

The supply determinants of real output. Real GDP is usefully viewed as the product of the quantity of labor inputs (worker-hours) multiplied by labor productivity.

Labor Productivity Figure 17.2 tells us that labor productivity is determined by technological progress, the quantity of capital goods available to workers, the quality of the labor itself, and the efficiency with which inputs are allocated, combined, and managed. Productivity rises when the health, training, education, and motivation of workers improve, when workers have more and better machinery and natural resources with which to work, when production is better organized and managed, and when labor is reallocated from less efficient industries to more efficient industries.

Growth in the AD-AS Model

Let's now link the production possibilities analysis to long-run aggregate supply so that we can show the process of economic growth through the extended

aggregate demand–aggregate supply model developed in Chapter 16.

Production Possibilities and Aggregate Supply The supply factors that shift the economy's production possibilities curve outward also shift its long-run aggregate supply curve rightward. As shown in Figure 17.3, the outward shift of the production possibilities curve from *AB* to *CD* in graph (a) is equivalent to the rightward shift of the economy's long-run aggregate supply curve from AS_{LR1} to AS_{LR2} in graph (b). The long-run AS curves are vertical because an economy's potential output—its full-employment output—is determined by the supply and efficiency factors, not by its price level. Whatever the price level, the economy's potential output remains the same. Moreover, just as price-level changes do not shift an economy's production possibilities curve, they do not shift an economy's long-run aggregate supply curve.

Extended AD-AS Model In Figure 17.4 we use the extended aggregate demand–aggregate supply model to depict the economic growth process. (The model is extended to include the distinction between short- and long-run aggregate supply. See Chapter 16.)

Suppose that an economy's aggregate demand curve, long-run aggregate supply curve, and short-run aggregate supply curve initially are AD_1, AS_{LR1}, and AS_1, as shown. The equilibrium price level and level of real output are P_1 and Q_1. At price level P_1, the short-run aggregate supply is AS_1; it slopes upward because, in the short run, changes in the price level cause firms to adjust their output. In the long run, however, price-level changes do not affect the economy's real output, leaving the long-run aggregate supply curve vertical at the economy's potential level of output, here Q_1. This potential level of output depends on the supply and efficiency factors previously discussed.

Now let's assume that changes in the supply factors (quantity and quality of resources and technology) shift the long-run aggregate supply curve rightward from AS_{LR1} to AS_{LR2}. The economy's potential output has increased, as reflected in the shift of the long-run aggregate supply curve from AS_{LR1} to AS_{LR2}.

If prices and wages are inflexible downward, the economy can realize its greater production potential

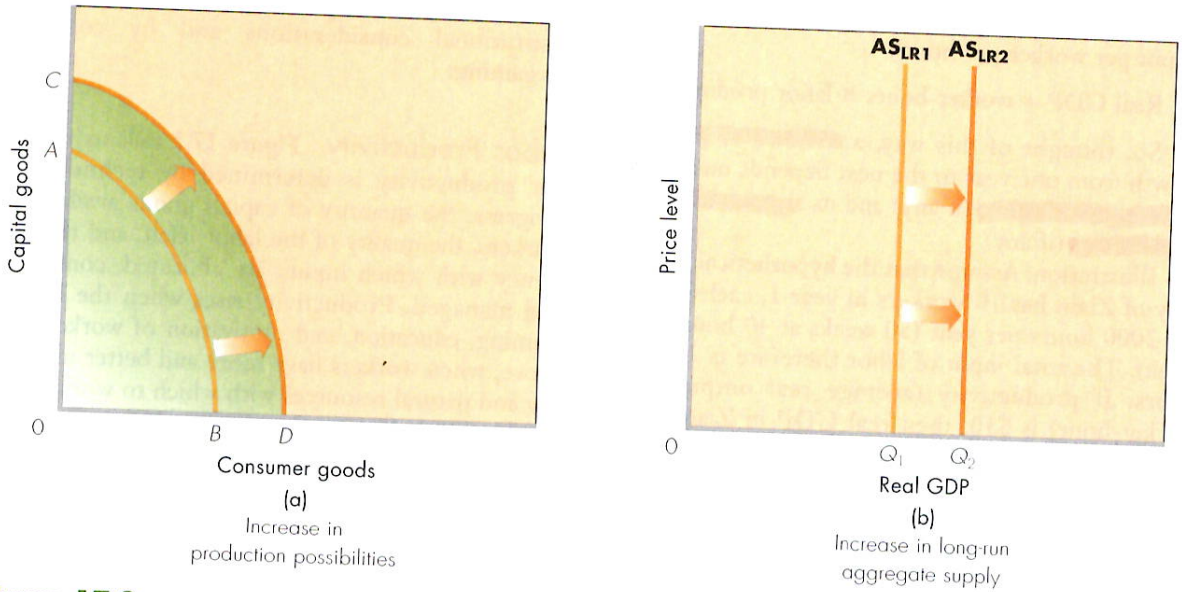

Figure 17.3

Production possibilities and long-run aggregate supply. (a) Supply factors shift an economy's production possibilities curve outward, as from *AB* to *CD*. (b) The same factors (along with the efficiency factor) shift the economy's long-run aggregate supply curve to the right, as from AS_{LR1} to AS_{LR2}.

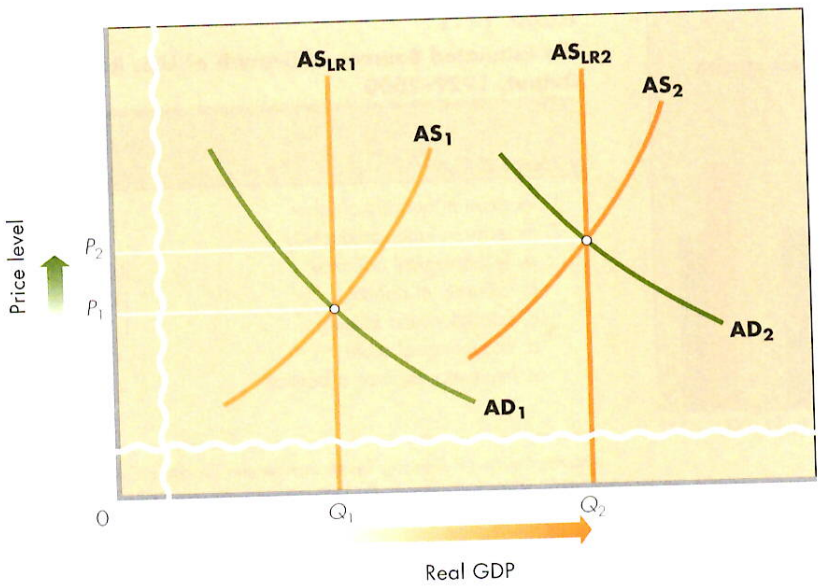

Figure 17.4

Economic growth in the extended AD-AS model. Long-run aggregate supply and short-run aggregate supply have increased over time, as from AS_{LR1} to AS_{LR2} and AS_1 to AS_2. Simultaneously, aggregate demand has shifted rightward, as from AD_1 to AD_2. The actual outcome of these combined shifts has been economic growth, shown as the increase in real output from Q_1 to Q_2, accompanied by inflation, shown as the rise in the price level from P_1 to P_2.

