Economic Growth

17

LEARNING OBJECTIVES

After reading this chapter, you should be able to:

1. Show how small differences in growth rates can lead to large differences in living standards.
2. Explain why GDP per capita is the product of average labor productivity and the proportion of the population that is employed and use this decomposition to discuss the sources of economic growth.
3. Discuss the determinants of average labor productivity within a particular country and use these concepts to analyze per capita GDP differences across countries.
4. Compare and contrast the benefits of economic growth with its costs.
5. Discuss and evaluate government policies that promote economic growth.
6. Understand the trade-offs between economic growth and environmental quality.

No doubt you can think of enormous changes in the way average people live, even over the past few decades. Computer technologies and the Internet have changed the ways people work and study in just a few years, for example. Though these changes are due in large part to scientific advances, such discoveries *by themselves* usually have little effect on most people's lives. New scientific knowledge leads to widespread improvements in living standards only when it is commercially applied. Better understanding of the human immune system, for example, has little impact unless it leads to new therapies or drugs. And a new drug will do little to help unless it is affordable to those who need it.

A tragic illustration of this point is the AIDS epidemic in Africa. Although some new drugs will moderate the effects of the virus that causes AIDS, they are so expensive that they are of little practical value in poverty-stricken African nations grappling with the disease. But even if the drugs were affordable, they would have limited benefit without modern hospitals, trained health professionals, and adequate nutrition and sanitation. In short, most improvements in a nation's living standards are the result not just of scientific and technological advances but of an economic system that makes the benefits of those advances available to the average person.

In this chapter we will explore the sources of economic growth and rising living standards in the modern world. We will begin by reviewing the remarkable

economic growth in the industrialized countries, as measured by real GDP per person. Since the mid-nineteenth century (and earlier in some countries), a radical transformation in living standards has occurred in these countries. What explains this transformation? The key to rising living standards is a *continuing increase in average labor productivity*, which depends on several factors, from the skills and motivation workers bring to their jobs to the legal and social environment in which they work. We will analyze each of these factors and discuss its implications for government policies to promote growth. We also will discuss the costs of rapid economic growth and consider whether there may be limits to the amount of economic growth a society can achieve.

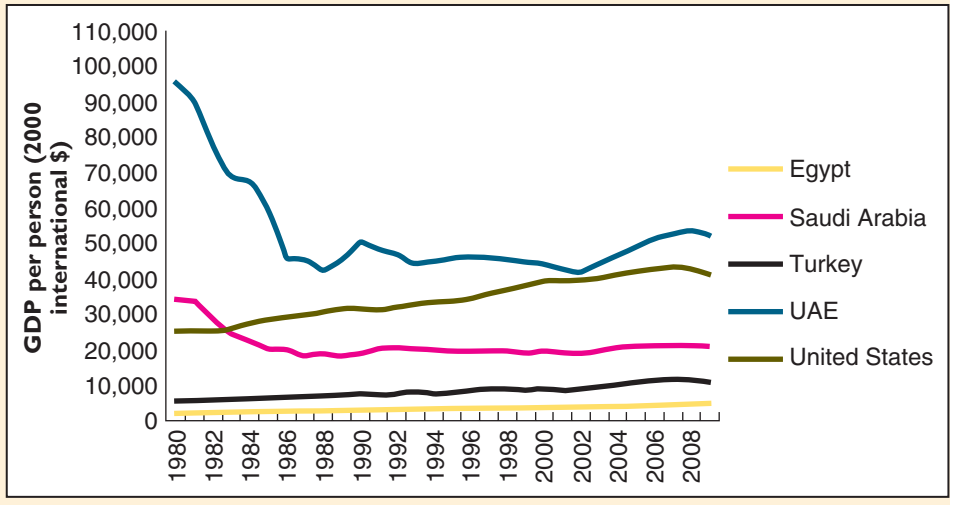
17.1 THE REMARKABLE RISE IN LIVING STANDARDS: THE RECORD

The advances in health care and transportation mentioned in the beginning of this chapter illustrate only a few of the impressive changes that have taken place in people's material well-being over the past two centuries, particularly in industrialized countries like the United States. To study the factors that affect living standards systematically, however, we must go beyond anecdotes and adopt a specific measure of economic well-being in a particular country and time.

In Chapter 14, we introduced the concept of real GDP as a basic measure of the level of economic activity in a country. Recall that, in essence, real GDP measures the physical volume of goods and services produced within a country's borders during a specific period, such as a quarter or a year. Consequently, real GDP *per person* provides a measure of the quantity of goods and services available to the typical resident of a country at a particular time. Although real GDP per person is certainly not a perfect indicator of economic well-being, as we saw in Chapter 14, it is positively related to a number of pertinent variables, such as life expectancy, infant health, and literacy. Lacking a better alternative, economists have focused on real GDP per person as a key measure of a country's living standard and stage of economic development.

Figure 17.1 shows the changes in real GDP per person that occurred in five countries between 1980 and 2009. GDP per person in the United States experienced remarkable growth in the past three decades, from about $25,531 in 1980 to

FIGURE 17.1
Output per Person, 1980–2009.
The lines show the output per worker in five economies since 1980. Relative to 1980, output per person today is 2.11 times greater in Egypt, 1.96 times greater in Turkey, 1.6 times greater in the United States, and about half the size in Saudi Arabia and the UAE.



SOURCE: World Bank, *World Development Indicators* (http://databank.worldbank.org).

$43,662 in 2006, before dipping slightly in 2008 and 2009. Of these five countries, the UAE had the highest GDP per person in 1980 at $95,434, but the country registered a sharp decline to just $52,434 in 2009. Nevertheless, the UAE's real GDP per person remains one of the highest in the world. Saudi Arabia, on the other hand, has kept its GDP per person at a relatively steady level; it declined from $34,598 in 1980 to $19,162 in 1990, then fluctuated tightly around $20,000 through 2009. GDP per person in Egypt and Turkey experienced moderate growth with frequent bouts of declines or slowdowns. Egypt's GDP per person was $2,431 in 1980 and barely reached $5,151 in 2009, whereas Turkey's was $5,693 in 1980 and $11,208 in 2009.

Figure 17.2 shows the changes in real GDP per worker that occurred between 1980 and 2008. The observed trends are consistent with those that appear in Figure 17.1. Real GDP per worker in the United States has experienced remarkable growth from $41,649 in 1980 to $65,480 in 2008. Both Saudi Arabia and the UAE experienced a decrease in real GDP per worker from $52,476 and $55,466 in 1980 to $28,460 and $21,001 in 2008, respectively. Egypt and Turkey, on the other hand, experienced moderate growth from $7,627 and 11,322 in 1980 to $13,248 and $26,187 in 2008, respectively.