only through an increase in aggregate demand. Under usual circumstances, such an increase is forthcoming because the production of additional output produces additional income to households and businesses. In Figure 17.4, suppose that this additional income results in increases in consumption and investment spending such that the aggregate demand curve shifts from AD_1 to AD_2. Also suppose that the economy continues to use its resources efficiently.

The increases of aggregate supply and aggregate demand in Figure 17.4 have increased real output from Q_1 to Q_2 and have boosted the price level from P_1 to P_2. At the higher price level P_2, the economy confronts a new short-run aggregate supply curve AS_2. The result of the dynamics described in Figure 17.4 is economic growth, accompanied by mild inflation.

In brief, economic growth results from increases in aggregate supply and aggregate demand. Whether zero, mild, or rapid inflation accompanies economic growth depends on the extent to which aggregate demand increases relative to aggregate supply. **(Key Question 5)** 17.1

QUICK REVIEW 17.1

- The ingredients of economic growth include (a) four supply factors (increases in the quantity and quality of natural resources, increases in the quantity and quality of human resources, increases in the stock of capital goods, and improvements in technology), (b) a demand factor (increased total spending), and (c) an efficiency factor (achieving economic efficiency)
- Economic growth is shown as an outward shift of a nation's production possibilities curve (accompanied by movement from some point on the old curve to a point on the new curve) and combined rightward shifts of the long-run aggregate supply curve, the short-run aggregate supply curve, and the aggregate demand curve.
- Real GDP grew by an average of 3.5 percent annually between 1950 and 2000; over that same period, real GDP per capita grew at an average annual rate of about 2.3 percent.

U.S. Economic Growth Rates

Figure 17.5 shows the average annual growth rates of real GDP and real per capita GDP in the United States for the past five decades. *Over the full 50 years, real GDP grew by about 3.5 percent annually, whereas real GDP per capita grew by about 2.3 percent annually.* Economic growth was particularly strong in the 1960s but declined during the 1970s and 1980s. Although the average annual growth rate for the 1990s only slightly exceeded that of the 1980s, real GDP surged between 1996 and 1999. Specifically, it grew by 3.6 percent in 1996, 4.4 percent in 1997, 4.4 percent in 1998, and 4.2 percent in 1999. These

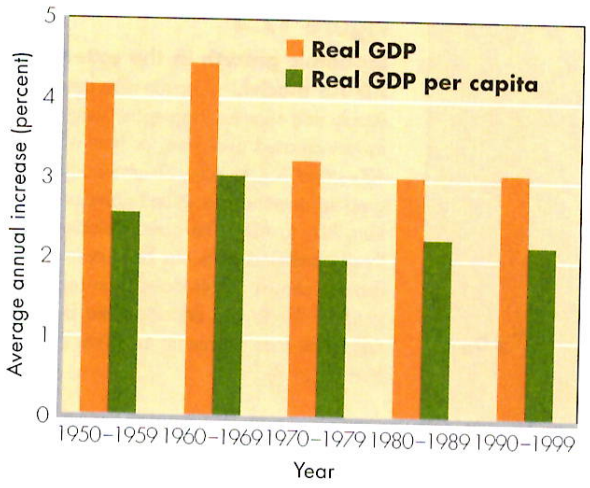

Figure 17.5

U.S. economic growth, annual averages for five decades. Growth of real GDP has averaged about 3.5 percent annually in the last half century and annual growth of real GDP per capita averaged about 2.3 percent. Growth rates in the 1970s and 1980s were less than those in the 1960s, but the rates rebounded in the last half of the1990s.

recent rates were not only higher than previous rates but higher than those in most other advanced industrial nations during this period. (We will defer discussion of this recent growth surge to later in this chapter.) ! 17.1

Accounting for Growth

Table 17.1, based on the research of economist Edward Denison (1915–1992), provides estimates of the relative contributions of various factors to U.S. economic growth between 1929 and 2000.

Inputs versus Productivity

We see from Table 17.1 that the increase in labor productivity (output per hour of work) has been the single most important source of economic growth. Increases in the quantity of labor (item 1) account for only about one-third of the increase in real output since 1929; two-thirds are attributable to rising labor productivity (item 2).

Quantity of Labor

The U.S. population and the size of the labor force have both expanded significantly. Between 1929 and 2000, total population grew from 122 million to 275 million, and the labor force increased from 49 million to 141 million workers. Reductions in the length of the workweek reduced the growth of labor inputs before the Second World War, but the workweek has remained relatively stable since then. Falling birthrates over the past 30 years have slowed the growth of the native population, but increased immigration has partly offset that slowdown. Of greatest significance has been a surge of women's participation in the labor force. Partly because of that increased participation, U.S. labor force growth has averaged 2 million workers per year during the past 25 years.

Table 17.1

The Estimated Sources of Growth of U.S. Real Output, 1929–2000

Source of Growth		Percentage of Total Growth
1. Increase in quantity of labor		33
2. Increase in labor productivity		67
a. Technological advance	26	
b. Quantity of capital	18	
c. Education and training	11	
d. Economies of scale	6	
e. Improved resource allocation	6	
		100

Source: Edward F. Denison, *Trends in American Economic Growth, 1929–1982* (Washington, D.C.: Brookings Institution, 1985), p. 30; *Economic Report of the President*, various years; authors' revisions and estimates.

Technological Advance

Technological advance (item 2*a* in Table 17.1) is a critical engine of productivity growth and has accounted for 26 percent of the increase in real output since 1929.

Technological advance includes not only innovative production techniques but new managerial methods and new forms of business organization that improve the process of production. Generally, technological advance is generated by the discovery of new knowledge, which allows for resources to be combined in improved ways that increase output. Once discovered and implemented, new knowledge soon becomes available to entrepreneurs and firms at relatively low cost. Technological advance therefore eventually spreads through the entire economy, boosting productivity and economic growth.

Technological advance and capital formation (investment) are closely related, since technological advance usually promotes investment in new machinery and equipment. In fact, technological advance is often *embodied* within new capital. For example, the purchase of new computers brings to industry speedier, more powerful computers that incorporate new technology.

Technological advance has been both rapid and profound. Gas and diesel engines, conveyor belts, and assembly lines are significant developments of the past. So, too, are fuel-efficient commercial aircraft, integrated microcircuits, personal computers, xerography, and containerized shipping. More recently, technological advance has exploded, particularly in the areas of medicine, wireless communication, biotechnology, and the Internet. ! 17.2

Quantity of Capital

Eighteen percent of the annual growth of real output since 1929 is attributed to increases in the quantity of capital (item 2*b* in Table 17.1). More and better plants and equipment make workers more productive. And a nation acquires more capital by saving some of its income and using that saving to invest in plant and equipment.

A key determinant of labor productivity is the amount of capital goods available per worker. If both the aggregate stock of capital goods and the size of the labor force increase over a given period, the individual worker is not necessarily better equipped and productivity will not necessarily rise. But the quantity of capital equipment available per U.S. worker has increased greatly over time. (It is currently about $75,000 per worker.)

Public investment in the U.S. **infrastructure** (highways and bridges, public transit systems, wastewater treatment facilities, water systems, airports, educational facilities, and so on) has also grown since 1929. This public capital (infrastructure) complements private capital. Investments in new highways promote private investment in new factories and retail stores along their routes. Industrial parks developed by local governments attract manufacturing and distribution firms.

Education and Training

Ben Franklin once said: "He that hath a trade hath an estate," meaning that education and training contribute to a worker's stock of **human capital**—*the knowledge and skills that make for a productive worker.* Investment in human capital includes not only formal education but also on-the-job training. Like investment in physical capital, investment in human capital is an important means of increasing labor productivity and earnings. As Table 17.1 shows, 11 percent of the growth of U.S. real GDP since 1929 owes to such investment in people's education and skills (item 2*c*).

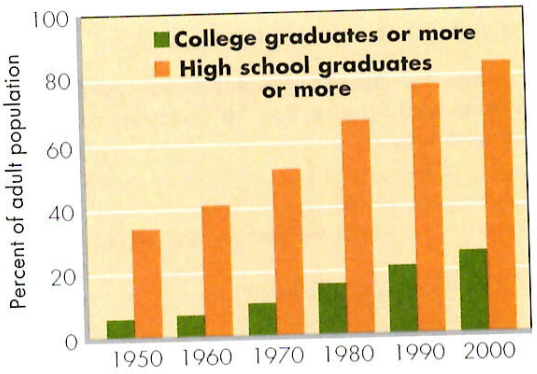

Figure 17.6

Changes in the educational attainment of the U.S. adult population. The percentage of the U.S. adult population, age 25 or more, completing high school and college has been rising in recent decades.

Source: U.S. Census Bureau, www.census.gov.

One measure of a nation's quality of labor is its level of educational attainment. Figure 17.6 shows large gains in educational attainment over the past several decades. In 1960 only 41 percent of the U.S. population age 25 or more had at least a high school education, and only 8 percent had a college education or more. By 2000, those numbers had increased to 84 percent and 26 percent, respectively. Clearly, education has become accessible to more people in the United States during the recent past.

But all is not upbeat with education in the United States. Many observers think that the quality of education in the United States has declined. Average scores on standardized college admission tests are lower than they were a few decades ago. U.S. students in science and mathematics do not do as well as students in many other nations (see Global Perspective 17.1). The United States has been producing fewer engineers and scientists, a problem that may trace back to inadequate training in math and science in elementary and high schools. And it is

GLOBAL PERSPECTIVE 17.1

Average Test Scores of Eighth-Grade Students in Math and Science, Top 10 Countries and the United States

The test performance of U.S. eighth-grade students did not rank favorably with that of eighth-graders in several other nations in the Third International Math and Science Study (1999).

Mathematics

Rank		Score
1	Singapore	604
2	South Korea	587
3	Taiwan	585
4	Hong Kong (China)	582
5	Japan	579
6	Belgium	558
7	Netherlands	540
8	Slovak Republic	534
9	Hungary	532
10	Canada	531
19	United States	502

Science

Rank		Score
1	Taiwan	569
2	Singapore	568
3	Hungary	552
4	Japan	550
5	South Korea	549
6	Netherlands	545
7	Australia	540
8	Czech Republic	539
9	United Kingdom	538
10	Finland	535
18	United States	515

argued that on-the-job training programs (apprenticeship programs) in several European nations are superior to those in the United States. For these reasons, much recent public policy discussion and legislation has been directed toward improving the quality of the U.S. education and training system.

Resource Allocation and Economies of Scale

Table 17.1 also tells us that economies of scale (item 2*d*) and improved resource allocation (item 2*e*) together explain 12 percent of U.S. growth.

Economies of Scale

Reductions in per-unit cost that result from increases in the size of markets and firms are called **economies of scale.** Markets have increased in size over time, allowing firms to achieve production advantages associated with greater size. As firms expand, they use more efficient plant and equipment and methods of manufacturing and delivery that result in greater productivity. They also are better able to recoup substantial investments in developing new products and production methods. Examples: A large manufacturer of autos can use elaborate assembly lines with computerization and robotics, while smaller producers must settle for less advanced technologies using more labor inputs. Large pharmaceutical firms greatly reduce the average amount of labor (researchers, production workers) needed to produce each pill as they increase the number of pills produced. Accordingly, economies of scale result in greater real GDP and thus contribute to economic growth.

Improved Resource Allocation

Improved resource allocation means that workers over time have moved from low-productivity employment to high-productivity employment. Historically, much labor has shifted from agriculture, where labor productivity is low, to manufacturing, where it is quite high. More recently, labor has shifted away from some manufacturing industries to even higher productivity industries such as computer software, business consulting, and pharmaceuticals. As a result of such shifts, the average productivity of U.S. workers has increased.