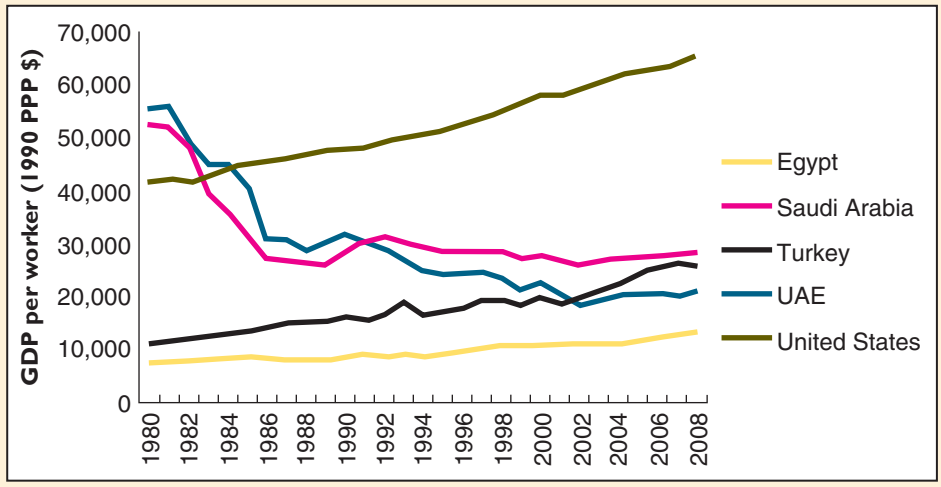


FIGURE 17.2
Output per worker, 1980–2008.
The lines show the output per worker in five economies since 1980. Relative to 1980, output per worker is 2.3 times greater in Turkey, 1.73 times greater in Egypt, 1.57 times greater in the United States, about half the size in Saudi Arabia, and about one-third the size in the UAE.

SOURCE: World Bank, *World Development Indicators* (http://databank.worldbank.org).

For comparison, Table 17.1 shows real GDP per person in eight countries in selected years from 1870 to 2008. The data in Table 17.1 tell a dramatic story. For example, in the United States (which was already a relatively wealthy industrialized country in 1870), real GDP per person grew more than twelve-fold between 1870 and 2008. Japan's real GDP per person grew more than 30 times over the same period, Germany's grew more than 11 times, China's grew more than 12 times, and Turkey's and Iran's grew about 10 times. In contrast, real GDP per person in Egypt and Morocco grew only about 6 times. Underlying these statistics is an amazingly rapid process of economic growth and transformation, at least for some countries, through which in just a few generations relatively poor agrarian societies became highly industrialized economies—with average standards of living that could scarcely have been imagined in 1870.

A note of caution is in order. The farther back in time we go, the less precise are historical estimates of real GDP. Most governments did not keep official GDP statistics until after World War II; production records from earlier periods are often incomplete or of questionable accuracy. Comparing economic output over a century or more is also problematic because many goods and services that are

TABLE 17.1
Real GDP per Person in Selected Countries, 1870–2008

Country	1870	1913	1950	1979	2008	Annual % change 1870–2008	Annual % change 1950–2008	Annual % change 1979–2008
United States	2,445	4,301	9,561	18,789	31,178	1.86	2.06	1.76
Germany	1,839	3,648	3,881	13,993	20,801	1.77	2.93	1.37
Japan	737	1,387	1,921	13,163	22,816	2.51	4.35	1.91
China	530	552	448	1,039	6,725	1.85	4.78	6.65
Turkey	825	1,213	1,623	4,133	8,066	1.66	2.80	2.33
Egypt	649	902	910	1,930	3,725	1.27	2.46	2.29
Morocco	563	710	1,455	2,122	3,465	1.32	1.50	1.70
Iran	719	1,000	1,720	4,817	6,944	1.65	2.43	1.27

SOURCE: Angus Maddison, *The World Economy: A Millennial Perspective* (Paris: OECD, 2001), updated tables downloaded from www.ggdc.net/ maddison. Based to 1990 International Geary-Khamis dollars. "Germany" refers to West Germany in 1950 and 1979.

produced today were unavailable—indeed, inconceivable—in 1870. How many nineteenth-century horse-drawn wagons, for example, would be the economic equivalent of a BMW 328i automobile or a Boeing 757 jet? Despite the difficulty of making precise comparisons, however, we can say with certainty that the variety, quality, and quantity of available goods and services increased enormously in industrialized countries during the nineteenth and twentieth centuries, a fact reflected in the data on real GDP per capita.

17.2 WHY "SMALL" DIFFERENCES IN GROWTH RATES MATTER

The last three columns of Table 17.1 show the annual growth rates of real GDP per person, for both the entire 1870–2008 period and two more recent periods. At first glance, these growth rates don't seem to differ much from country to country. For example, for the period 1870–2008, the highest growth rate is 2.51 percent (Japan) and the lowest is 1.27 percent (Egypt). But consider the long-run effect of this seemingly "small" difference in annual growth rates. In 1870, in terms of output per person, Germany was about three times as rich as Morocco. Yet, by 2008, Germany was six times richer than Morocco. This widening of the gap between these two countries is the result of the apparently small difference between a 1.77 percent growth rate and a 1.32 percent growth rate, maintained over 138 years.

The fact that what seem to be small differences in growth rates can have large long-run effects results from what is called the power of compounding, which is often illustrated by *compound interest*.

Compound interest (1)

In 1800 your great-great-grandfather deposited $10.00 in a checking account at 4 percent interest. Interest is compounded annually (so that interest paid at the end of each year receives interest itself in later years). Great-Grandpa's will specified that the account be turned over to his most direct descendant (you) in the year 2005. When you withdrew the funds in that year, how much was the account worth?

The account was worth $10.00 in 1800; $\$10.00 \times 1.04 = \$10.40$ in 1801; $\$10.00 \times 1.04 \times 1.04 = \$10.00 \times (1.04)^2 = \$10.82$ in 1802; and so on. Since 205

years elapsed between 1800, when the deposit was made, and the year 2005, when the account was closed, the value of the account in the year 2005 was $\$10.00 \times (1.04)^{205}$, or $\$10.00 \times 1.04$ to the 205th power. Using a calculator, you will find that \$10.00 times 1.04 to the 205th power is \$31,033.77—a good return for a \$10.00 deposit! ◆

Compound interest—an arrangement in which interest is paid not only on the original deposit but on all previously accumulated interest—is distinguished from *simple interest*, in which interest is paid only on the original deposit. If your great-great-grandfather's account had been deposited at 4 percent simple interest, it would have accumulated only 40 cents each year (4 percent of the original \$10.00 deposit), for a total value of $\$10.00 + 205 \times \$0.40 = \$92.00$ after 205 years. The tremendous growth in the value of his account came from the compounding of the interest—hence the phrase "the power of compound interest."

compound interest the payment of interest not only on the original deposit but on all previously accumulated interest

Compound interest (2)

Continuing with the previous example, what would your great-great-grandfather's \$10.00 deposit have been worth after 205 years if the annual interest rate had been 2 percent? 6 percent?

At 2 percent interest, the account would be worth \$10.00 in 1800; $\$10.00 \times 1.02 = \$10.20$ in 1801; $\$10.00 \times (1.02)^2 = \$10.40$ in 1802; and so on. In the year 2005, the value of the account would be $\$10.00 \times (1.02)^{205}$, or \$579.48. If the interest rate were 6 percent, after 205 years the account would be worth $\$10.00 \times (1.06)^{205}$, or \$1,540,644.29. Let's summarize the results of these two examples:

Interest rate (%)	Value of \$10 after 205 years
2	\$579.48
4	\$31,033.77
6	\$1,540,644.29

The power of compound interest is that, even at relatively low rates of interest, a small sum, compounded over a long enough period, can greatly increase in value. A more subtle point, illustrated by this example, is that small differences in interest rates matter a lot. The difference between a 2 percent and a 4 percent interest rate doesn't seem tremendous, but over a long period of time it implies large differences in the amount of interest accumulated on an account. Likewise, the effect of switching from a 4 percent to a 6 percent interest rate is enormous, as our calculations show.[1] ◆

Economic growth rates are similar to compound interest rates. Just as the value of a bank deposit grows each year at a rate equal to the interest rate, so the size of a nation's economy expands each year at the rate of economic growth. This analogy suggests that even a relatively modest rate of growth in output per person—say, 1 to 2 percent per year—will produce tremendous increases in average living standards over a long period. And relatively small *differences* in growth rates, as in the case of Germany and Morocco, will ultimately produce very different living standards.