Also, discrimination in education and the labor market has historically deterred some women and minorities from entering high-productivity jobs. With the decline of such discrimination, over time many members of those groups have shifted from low-productivity jobs to higher-productivity jobs. The result has been higher overall labor productivity and real GDP.

Finally, we know from discussions in Chapter 6 that tariffs, import quotas, and other barriers to international trade tend to relegate resources to relatively unproductive pursuits. The long-run move-

ment toward liberalized international trade through international agreements has improved the allocation of resources, increased labor productivity, and expanded real output, both here and abroad. **(Key Question 6)**

Other Factors

Several difficult-to-measure factors influence a nation's rate of economic growth. The overall social-cultural-political environment of the United States, for example, has facilitated economic growth. The market system that has prevailed in the United States since its founding has fostered many personal and corporate incentives that promote growth. The United States has also had a stable political system characterized by democratic principles, internal order, the right of property ownership, the legal status of enterprise, and the enforcement of contracts. Economic freedom and political freedom have been "growth-friendly."

Unlike the case in some nations, there are virtually no social or moral taboos on production and material progress in the United States. The nation's social philosophy has embraced material advance as an attainable and desirable economic goal. The inventor, the innovator, and the businessperson are accorded high degrees of prestige and respect in American society.

Moreover, Americans have had positive attitudes toward work and risk taking, resulting in an ample supply of willing workers and innovative entrepreneurs. A flow of energetic immigrants has greatly augmented that supply.

QUICK REVIEW 17.2

- Improvements in labor productivity account for about two-thirds of the increases in U.S. real GDP; the use of more labor inputs accounts for the remaining one-third.
- Improved technology, more capital, greater education and training, economies of scale, and better resource allocation have been the main contributors to U.S. productivity growth and thus to U.S. economic growth.
- Other factors that have been favorable to U.S. growth include reliance on the market system, a stable political system, a social philosophy that embraces material progress, and an abundant supply of willing workers and entrepreneurs.

Productivity Growth and the New Economy

Real output, real income, and real wages are linked to labor productivity. To see why, suppose you are alone on an uninhabited island. The number of fish you can catch or coconuts you can pick per hour—your productivity—is your real wage (or real income) per hour. By *increasing* your productivity, you can improve your standard of living because greater output per hour means there are more fish and coconuts (goods) available to consume.

So it is for the economy as a whole: Over long periods, the economy's labor productivity determines its average real hourly wage. The economy's income per hour is equal to its output per hour. Productivity growth therefore is its main route for increasing its standard of living. It allows firms to pay higher wages without lowering their business profits. Even a seemingly small percentage change in productivity growth, if sustained over several years, can make a substantial difference as to how fast a nation's standard of living rises. We know from the *rule of 70* (Chapter 8) that if a nation's productivity grows by 2.5 percent annually rather than 1.5, its standard of living will double in 28 years rather than 47 years.

Figure 17.7 shows the growth of labor productivity (as measured by changes in the index of labor productivity) in the United States from 1973 to 2000, along with separate trend lines for 1973–1995 and 1995–2000. Labor productivity grew by an average of only 1.4 percent yearly over the 1973–1995 period. But between 1995 and 2000 productivity growth averaged 3.1 percent annually. Many economists believe that this higher productivity growth resulted from a significant new wave of technological advance, coupled with global competition. They assert that the United States has achieved a **New Economy**—one that has faster productivity growth and therefore faster economic growth.

Characteristics of the New Economy

What are the characteristics of this New Economy? What, according to its advocates, distinguishes it from the economy that it superseded?

The Microchip and Information Technology

The core element of the New Economy is an explosion of entrepreneurship and innovation based on the microprocessor, or *microchip*, which bundles

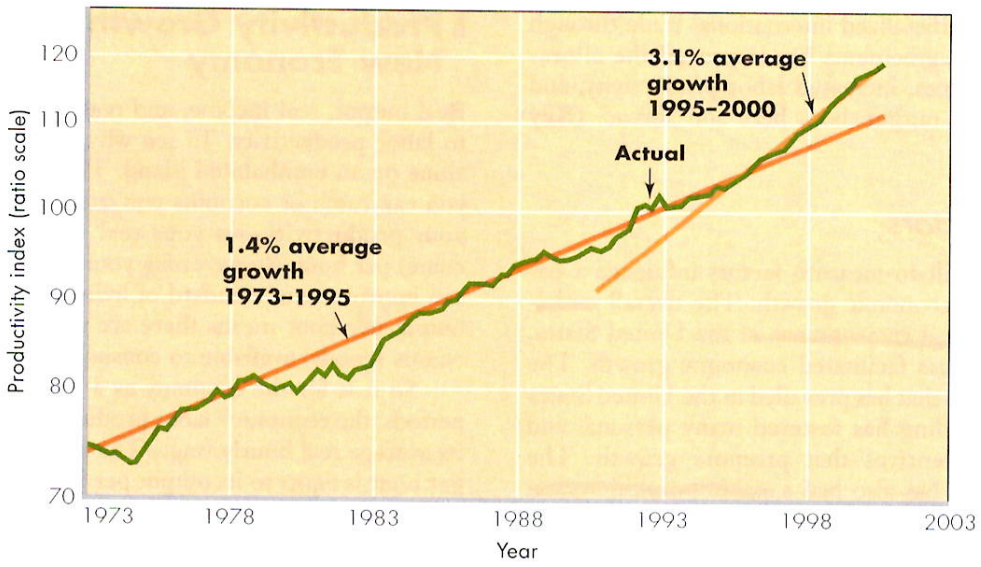

Figure 17.7

Growth of labor productivity in the United States, 1973–2000. U.S. labor productivity increased at an average annual rate of only 1.4 percent from 1973 to 1995. But between 1995 and 2000 it accelerated to an annual rate of 3.1 percent. (A ratio scale plots equal percentage changes as equal vertical distances.)
Source: Economic Report of the President, 2000; updated.

transistors on a piece of silicon. Advocates of the New Economy liken the invention of the microchip to that of electricity, the automobile, air travel, the telephone, and television in importance and scope.