[1] Economists employ a useful formula for approximating the number of years it will take for an initial amount to double at various growth or interest rates. The formula is 72 divided by the growth or interest rate. Thus, if the interest rate is 2 percent per year, it will take 72/2 = 36 years for the initial sum to double. If the interest rate is 4 percent, it will take 72/4 = 18 years. This formula is a good approximation only for small and moderate interest rates.

Over the long run, then, the rate of economic growth is an extremely important variable. Hence, government policy changes or other factors that affect the long-term growth rate even by a small amount will have a major economic impact.

EXERCISE 17.1

Suppose that real GDP per capita in the United States had grown at 2.51 percent per year, as Japan's did, instead of the actual 1.86 percent per year, from 1870 to 2008. How much larger would real GDP per person have been in the United States in 2008?

17.3 WHY NATIONS BECOME RICH: THE CRUCIAL ROLE OF AVERAGE LABOR PRODUCTIVITY

What determines a nation's economic growth rate? To get some insight into this vital question, we will find it useful to express real GDP per person as the product of two terms: average labor productivity and the share of the population that is working.

To do this, let Y equal total real output (as measured by real GDP, for example), N equal the number of employed workers, and POP equal the total population. Then real GDP per person can be written as Y/POP; **average labor productivity**, or output per employed worker, equals Y/N; and the share of the population that is working is N/POP. The relationship between these three variables is

average labor productivity
output per employed worker

$$\frac{Y}{POP} = \frac{Y}{N} \times \frac{N}{POP},$$

which, as you can see by canceling out N on the right-hand side of the equation, always holds exactly. In words, this basic relationship is

$$\begin{aligned}\text{Real GDP per person} = {} & \text{Average labor productivity} \\ & \times \text{Share of population employed}\end{aligned}$$

This expression for real GDP per person tells us something very basic and intuitive: The quantity of goods and services that each person can consume depends on (1) how much each worker can produce and (2) how many people (as a fraction of the total population) are working. Furthermore, because real GDP per person equals average labor productivity times the share of the population that is employed, real GDP per person can *grow* only to the extent that there is *growth* in worker productivity and/or the fraction of the population that is employed.

Figure 17.3 shows the U.S. figures for real GDP per worker (average labor productivity) and the portion of the entire U.S. population (not just the working-age population) that was employed over the period 1950–2010. Between 1950 and 2010, real GDP per person in the United States grew by 184 percent from $36,350 to $103,320. Thus, in 2010, the average American enjoyed almost 3 times as many goods and services as in 1950. We also observe that the share of the population holding a job grew by 12.5 percent, from 40 percent in 1950 to 45 percent in 2010, down from a peak of 49 percent in 1998–2001 and 2006–2007. Overall, such simultaneous increases in both labor productivity and the share of the population holding a job have clearly contributed to the rise in living standards in the United States.

Figure 17.4 shows average labor productivity and the portion of the Moroccan population that was employed over the period 1960–2010. Real GDP per person grew by 133 percent (from $5,500 to $12,815) and the share of the population holding a job grew by 27.6 percent (from 29 percent to 37 percent) between 1960 and 2010. Thus, in 2010, the average Moroccan enjoyed more than 2 times as

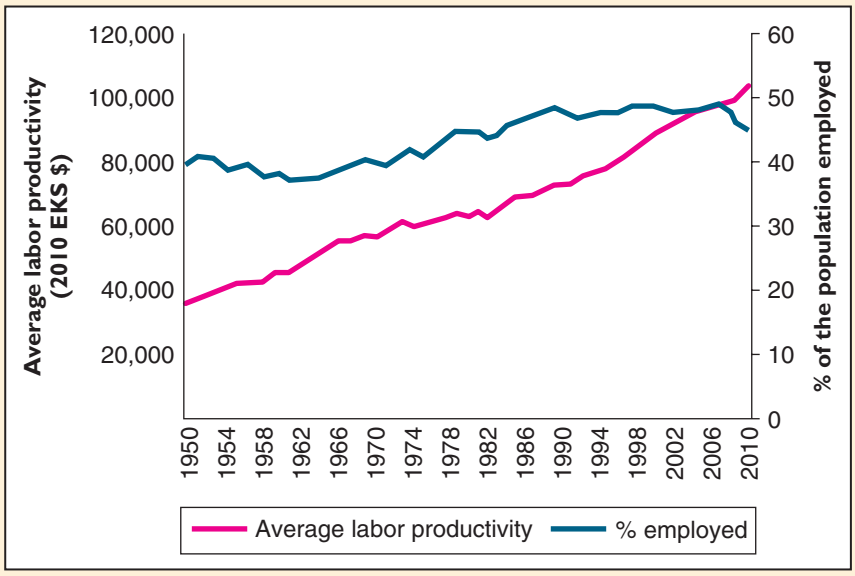


FIGURE 17.3
Average Labor Productivity and Share of Population with Jobs in the United States, 1950–2010.

SOURCE: The Conference Board and Groningen Growth and Development Centre (http://www.conference-board.org/economics).

many goods and services as in 1960. Both the average labor productivity and the share of the population with jobs have clearly contributed to the growth in Morocco's output per person.

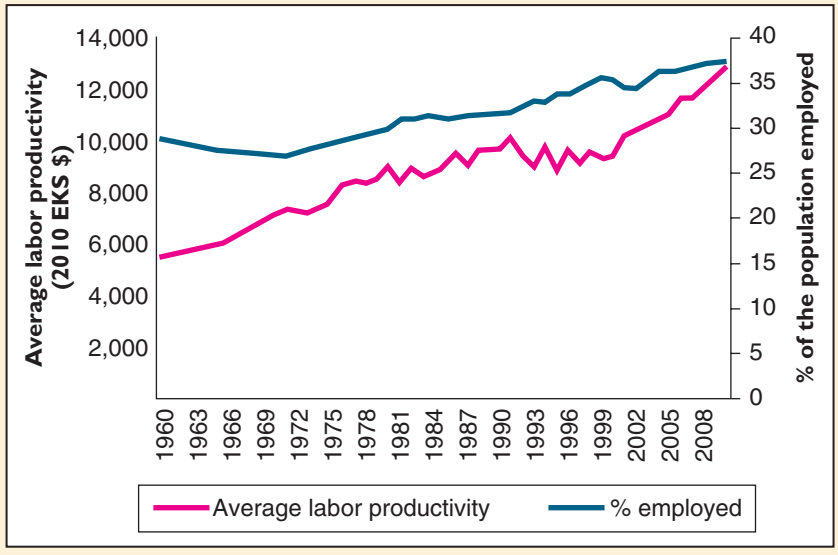
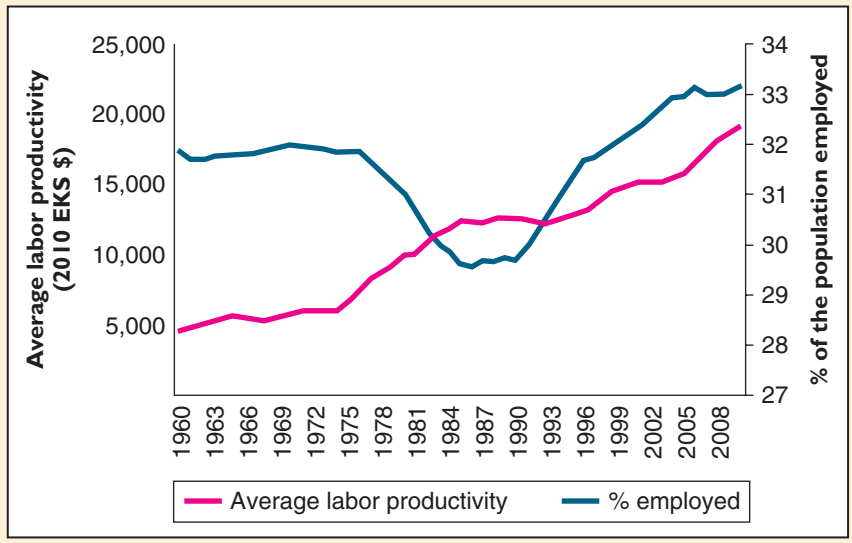