The microchip has found its way into thousands of applications. It has helped create a wide array of new products and services and new ways of doing business. Its immediate result was the pocket calculator, the bar-code scanner, the personal computer, the laptop computer, and more powerful business computers. But the miniaturization of electronic circuits also advanced the development of other products such as the cell phone and pager, computer-guided lasers, deciphered genetic codes, global positioning equipment, energy conservation systems, Doppler radar, digital cameras, and many more.

Perhaps of greatest significance, the widespread availability of personal and laptop computers stimulated the desire to tie them together. That desire promoted rapid development of the Internet and all its many manifestations, such as business-to-household and business-to-business electronic commerce (e-commerce). The combination of the computer, fiber-optic cable, wireless technology, and the Internet constitutes a spectacular advance in **information technology,** which has been used to connect all parts of the world.

New Firms and Increasing Returns

Hundreds of new **start-up firms** advanced various aspects of the new information technology. Some of the most successful of these firms include Intel (microchip); Apple, Dell, and Gateway (personal computers); Microsoft and Oracle (computer software); Cisco Systems (Internet switching systems); American Online (Internet service provision); Yahoo (Internet search engine); and Amazon.com (electronic commerce). There are hundreds more! Most of these firms were either "not on the radar" or "a small blip on the radar" 25 years ago. Today they each have billions of annual revenue and employ thousands of workers.

Successful new firms often experience **increasing returns,** which occur *when a firm's output increases by a larger percentage than the increase in its inputs (resources).* For example, suppose that Ima.com decides to double the size of its operations to meet the growing demand for its services. After doubling its plant and equipment and doubling its workforce, say, from 100 workers to 200 workers, it finds that its total output has tripled from 8000 units to 24,000

units. Ima.com has experienced increasing returns; its output has increased by 200 percent while its inputs have increased by only 100 percent. Consequently, its labor productivity has gone up from 80 (= 8000 units/100 workers) to 120 (= 24,000 units/200 workers). Increasing returns boost labor productivity, and this, other things equal, lowers per-unit costs of production. These reductions in costs resulting from larger firm size are *economies of scale* (Table 17.1).

There are a number of sources of increasing returns and economies of scale within the New Economy:

- ***More specialized inputs*** Firms can use more specialized and thus more productive capital and workers as they expand their operations. A growing new e-commerce business, for example, can purchase highly specialized inventory management systems and hire specialized personnel such as accountants, marketing managers, and system maintenance experts.
- ***Spreading of development costs*** Firms can spread high product-development costs over greater output. For example, suppose that a new software product costs $100,000 to develop and only $2 per unit to manufacture and sell. If the firm sells 1000 units of the software, its per-unit cost will be $102 [= ($100,000 + $2000)/1000], but if it sells 500,000 units, the cost will drop to only $2.20 [= ($100,000 + $1 million)/500,000].
- ***Simultaneous consumption*** Many of the products and services of the New Economy can satisfy many customers at the same time. Unlike a gallon of gas that needs to be produced for each buyer, a software program needs to be produced only once. It then becomes available at very low expense to thousands or even millions of buyers. The same is true of entertainment delivered on CDs, movies distributed on film, and information disseminated through the Internet.
- ***Network effects*** Software and Internet service becomes more beneficial to a buyer the greater the number of households and businesses that buy them. When others have Internet service, you can send e-mail messages to them. When they also have software that allows display of documents and photos, you can attach those items to your e-mail messages. These system advantages are called **network effects,** which are *increases in the value of the product to each user, including existing users, as the total number of users rises.* The domestic and global expansion of the Internet, in particular, has produced network effects, as have cell phones, pagers, hand-held computers, and other aspects of wireless communication. Network effects magnify the value of output well beyond the costs of inputs.
- ***Learning by doing*** Finally, firms that produce new products or pioneer new ways of doing business experience increasing returns through **learning by doing.** Tasks that initially may have taken them hours may take them only minutes once the methods are perfected.

Whatever the particular source of increasing returns, the result is higher productivity, which tends to reduce the per-unit cost of producing and delivering products. Table 17.2 lists a number of specific examples of cost reduction from technology in the New Economy.

Global Competition The New Economy is characterized not only by information technology and increasing returns but also by heightened global competition. The collapse of the socialist economies in the

Table 17.2

Examples of Cost Reductions from Technology in the New Economy

- The cost of storing one megabit of information—enough for a 320-page book—fell from $5257 in 1975 to 17 cents in 1999.
- Prototyping each part of a car once took Ford weeks and cost $20,000 on average. Using an advanced 3-D object printer, it cut the time to just hours and the cost to less than $20.
- Studies show that telecommuting saves businesses about $20,000 annually for a worker earning $44,000—a saving in lost work time and employee retention costs, plus gains in worker productivity.
- Using scanners and computers, Weyerhaeuser increased the lumber yield and value from each log by 30 percent.
- Amoco has used 3-D seismic exploration technology to cut the cost of finding oil from nearly $10 per barrel in 1991 to under $1 per barrel today.
- Wal-Mart reduced the operating cost of its delivery trucks by 20 percent through installing computers, global positioning gear, and cell phones in 4300 vehicles.
- Banking transactions on the Internet cost 1 cent each, compared with $1.14 for face-to-face, pen-and-paper communication.

Source: Compiled and directly quoted from W. Michael Cox and Richard Alm, "The New Paradigm," Federal Reserve Bank of Dallas Annual Report, May 2000, various pages.

late 1980s and early 1990s, together with the success of market systems, has led to a reawakening of capitalism throughout the world. The new information technologies have "shrunk the globe" and made it imperative for all firms to lower their costs and prices and to innovate in order to remain competitive. Free-trade zones such as NAFTA and the European Union (EU), along with trade liberalization through the World Trade Organization (WTO), have heightened competition internationally by removing trade protection from domestic firms. The larger geographic markets, in turn, have enabled the firms of the New Economy to expand beyond their national borders.

Macroeconomic Implications

The New Economy has a number of important implications for the macroeconomy. Chief among them is that the higher productivity growth allows the economy to achieve a higher rate of economic growth. A glance back at Figure 17.3 will help make this point. If the shifts of the curves reflect annual changes in the old economy, then the New Economy would be depicted by an outward shift of the production possibilities curve beyond *CD* in Figure 17.3a and a shift of the long-run aggregate supply curve farther to the right than AS_{LR2} in Figure 17.3b. When coupled with economic efficiency and increased total spending, the economy's real GDP would rise by more than that shown. That is, the economy would achieve a higher rate of economic growth.