FIGURE 17.4
Average Labor Productivity and Share of Population with Jobs in Morocco, 1960–2010.

SOURCE: The Conference Board and Groningen Growth and Development Centre (http://www.conference-board.org/economics).

Figure 17.5 shows average labor productivity and the portion of the Egyptian population that was employed over the period 1960–2010. Consistent with the other figures, average labor productivity grew by 314 percent (from $4,617 to $19,122) and the share of the population with jobs grew by only 3 percent (from 32 percent to 33 percent) between 1960 and 2010. Hence, in 2010, Egyptians

FIGURE 17.5
Average Labor Productivity and Share of Population with Jobs in Egypt, 1960–2010.



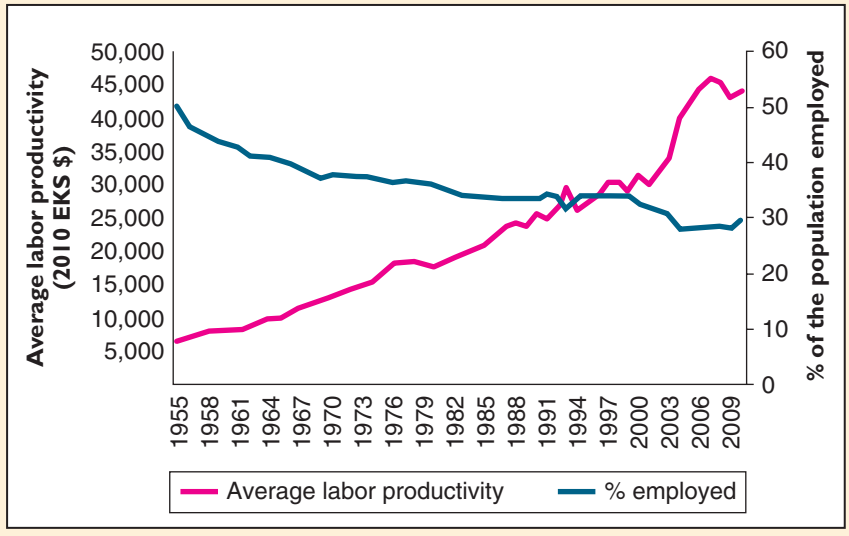
SOURCE: The Conference Board and Groningen Growth and Development Centre (http://www.conference-board.org/economics).

enjoyed more than 4 times as many goods and services as in 1960 despite no observable improvements in the share of the population with jobs. Once again, average labor productivity is the driving force in the growth of Egypt's standards of living, as measured by output per person.

Figure 17.6 shows average labor productivity and the portion of the Turkish population that was employed over the period 1955–2010. Average labor productivity grew by 556 percent (from $6,706 to $44,040) between 1955 and 2010. In contrast, however, the share of the population with jobs declined by 40 percent (from 50 percent to 30 percent). Just like other countries, we can see that Turkey owes its increase in standards of living solely to its average labor productivity.

Let's look a bit more closely at these two contributing factors, beginning with the share of the population that is employed. In the United States, the growing

FIGURE 17.6
Average Labor Productivity and Share of Population with Jobs in Turkey, 1955–2010.



SOURCE: The Conference Board and Groningen Growth and Development Centre (http://www.conference-board.org/economics).

tendency of women to work outside the home was the most important reason for the rise in employment. Another factor leading to higher rates of employment was an increase in the share of the general population that is of working age (ages 16 to 65). The coming of age of the "baby boom" generation, born in the years after World War II, and to a lesser extent the immigration of young workers from other countries, helped cause this growth in the workforce.

Although the rising share of the U.S. population with jobs contributed significantly to the increase in real GDP per person during the past four decades, this trend almost certainly will not continue in the future. Women's participation in the labor force seems unlikely to continue rising at the same rate as in the past four decades. More important, the baby boom generation began to reach retirement age around the year 2010. As more and more baby boomers retire, the fraction of the population that is employed will begin to drop, probably significantly. In the long run, then, the improvement in living standards brought about by the rising share of Americans with jobs will likely prove transitory.

Figure 17.7 shows the labor force participation rate of females in the four selected countries from 1980 to 2008. The average labor force participation rate in the United States over this period is about 57 percent, versus about 26 percent, 25 percent, and 30 percent in Egypt, Morocco, and Turkey, respectively. While female participation in the labor force may have reached a steady state in the United States and may not contribute to the country's standards of living, it remains remarkably high. The data for Egypt, Morocco, and Turkey provide interesting, yet potentially troubling, insight about the role played by the share of the population with jobs in improving standards of living. As Figure 17.7 shows, female labor force participation has been on a downward trend in Egypt and Turkey and virtually constant in Morocco. This raises an important question about the likely prospects for increased female labor participation going into the future. In fact, although beyond the scope of this chapter, it is worth noting that these countries suffer from a number of symptoms that may prevent the share of the population with jobs from contributing positively to the standard of living. First, major social, political, and economic changes may be required to reverse the downward trend in female labor force participation and to bring it up to a level compa-

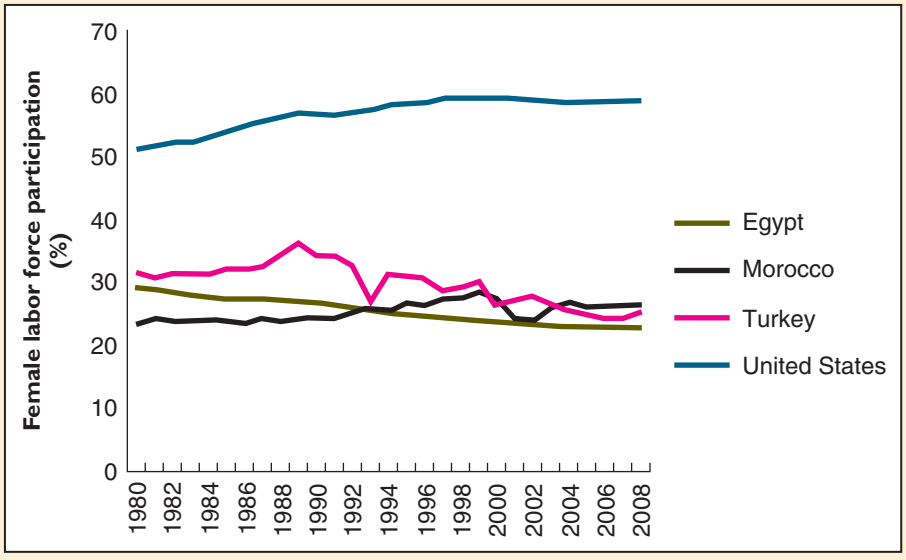


FIGURE 17.7
Female Labor Force Participation, 1980–2008.

SOURCE: International Labour Organization, Key Indicators of the Labour Market database. (http://kilm.ilo.org/KILMnetBeta/default2.asp).

rable to other industrialized nations such as the United States. Such changes take time and a substantial amount of resources. Hence, in the absence of immediate reforms, this process is likely to be slow, potentially extending over generations. Second, these countries have youth-bulged populations that will present further challenges going into the future as the younger generations enter the workforce. In light of this, just like in the United States, the share of the population with jobs is not likely to contribute positively to the standards of living in these countries.

This quick look at data for the United States, Egypt, Morocco, and Turkey supports a more general conclusion. *Increases in output per person arise primarily from increases in average labor productivity.* Furthermore, the more people can produce, the more they can consume. To understand why economies grow, then, we must understand the reasons for increased labor productivity.

RECAP | **ECONOMIC GROWTH AND PRODUCTIVITY**

Real GDP per person, a basic indicator of living standards, has grown dramatically in most countries. This growth reflects the *power of compound interest*: Even a modest growth rate, if sustained over a long period of time, can lead to large increases in the size of the economy.

Output per person equals average labor productivity times the share of the population that is employed. Increases in output per person and hence living standards arise primarily from increases in average labor productivity.

17.4 THE DETERMINANTS OF AVERAGE LABOR PRODUCTIVITY

What determines the productivity of the average worker in a particular country at a particular time? Popular discussions of this issue often equate worker productivity with the willingness of workers of a given nationality to work hard. Everything else being equal, a culture that promotes hard work certainly tends to increase worker productivity. But intensity of effort alone cannot explain the huge differences in average labor productivity that we observe around the world. For example, average labor productivity in the United States is about 24 times what it is in Indonesia and 100 times what it is in Bangladesh, though there is little doubt that Indonesians and Bangladeshis work very hard.

In this section we will examine six factors that appear to account for the major differences in average labor productivity, both between countries and between generations. Later in the chapter we will discuss how economic policies can influence these factors to spur productivity and growth.

17.4.1 HUMAN CAPITAL

To illustrate the factors that determine average labor productivity, we introduce two prototypical assembly line workers, Hala and Jana.

Hala and Jana on the assembly line

Hala and Jana have jobs wrapping chocolate candies and placing them into boxes. Hala, a novice wrapper, can wrap only 100 candies per hour. Jana, who has had on-the-job training, can wrap 300 candies per hour. Both Hala and Jana work 40 hours per week. What is average labor productivity, in terms of candies wrapped per week and candies wrapped per hour, (a) for Hala, (b) for Jana, and (c) for Hala and Jana as a team?

We have defined average labor productivity in general terms as output per worker. Note, though, that the measurement of average labor productivity depends on the time period that is specified. For example, the data presented in Figures 17.3–17.6 tell us how much the average worker produces *in a year*. In this example we are concerned with how much Hala and Jana can produce *per hour* of work or *per week* of work. Any one of these ways of measuring labor productivity is equally valid, as long as we are clear about the time unit we are using.

Hala and Jana's hourly productivities are given in the problem: Hala can wrap 100 candies per hour and Jana can wrap 300. Hala's weekly productivity is (40 hours/week) × (100 candies wrapped/hour) = 4,000 wrapped candies per week. Jana's weekly productivity is (40 hours/week) × (300 candies wrapped/hour), or 12,000 candies per week.

Together, Hala and Jana can wrap 16,000 candies per week. As a team, their average weekly productivity is (16,000 candies wrapped)/(2 weeks of work), or 8,000 candies per week. Their average hourly productivity as a team is (16,000 candies wrapped)/(80 hours of work) = 200 candies per hour. Notice that, taken as a team, the two women's productivity lies midway between their individual productivities. ◆

Jana is more productive than Hala because she has had on-the-job training, which has allowed her to develop her candy-wrapping skills to a higher level than Hala's. Because of her training, Jana can produce more than Hala can in a given number of hours.

EXERCISE 17.2

Suppose Jana attends additional classes in candy wrapping and learns how to wrap 500 candies per hour. Find the output per week and output per hour for Hala and Jana, both individually and as a team.

Economists would explain the difference in the two women's performance by saying that Jana has more human capital than Hala. **Human capital** comprises the talents, education, training, and skills of workers. Workers with a large stock of human capital are more productive than workers with less training. For example, a secretary who knows how to use a word-processing program will be able to type more letters than one who doesn't; an auto mechanic who is familiar with computerized diagnostic equipment will be able to fix engine problems that less-well-trained mechanics could not.

human capital an amalgam of factors such as education, training, experience, intelligence, energy, work habits, trustworthiness, initiative, and others that affect the value of a worker's marginal product

Why did West Germany and Japan recover so successfully from the devastation of World War II?

Germany and Japan sustained extensive destruction of their cities and industries during World War II and entered the postwar period impoverished. Yet within 30 years both countries had not only been rebuilt but had become worldwide industrial and economic leaders. What accounts for these "economic miracles"?

Many factors contributed to the economic recovery of West Germany and Japan from World War II. Most economists agree, however, that high levels of human capital played a crucial role in both countries. At the end of the war, Germany's population was exceptionally well-educated, with a large number of highly-qualified scientists and engineers. The country also had (and still does today) an extensive apprentice system that provided on-the-job training to young workers. As a result, Germany had a skilled industrial workforce. In addition, the area that became West Germany benefited substantially from an influx of skilled

workers from East Germany and the rest of Soviet-controlled Europe, including 20,000 trained engineers and technicians. Beginning as early as 1949, this concentration of human capital contributed to a major expansion of Germany's technologically sophisticated, highly productive manufacturing sector. By 1960 West Germany was a leading exporter of high-quality manufactured goods, and its citizens enjoyed one of the highest standards of living in Europe.

Japan, which probably sustained greater physical destruction in the war than Germany, also began the postwar period with a skilled and educated labor force. Even more so than the Germans, however, the Japanese emphasized on-the-job training. As part of a lifetime employment system, under which workers were expected to stay with the same company their entire career, Japanese firms invested extensively in worker training. The payoff to these investments in human capital was a steady increase in average labor productivity, particularly in manufacturing. By the 1980s, Japanese manufactured goods were among the most advanced in the world and Japan's workers among the most skilled.

Although high levels of human capital were instrumental in the rapid economic growth of West Germany and Japan, human capital alone cannot create a high living standard. A case in point is Soviet-dominated East Germany, which had a level of human capital similar to West Germany's after the war but did not enjoy the same economic growth. For reasons we will discuss later in the chapter, the communist system imposed by the Soviets utilized East Germany's human capital far less effectively than the economic systems of Japan and West Germany. ◆

Human capital is analogous to physical capital (such as machines and factories) in that it is acquired primarily through the investment of time, energy, and money. For example, to learn how to use a word-processing program, a secretary might need to attend a technical school at night. The cost of going to school includes not only the tuition paid but also the *opportunity cost* of the secretary's time spent attending class and studying. The benefit of the schooling is the increase in wages the secretary will earn when the course has been completed. We know from the Cost–Benefit Principle that the secretary should learn word processing only if the benefits exceed the costs, including the opportunity costs. In general, then, we would expect to see people acquire additional education and skills when the difference in the wages paid to skilled and unskilled workers is significant.