Faster Noninflationary Growth In this view, the New Economy has a higher "safe speed limit" than the old economy because production capacity rises more rapidly. The New Economy can grow by, say, 4 percent, rather than 2 or 3 percent, each year without igniting demand-pull inflation. Increases in aggregate demand that in the past would have caused inflation do not cause inflation in the New Economy.

In the old economy prices rose as the economy approached its capacity because increased output produced decreasing returns and higher per-unit production costs. But in the New Economy proportionately more spending is for goods and services whose per-unit costs decline as output increases. Even when wage increases rise to match the productivity increases, per-unit production costs and therefore prices remain stable. Global competition in the New Economy also contributes to price stability. Proponents of the New Economy say that increasing returns and global competition explain why inflation remained mild as real GDP rapidly increased between 1995 and 2000.

Low Natural Rate of Unemployment A low natural rate of unemployment (NRU) such as that of 1995–2000 (4 to 5 percent) is also consistent with the New Economy. The information technology reduces frictional unemployment by enabling workers and employers to quickly find each other. And the strong demand for high-tech workers means that high-tech firms are willing to hire and train workers. Thus the transition from old economy to New Economy jobs occurs without creating significant structural unemployment.

Growing Tax Revenues Finally, the faster economic growth in the New Economy means larger increases in personal income and therefore larger increases in government tax revenues. The quick and unexpected elimination of the Federal budget deficit during the last half of the 1990s owed much to the higher growth rate of the New Economy. The Federal government had a budget *deficit* of $160 billion in 1995; in 2000 it had a budget *surplus* of $167 billion!

A caution: Those who champion the idea of a New Economy emphasize that it does not mean that the business cycle is dead. The New Economy is simply one for which the *trend line* of economic growth is steeper than it was in the preceding two decades. Real output may periodically deviate below and above that trend line.

Skepticism about the New Economy

Sound too good to be true? Maybe so! Although most macroeconomists have revised their forecasts for long-term productivity growth upward, others are skeptical about the New Economy and urge a "wait-and-see" approach. Skeptics acknowledge that the economy has experienced a rapid advance of new technology, that many new firms have experienced increasing returns, and that global competition has increased. But they doubt that these factors are sufficiently profound to produce a 10- to 15-year period of substantially higher rates of productivity growth and real GDP growth.

The higher rates of productivity and real GDP growth between 1995 and 2000 *are* consistent with a long-lived New Economy. Unfortunately, they are also consistent with a rapid short-run economic expansion fueled by an extraordinarily brisk rise in

consumption and investment spending. Such *economic booms* raise productivity by increasing real output faster than employment (labor inputs), but they are unsustainable over longer periods. Skeptics point out that productivity surged between 1975 and 1978 and between 1983 and 1986, but in each case soon reverted to its lower long-run trend.

For a time, economic expansions need not create inflation, as long as wage growth does not exceed the growth of productivity. But economic booms eventually create shortages, which produce inflationary pressures. Even industries that have decreasing or constant costs can begin to experience rising costs when the pool of available workers dries up. The excessive demand that is causing the boom eventually raises all prices, including the price of labor. Rising inflation or the threat of rising inflation prompts the Federal Reserve to engineer increases in interest rates. For example, the Fed raised rates in a series of steps in 1999 and 2000.

By reducing investment spending, the higher interest rates dampen some of the inflationary pressure but may inadvertently slow the economy too much, causing recession. In any event, productivity and output growth stall. The higher trend line of productivity inferred from the short-run spurt of productivity proves to be an illusion. Only by looking backward over long periods can economists distinguish the start of a new long-secular trend from a shorter-term boost in productivity related to the business cycle.

Given the different views on the New Economy, what should we conclude? Perhaps the safest conclusions are these:

- We should be pleased with the exceptional performance of the economy between 1995 and 2000, *for its own sake*, whether or not it represents a New Economy (see Global Perspective 17.2). These were remarkable times for the U.S. economy. Although the prospects for a long-lived New Economy are good, it will be several more years before we will be able to declare it a reality.
- We should also remember that economic expansions, no matter how prolonged, are prone to end eventually. In fact, the U.S. economy stalled in early 2001, leading to concerns about recession. In response, the Fed reduced interest rates by a full percentage point in two steps in January 2001. But even a recession does not negate the potential of a New Economy, which is defined in terms of long-run trends of productivity advance and economic growth, not in terms of stability. **(Key Question 9)**

GLOBAL PERSPECTIVE 17.2

Growth Competitiveness Index

The World Economic Forum annually compiles a growth competitiveness index, which uses various factors (such as innovativeness, effective transfer of technology among sectors, efficiency of the financial system, rates of investment, and degree of integration with the rest of the world) to measure the ability of a country to achieve economic growth over time. Here is its latest top 10 list:

Country	Growth Competitiveness Ranking, 2000
United States	1
Singapore	2
Luxembourg	3
Netherlands	4
Ireland	5
Finland	6
Canada	7
Hong Kong, China	8
United Kingdom	9
Switzerland	10

Source: World Economic Forum, www.weforum.org/

QUICK REVIEW 17.3

- Over long time periods, labor productivity growth determines an economy's growth of real wages and its standard of living.
- Many economists believe that the United States has achieved a New Economy of faster productivity growth and higher rates of economic growth.
- The New Economy is based on rapid technological change in the form of the microchip and information technology, increasing returns and lower per-unit costs, and heightened global competition that helps hold down prices.
- The New Economy has a higher "economic speed limit": It can grow more rapidly than the old economy without producing inflation; it can lower the NRU; and it generates large increases in tax revenues. Nonetheless, many economists caution that it is too early to determine whether the New Economy is a lasting long-run trend or a short-lived occurrence.

Is Growth Desirable and Sustainable?

Economists usually take for granted that economic growth is desirable and sustainable. But not everyone agrees.

The Antigrowth View

Critics of growth say industrialization and growth result in pollution, global warming, ozone depletion, and other environmental problems. These adverse spillover costs occur because inputs in the production process reenter the environment as some form of waste. The more rapid our growth and the higher our standard of living, the more waste the environment must absorb—or attempt to absorb. In an already wealthy society, further growth usually means satisfying increasingly trivial wants at the cost of mounting threats to the ecological system.