17.4.2 PHYSICAL CAPITAL

Workers' productivity depends not only on their skills and effort but on the tools they have to work with. Even the most skilled surgeon cannot perform open-heart surgery without sophisticated equipment, and an expert computer programmer is of limited value without a computer. These examples illustrate the importance of *physical capital* such as factories and machines. More and better capital allows workers to produce more efficiently, as the next example shows.

Hala and Jana get automated

Continuing with the earlier example, suppose that Hala and Jana's boss acquired an electric candy-wrapping machine, which is designed to be operated by one worker. Using this machine, an untrained worker can wrap 500 candies per hour. What are Hala and Jana's hourly and weekly outputs now? Will the answer change if the boss gets a second machine? A third?

Suppose for the sake of simplicity that a candy-wrapping machine must be assigned to one worker only. (This assumption rules out sharing arrangements, in which one worker uses the machine on the day shift and another on the night

shift.) If the boss buys just one machine, she will assign it to Hala. (Why? See Exercise 17.3.) Now Hala will be able to wrap 500 candies per hour, while Jana can wrap only 300 per hour. Hala's weekly output will be 20,000 wrapped candies (40 hours × 500 candies wrapped per hour). Jana's weekly output is still 12,000 wrapped candies (40 hours × 300 candies wrapped per hour). Together they can now wrap 32,000 candies per week, or 16,000 candies per week each. On an hourly basis, average labor productivity for the two women taken together is 32,000 candies wrapped per 80 hours of work, or 400 candies wrapped per hour—twice their average labor productivity before the boss bought the machine.

With two candy-wrapping machines available, both Hala and Jana could use a machine. Each could wrap 500 candies per hour, for a total of 40,000 wrapped candies per week. Average labor productivity for both women taken together would be 20,000 wrapped candies per week, or 500 wrapped candies per hour.

What would happen if the boss purchased a third machine? With only two workers, a third machine would be useless: it would add nothing to either total output or average labor productivity. ◆

EXERCISE 17.3

Using the assumptions made in the examples above, explain why the boss should give the single available candy-wrapping machine to Hala rather than Jana. (*Hint:* Apply the Principle of Increasing Opportunity Cost.)

Increasing Opportunity Cost

The candy-wrapping machine is an example of a *capital good*, which was defined Chapter 14 as a long-lived good, which is itself produced and used to produce other goods and services. Capital goods include machines and equipment (such as computers, earthmovers, or assembly lines) as well as buildings (such as factories or office buildings).

Capital goods like the candy-wrapping machine enhance workers' productivity. Table 17.2 summarizes the results of our Hala and Jana examples. For each number of machines the boss might acquire (column 1), Table 17.2 gives the total weekly output of Hala and Jana taken together (column 2), the total number of hours worked by the two women (column 3), and average output per hour (column 4), equal to total weekly output divided by total weekly hours.

TABLE 17.2
Capital, Output, and Productivity in the Candy-Wrapping Factory

(1) Number of machines (capital)	(2) Total number of candies wrapped each week (output)	(3) Total hours worked per week	(4) Candies wrapped per hour worked (productivity)
0	16,000	80	200
1	32,000	80	400
2	40,000	80	500
3	40,000	80	500

Table 17.2 demonstrates two important points about the effect of additional capital on output. First, for a given number of workers, adding more capital generally increases both total output and average labor productivity. For example, adding the first candy-wrapping machine increases weekly output (column 2) by 16,000 candies and average labor productivity (column 4) by 200 candies wrapped per hour.

diminishing returns to capital if the amount of labor and other inputs employed is held constant, then the greater the amount of capital already in use, the less an additional unit of capital adds to production

The second point illustrated by Table 17.2 is that, the more capital that is already in place, the smaller the benefits of adding extra capital. Notice that the first machine adds 16,000 candies to total output, but the second machine adds only 8,000. The third machine, which cannot be used since there are only two workers, does not increase output or productivity at all. This result illustrates a general principle of economics, called **diminishing returns to capital**: if the amount of labor and other inputs employed is held constant, then the greater the amount of capital already in use, the less an additional unit of capital adds to production. In the case of the candy-wrapping factory, diminishing returns to capital implies that the first candy-wrapping machine acquired adds more output than the second, which in turn adds more output than the third.

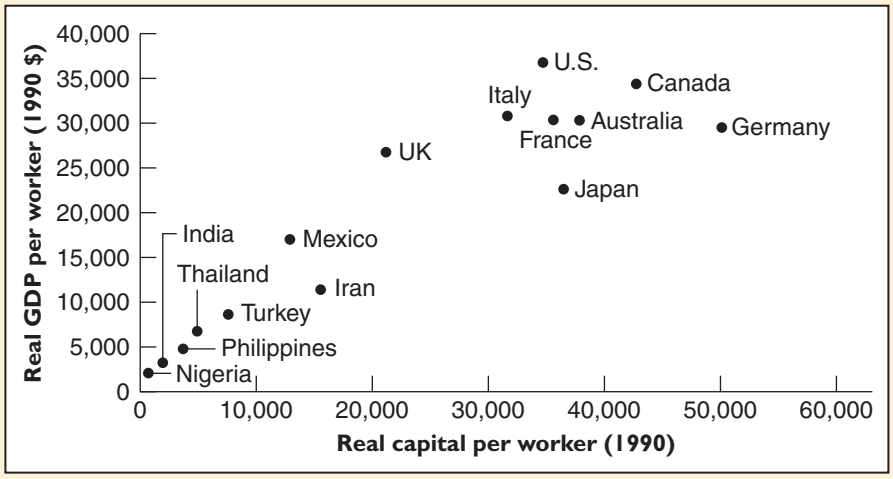
Increasing Opportunity Cost

Diminishing returns to capital are a natural consequence of firms' incentive to use each piece of capital as productively as possible. To maximize output, managers will assign the first machine that a firm acquires to the most productive use available, the next machine to the next-most productive use, and so on—an illustration of the Principle of Increasing Opportunity Cost, or Low-Hanging-Fruit Principle. When many machines are available, all the highly productive ways of using them already have been exploited. Thus, adding yet another machine will not raise output or productivity by very much. If Hala and Jana are already operating two candy-wrapping machines, there is little point to buying a third machine, except perhaps as a replacement or spare.

The implications of Table 17.2 can be applied to the question of how to stimulate economic growth. First, increasing the amount of capital available to the workforce will tend to increase output and average labor productivity. The more adequately equipped workers are, the more productive they will be. Second, the degree to which productivity can be increased by an expanding stock of capital is limited. Because of diminishing returns to capital, an economy in which the quantity of capital available to each worker is already very high will not benefit much from further expansion of the capital stock.

Is there empirical evidence that giving workers more capital makes them more productive? Figure 17.8 shows the relationship between average labor productivity (real GDP per worker) in 1990 and the amount of capital per worker in 15 countries. The figure shows a strong relationship between the amounts of capital per worker and productivity, consistent with the theory. Note, though, that the relationship between capital and productivity is somewhat weaker for the richest countries. For example, Germany has more capital per worker than

FIGURE 17.8
Average Labor Productivity and Capital per Worker in 15 Countries, 1990.
Countries with large amounts of capital per worker also tend to have high average labor productivity, as measured by real GDP per worker.