Critics of growth also argue that there is little compelling evidence that economic growth has solved sociological problems such as poverty, homelessness, and discrimination. Consider poverty: In the antigrowth view, American poverty is a problem of distribution, not production. The requisite for solving the problem is commitment and political courage to redistribute wealth and income, not further increases in output.

Antigrowth sentiment also says that while growth may permit us to "make a better living," it does not give us "the good life." We may be producing more and enjoying it less. Growth means frantic paces on jobs, worker burnout, and alienated employees who have little or no control over decisions affecting their lives. The changing technology at the core of growth poses new anxieties and new sources of insecurity for workers. Both high-level and low-level workers face the prospect of having their hard-earned skills and experience rendered obsolete by an onrushing technology. High-growth economies are high-stress economies, which may impair our physical and mental health.

Finally, critics of high rates of growth doubt that they are sustainable. The planet Earth has finite amounts of natural resources available, and they are being consumed at alarming rates. Higher rates of economic growth simply speed up the degradation and exhaustion of the earth's resources. In this view, slower economic growth that is sustainable is preferable to faster growth.

In Defense of Economic Growth

The primary defense of growth is that it is the path to the greater material abundance and higher living standards desired by the vast majority of people. Rising output and incomes allow people to buy:

> more education, recreation, and travel, more medical care, closer communications, more skilled personal and professional services, and better-designed as well as more numerous products. It also means more art, music, and poetry, theater, and drama. It can even mean more time and resources devoted to spiritual growth and human development.[1]

Growth also enables society to improve the nation's infrastructure, enhance the care of the sick and elderly, provide greater access for the disabled, and provide more police and fire protection. Economic growth may be the only realistic way to reduce poverty, since there is little political support for greater redistribution of income. The way to improve the economic position of the poor is to increase household incomes through higher productivity and economic growth. Also, a no-growth policy among industrial nations might severely limit growth in poor nations. Foreign investment and development assistance in those nations would fall, keeping the world's poor in poverty longer.

Economic growth has not made labor more unpleasant or hazardous, as critics suggest. New machinery is usually less taxing and less dangerous than the machinery it replaces. Air-conditioned workplaces are more pleasant than steamy workshops. Furthermore, why would an end to economic growth reduce materialism or alienation? The loudest protests against materialism are heard in those nations and groups that now enjoy the highest levels of material abundance! The high standard of living that growth provides has increased our leisure and given us more time for reflection and self-fulfillment.

Does growth threaten the environment? The connection between growth and environment is tenuous, say growth proponents. Increases in economic growth need not mean increases in pollution. Pollution is not so much a by-product of growth as it is a "problem of the commons." Much of the environment—streams, lakes, oceans, and the air—is treated as "common property," with no restrictions on its use. The commons have become our dumping

[1] Alice M. Rivlin, *Reviving the American Dream* (Washington, D.C.: Brookings Institution, 1992), p. 36.

grounds; we have overused and debased them. Environmental pollution is a case of spillover or external costs, and correcting this problem involves regulatory legislation, specific taxes ("effluent charges"), or market-based incentives to remedy misuse of the environment.

Those who support growth admit there are serious environmental problems. But they say that limiting growth is the wrong solution. Growth has allowed economies to reduce pollution, be more sensitive to environmental considerations, set aside wilderness, create national parks and monuments, and clean up hazardous waste, while still enabling rising household incomes.

Is growth sustainable? Yes, say the proponents of growth. If we were depleting natural resources faster than their discovery, we would see the prices of those resources rise. That has not been the case for most natural resources; in fact, the prices of most of them have declined. And if one natural resource becomes too expensive, another resource will be substituted for it. Moreover, say economists, economic growth has more to do with the expansion and application of human knowledge and information, not of extractable natural resources. In this view, economic growth is limited only by human imagination.

Some Pleasant Side Effects of the New Economy

According to Economists Jason L. Saving and W. Michael Cox, the New Economy Has Done Much More Than Simply Lift the Standard of Living of Americans.

Saving and Cox contend that the New Economy has reduced crime rates, trimmed welfare rolls, increased charitable contributions, and enhanced minority well-being. Here is their evidence.

Crime Rates Crime rates per 100,000 people clearly plummeted in the 1990s. Between 1990 and 1999, the robbery rate declined by 46 percent, the murder rate by 45 percent, the burglary rate by 41 percent, the motor vehicle theft rate by 39 percent, and the larceny-theft rate by 23 percent.

Although changes in the age composition of the population and increases in the percentage of the population incarcerated explain a substantial portion of the declining crime rate, the strong economy also has significantly contributed. People's job and income prospects influence their decisions to commit crimes. Those who expect a good future by working to earn income are less likely than others to engage in illegal activities. Also, those working full time have less time and energy for participating in illegal activities.

Welfare Rolls In 1994 the number of Americans receiving cash welfare payments (now called Temporary Assistance for Needy Families) reached an all-time high of 5.5 percent of the U.S. population. By 1999 the percentage had declined by more than one-half to 2.5 percent. The landmark Welfare Reform Act of 1996, which set time limits for welfare and established work requirements, explains much of the sharp decline. But an equally substantial part is explained by the strong economic growth and low unemployment rates of the late 1990s. With the buoyant economy, more families were able to extricate themselves from poverty.

Charitable Contributions Increases in charitable giving have also been a pleasant side effect of the expanding economy. Between 1970 and 1980, per capita contributions to charity declined at an average annual rate of .2 percent. During the expansion of the 1980s, such contributions increased at an annual average rate of 1.2 percent. In the 1990s they increased at an average annual rate of 4 percent. In fact, between 1995 and 2000 charitable giving increased by an average of 9 percent annually. The fast economic growth and new wealth associated with the New Economy explain much of this increase in charitable giving.

Minority Well-Being Saving and Cox contend that the strong economic growth and full employment of the past several years has benefited all Americans, including racial and ethnic minorities. For example, between 1993 and 1999 the poverty rate for black families declined from 31.3 to 23.6 percent. Over the same years, the rate for Hispanic families declined from 27.3 to 22.8 percent. In both cases, the percentage declines were larger than the decline for whites.

The unemployment rate also dropped more substantially for blacks and Hispanics than for whites. For blacks, it fell from 13.0 percent in 1993 to 7.6 percent in 2000; for Hispanics, it fell from 10.8 percent to 5.7 percent over those years.