SOURCE: Penn World Tables (www.nber.org).

the United States, but German workers are less productive than American workers on average. Diminishing returns to capital may help to explain the weakening of the relationship between capital and productivity at high levels of capital. In addition, Figure 17.8 does not account for many other differences among countries, such as differences in economic systems or government policies. Thus, we should not expect to see a perfect relationship between the two variables.

17.4.3 LAND AND OTHER NATURAL RESOURCES

Besides capital goods, other inputs to production help to make workers more productive, among them land, energy, and raw materials. Fertile land is essential to agriculture, and modern manufacturing processes make intensive use of energy and raw materials.

In general, an abundance of natural resources increases the productivity of the workers who use them. For example, a farmer can produce a much larger crop in a land-rich country than in a country where the soil is poor or arable land is limited in supply. With the aid of modern farm machinery and great expanses of land, today's farmers are so productive that, even though they constitute a small percentage of the population, they can provide enough food not only to feed their country but to export to the rest of the world.

Although there are limits to a country's supply of arable land, many other natural resources, such as petroleum and metals, can be obtained through international markets. Because resources can be obtained through trade, countries need not possess large quantities of natural resources within their own borders to achieve economic growth. Indeed, a number of countries have become rich without substantial natural resources of their own, including Japan, Hong Kong, Singapore, and Switzerland. On the other hand, there are countries, such as Algeria and Nigeria, which suffer from rampant poverty, corruption, and internal conflicts despite having substantial natural resources.[2] In fact, according to a study of OPEC economies, resources in countries like Algeria, Iraq, and Libya may be so poorly managed that such countries find themselves forced to not depend on them or reap any benefits from them.[3] Just as important as possessing natural resources is the ability to use them productively—for example, by means of advanced technologies.

17.4.4 TECHNOLOGY

Besides human capital, physical capital, and natural resources, a country's ability to develop and apply new, more productive technologies will help to determine its productivity. Consider just one industry, transportation. Two centuries ago, the horse and wagon were the primary means of transportation—a slow and costly method indeed. But in the nineteenth century, technological advances such as the steam engine supported the expansion of riverborne transportation and the development of national rail networks. In the twentieth century, the invention of the internal combustion engine and the development of aviation, supported by the construction of an extensive infrastructure of roads and airports, have produced increasingly rapid, cheap, and reliable transport. Technological change has clearly been a driving force in the transportation revolution.

New technologies can improve productivity in industries other than the one in which they are introduced. For instance, in the late eighteenth century, farmers could sell their produce only in local and regional markets. Now, the availability of rapid shipping and refrigerated transport allows farmers to sell their products virtually anywhere in the world. With a broader market in which to sell, farmers can

[2] This is commonly referred to as the "resource curse."
[3] Jay Squalli, "Electricity Consumption and Economic Growth: Bounds and Causality Analyses of OPEC Members," *Energy Economics*, 29 (2007), pp. 1192–205.

specialize in those products best suited to local land and weather conditions. Similarly, factories can obtain their raw materials wherever they are cheapest and most abundant, produce the goods they are most efficient at manufacturing, and sell their products wherever they will fetch the best price. Both these examples illustrate the Principle of Comparative Advantage: that overall productivity increases when producers concentrate on those activities at which they are relatively more efficient.

Comparative Advantage

Numerous other technological developments led to increased productivity, including advances in communication and medicine and the introduction of computer technology. All indications are that the Internet will have a major impact on world economies, not just in retailing but in many other sectors. In fact, *most economists would probably agree that new technologies are the single most important source of productivity improvement*, and hence of economic growth in general.

However, economic growth does not automatically follow from breakthroughs in basic science. To make the best use of new knowledge, an economy needs entrepreneurs who can exploit scientific advances commercially, as well as a legal and political environment that encourages the practical application of new knowledge.

EXERCISE 17.4

A new kind of wrapping paper has been invented that makes wrapping candy quicker and easier. The use of this paper *increases* the number of candies a person can wrap by hand by 200 per hour, and the number of candies a person can wrap by machine by 300 per hour. Using the data from our Hala and Jana examples, construct a table like Table 17.3 that shows how this technological advance affects average labor productivity. Do diminishing returns to capital still hold?

17.4.5 ENTREPRENEURSHIP AND MANAGEMENT

The productivity of workers depends in part on the people who help to decide what to produce and how to produce it: entrepreneurs and managers. **Entrepreneurs** are people who create new economic enterprises. Because of the new products, services, technological processes, and production methods they introduce, entrepreneurs are critical to a dynamic, healthy economy. In the late nineteenth and early twentieth centuries, individuals like Henry Ford (automobiles) and Bill Gates (software) played central roles in the development of American industry—and, not incidentally, amassed huge personal fortunes in the process. These people and others like them have been criticized for some of their business practices, in some cases with justification. Henry Ford, for example, developed the idea of mass production, which lowered costs sufficiently to bring automobiles within reach of the average American family. Ford began his business in his garage, a tradition that has been maintained by thousands of innovators ever since. Larry Page and Sergey Brin, the co-founders of Google, revolutionized the way college students and many professionals conduct research by developing a method to prioritize the list of Web sites obtained in a search of the Internet.

entrepreneurs people who create new economic enterprises

Entrepreneurship, like any form of creativity, is difficult to teach, although some of the supporting skills, like financial analysis and marketing, can be learned in college or business school. How, then, does a society encourage entrepreneurship? History suggests that the entrepreneurial spirit will always exist; the challenge to society is to channel entrepreneurial energies in economically productive ways. For example, economic policymakers need to ensure that taxation is not so heavy, and regulation not so inflexible, that small businesses—some of which will eventually become big businesses—cannot get off the ground. Sociological factors may play a role as well. Societies in which business and commerce are considered

to be beneath the dignity of refined, educated people are less likely to produce successful entrepreneurs. Overall, a social and economic milieu that allows entrepreneurship to flourish appears to promote economic growth and rising productivity, perhaps especially so in high-technology eras like our own.

Inventing the personal computer

In 1975 Steve Jobs and Steve Wozniak were two 20-year-olds who designed computer games for Atari. They had an idea to make a computer that was smaller and cheaper than the closet-sized mainframes that were then in use. To set up shop in Steve Jobs's parents' garage and buy their supplies, they sold their two most valuable possessions, Jobs's used Volkswagen van and Wozniak's Hewlett-Packard scientific calculator, for a total of $1,300. The result was the first personal computer, which they named after their new company (and Jobs's favorite fruit): Apple. The rest is history. Clearly, Jobs's and Wozniak's average labor productivity as the inventors of the personal computer was many times what it was when they designed computer games. Creative entrepreneurship can increase productivity just like additional capital or land. ◆

Example 17.1

THE ECONOMIC NATURALIST

Why did medieval China stagnate economically?

The Sung period in China (A.D. 960–1270) was one of considerable technological sophistication; its inventions included paper, waterwheels, water clocks, gunpowder, and possibly the compass. Yet no significant industrialization occurred, and in subsequent centuries Europe saw more economic growth and technological innovation than China. Why did medieval China stagnate economically?