Source: Jason L. Saving and W. Michael Cox, "Some Pleasant Side Effects," Federal Reserve Bank of Dallas, *Southwest Economy*, July–August 2000, pp. 7–12; updated.

SUMMARY

1. Economic growth—measured as either an increase in real output or an increase in real output per capita—increases material abundance and raises a nation's standard of living.
2. The supply factors in economic growth are (a) the quantity and quality of a nation's natural resources, (b) the quantity and quality of its human resources, (c) its stock of capital facilities, and (d) its technology. Two other factors—a sufficient level of aggregate demand and economic efficiency—are necessary for the economy to realize its growth potential.
3. The growth of production capacity is shown graphically as an outward shift of a nation's production possibilities curve or as a rightward shift of its long-run aggregate supply curve. Growth is realized when total spending rises sufficiently to match the growth of production capacity.
4. Since 1950 the annual growth rate of real GDP for the United States has averaged about 3.5 percent; the annual growth rate of real GDP per capita has been about 2.3 percent.
5. U.S. real GDP has grown partly because of increased inputs of labor and primarily because of increases in the productivity of labor. The increases in productivity have resulted mainly from technological progress, increases in the quantity of capital per worker, improvements in the quality of labor, economies of scale, and an improved allocation of labor.
6. Over long time periods, the growth of labor productivity underlies an economy's growth of real wages and its standard of living. Many economists believe that the United States has achieved a New Economy of faster productivity growth and higher rates of economic growth.
7. The New Economy is based on (a) rapid technological change in the form of the microchip and information technology, (b) increasing returns and lower per-unit costs, and (c) heightened global competition that holds down prices.
8. The main sources of increasing returns in the New Economy are (a) use of more specialized inputs as firms grow, (b) the spreading of development costs, (c) simultaneous consumption by consumers, (d) network effects, and (e) learning by doing. Increasing returns mean higher productivity and lower per-unit production costs.
9. Those who champion the New Economy say that it has a lower natural rate of unemployment than did the old economy, can grow more rapidly without producing inflation, and generates higher tax revenues because of faster growth of personal income.
10. Skeptics of the New Economy urge a wait-and-see approach. They point out that surges in productivity and real GDP growth have previously occurred during vigorous economic expansions but do not necessarily represent long-lived trends.
11. Critics of rapid growth say that it adds to environmental degradation, increases human stress, and exhausts the earth's finite supply of natural resources. Defenders of rapid growth say that it is the primary path to the rising living standards nearly universally desired by people, that it need not debase the environment, and that there are no indications that we are running out of resources. Growth is based on the expansion and application of human knowledge, which is limited only by human imagination.

TERMS AND CONCEPTS

economic growth
supply factors
demand factor
efficiency factor
labor productivity
labor-force participation rate
infrastructure
human capital
economies of scale
New Economy
information technology
start-up firms
increasing returns
network effects
learning by doing

STUDY QUESTIONS

1. **Key Question** What are the four supply factors of economic growth? What is the demand factor? What is the efficiency factor? Illustrate these factors in terms of the production possibilities curve.
2. Suppose that Alpha and Omega have identically sized working-age populations but that annual work hours are much greater in Alpha than in Omega. Provide two possible explanations.

3. Suppose that work hours in New Zombie are 200 in year 1 and productivity is $8. What is New Zombie's real GDP? If work hours increase to 210 in year 2 and productivity rises to $10, what is New Zombie's rate of economic growth?
4. What is the relationship between a nation's production possibilities curve and its long-run aggregate supply curve? How does each relate to the idea of a New Economy?
5. **Key Question** Between 1990 and 1999 the U.S. price level rose by about 20 percent while real output increased by about 33 percent. Use the aggregate demand–aggregate supply model to illustrate these outcomes graphically.
6. **Key Question** To what extent have increases in U.S. real GDP resulted from more labor inputs? From higher labor productivity? Rearrange the following contributors to the growth of real GDP in order of their quantitative importance: economies of scale, quantity of capital, improved resource allocation, education and training, technological advance.
7. True or false? If false, explain why.
   a. Technological advance, which to date has played a relatively small role in U.S. economic growth, is destined to play a more important role in the future.
   b. Many public capital goods are complementary to private capital goods.
   c. Immigration has slowed economic growth in the United States.
8. Explain why there is such a close relationship between changes in a nation's rate of productivity growth and changes in its average real hourly wage.
9. **Key Question** Relate each of the following to the New Economy:
   a. The rate of productivity growth
   b. Information technology
   c. Increasing returns
   d. Network effects
   e. Global competition
10. Provide three examples of products or services that can be simultaneously consumed by many people. Explain why labor productivity greatly rises as the firm sells more units of the product or service. Explain why the higher level of sales greatly reduces the per-unit cost of the product.
11. What is meant when economists say that the U.S. economy has "a higher safe speed limit" than it had previously? If the New Economy has a higher safe speed limit, what explains the series of interest-rate hikes engineered by the Federal Reserve in 1999 and 2000?
12. Productivity often rises during economic expansions and falls during economic recessions. Can you think of reasons why? Briefly explain. (Hint: Remember that the level of productivity involves both levels of output and levels of labor input.)
13. **(Last Word)** Explain how rapid U.S. economic growth can reduce crime rates, trim welfare rolls, increase charitable giving, and enhance the well-being of racial and ethnic minorities.
14. **Web-Based Question:** ***Current GDP growth rates and per capita incomes*** The Organization for Economic Cooperation and Development (OECD), at www.oecd.org/std/nahome.htm, via "On-Line Statistics" provides quarterly growth rates of real GDP for OECD member countries and an annual comparison of levels of GDP per capita based on exchange rates and purchasing power parities (PPPs). Which countries have the highest and lowest current GDP growth rates? Which have the highest and lowest per capita incomes? Does there seem to be a relationship? In your comparison, does it matter if you use per capita income based on exchange rates or that based on PPPs? Which is more reliable?
15. **Web-Based Question:** ***Productivity and technology—examples of innovations in computers and communications*** Recent innovations in computers and communications technologies are increasing productivity. Lucent Technologies (formerly Bell Labs), at www.lucent.com/minds/discoveries, provides a timeline of company innovations over the past 80 years. Cite five technological "home runs" (for example, the transistor in 1947) and five technological "singles" (for example, free space optical switching in 1990). Which single innovation do you think has increased productivity the most? List two innovations during the past decade. How might they boost productivity?