According to research by economist William Baumol,[4] the main impediment to industrialization during the Sung period was a social system that inhibited entrepreneurship. Commerce and industry were considered low-status activities, not fit for an educated person. In addition, the emperor had the right to seize his subjects' property and to take control of their business enterprises—a right that greatly reduced his subjects' incentives to undertake business ventures. The most direct path to status and riches in medieval China was to go through a system of demanding civil service examinations given by the government every three years. The highest scorers on these national examinations were granted lifetime positions in the imperial bureaucracy, where they wielded much power and often became wealthy, in part through corruption. Not surprisingly, medieval China did not develop a dynamic entrepreneurial class, and consequently its scientific and technological advantages did not translate into sustained economic growth. China's experience shows why scientific advances alone cannot guarantee economic growth; to have economic benefits, scientific knowledge must be commercially applied through new products and new, more efficient means of producing goods and services. ●

Although entrepreneurship may be more glamorous, managers—the people who run businesses on a daily basis—also play an important role in determining average labor productivity. Managerial jobs span a wide range of positions, from the supervisor of the loading dock to the CEO (chief executive officer) at the helm of a *Fortune 500* company. Managers work to satisfy customers, deal with suppliers, organize production, obtain financing, assign workers to jobs, and motivate them to work hard and effectively. Such activities enhance labor productivity. For example, in the 1970s and 1980s, Japanese managers introduced new production

[4] "Entrepreneurship: Productive, Unproductive, and Destructive," *Journal of Political Economy*, October 1990, pp. 893–921.

methods that greatly increased the efficiency of Japanese manufacturing plants. Among them was the *just-in-time* inventory system, in which suppliers deliver production components to the factory just when they are needed, eliminating the need for factories to stockpile components. Japanese managers also pioneered the idea of organizing workers into semi-independent production teams, which allowed workers more flexibility and responsibility than the traditional assembly line. Managers in the United States and other countries studied the Japanese managerial techniques closely and adopted many of them.

17.4.6 THE POLITICAL AND LEGAL ENVIRONMENT

So far we have emphasized the role of the private sector in increasing average labor productivity. But government too has a role to play in fostering improved productivity. One of the key contributions government can make is to provide a *political and legal environment* that encourages people to behave in economically productive ways—to work hard, save and invest wisely, acquire useful information and skills, and provide the goods and services that the public demands.

One specific function of government that appears to be crucial to economic success is the establishment of *well-defined property rights*. Property rights are well-defined when the law provides clear rules for determining who owns what resources (through a system of deeds and titles, for example) and how those resources can be used. Imagine living in a society in which a dictator, backed by the military and the police, could take whatever he wanted, and regularly did so. In such a country, what incentive would you have to raise a large crop or to produce other valuable goods and services? Very little, since much of what you produced would likely be taken away from you. Unfortunately, in many countries of the world today, this situation is far from hypothetical.

Political and legal conditions affect the growth of productivity in other ways, as well. Political scientists and economists have documented the fact that *political instability* can be detrimental to economic growth. This finding is reasonable, since entrepreneurs and savers are unlikely to invest their resources in a country whose government is unstable, particularly if the struggle for power involves civil unrest or guerrilla warfare. On the other hand, a political system that promotes the *free and open exchange of ideas* will speed the development of new technologies and products. For example, the Egyptian revolution of 2011 that resulted in the ousting of former president Mubarak has been responsible for bringing down the Egyptian tourism sector to a near complete halt. With tourism representing about 12 percent of Egypt's GDP, the effects on growth and productivity are expected to be drastic.

EXERCISE 17.5

A Bangladeshi worker who emigrates to America is likely to find that his average labor productivity is much higher in the United States than it was at home. The worker is, of course, the same person he was when he lived in Bangladesh. How can the simple act of moving to the United States increase the worker's productivity? What does your answer say about the incentive to emigrate?

Why did communism fail?

For more than 70 years, from the Russian revolution in 1917 until the collapse of the Soviet Union in 1991, communism was believed by many to pose a major challenge to market-based economic systems. Yet, by the time of the Soviet Union's

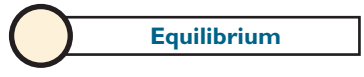
breakup, the poor economic record of communism had become apparent. Indeed, low living standards in communist countries, compared to those achieved in the West, were a major reason for the popular discontent that brought down the communist system in Europe. Economically speaking, why did communism fail?

The poor growth records of the Soviet Union and other communist countries did not reflect a lack of resources or economic potential. The Soviet Union had a highly educated workforce; a large capital stock; a vast quantity of natural resources, including land and energy; and access to sophisticated technologies.

Most observers would agree that the political and legal environment that established the structure of the communist economic system was a major cause of its ultimate failure. The economic system of the Soviet Union and other communist countries had two main elements: First, the capital stock and other resources were owned by the government rather than by individuals or private corporations. Second, most decisions regarding production and distribution were made and implemented by a government planning agency rather than by individuals and firms interacting through markets. This system performed poorly, we now understand, for several reasons.

One major problem was *the absence of private property rights*. With no ability to acquire a significant amount of private property, Soviet citizens had little incentive to behave in economically productive ways. For instance, the owner of a Japanese firm is strongly motivated to cut costs and to produce goods that are highly valued by the public because the owner's income is determined by the firm's profitability. In contrast, the performance of a Soviet firm manager was judged on whether the manager produced the quantities of goods specified by the government's plan—irrespective of the quality of the goods produced or whether consumers wanted them. Soviet managers had little incentive to reduce costs or produce better, more highly valued products, as any extra profits would accrue to the government and not to the manager; nor were there any opportunities for entrepreneurs to start new businesses. Likewise, workers had little reason to work hard or effectively under the communist system, as pay rates were determined by the government planning agency rather than by the economic value of what the workers produced.

A second major weakness of the communist system was the *absence of free markets*. In centrally planned economies, markets are replaced by detailed government plans that specify what should be produced and how. But, as we saw in the example of Cairo's food supply (Chapter 3), the coordination of even relatively basic economic activities can be extremely complex and require a great deal of information, much of which is dispersed among many people. In a market system, changes in prices both convey information about the goods and services people want and provide suppliers the incentives to bring these goods and services to market. Indeed, as we know from the Equilibrium Principle, a market in equilibrium leaves individuals with no unexploited opportunities. Central planners in communist countries proved far less able to deal with this complexity than decentralized markets. As a result, under communism consumers suffered constant shortages and shoddy goods.



After the collapse of communism, many formerly communist countries began the difficult transition to a market-oriented economic system. Changing an entire economic system (the most extreme example of a *structural policy*) is a slow and difficult task, and many countries saw economic conditions worsen at first rather than improve. *Political instability* and the absence of a modern *legal framework*, particularly laws applying to commercial transactions, have often hampered the progress of reforms. However, a number of formerly communist countries, including Poland, the Czech Republic, and the former East Germany, have succeeded in implementing Western-style market systems and have begun to achieve significant economic growth. ◆

RECAP | **DETERMINANTS OF AVERAGE LABOR PRODUCTIVITY**

Key factors determining average labor productivity in a country include:

- The skills and training of workers, called *human capital*.
- The quantity and quality of *physical capital*—machines, equipment, and buildings.
- The availability of land and other *natural resources*.
- The sophistication of the *technologies* applied in production.
- The effectiveness of *management* and *entrepreneurship*.
- The broad *social and legal environment*.

BOX 17.1 PRODUCTION FUNCTIONS

Economists often use a mathematical expression called a *production function* to describe the relationship between the amounts of inputs and outputs. In its general form, a production function is written as

$$Y = f(K, L, M, A)$$

where

Y = the amount of output or real GDP,
K = the amount of physical capital,
L = the amount of labor, adjusted for the level of human capital,
M = the amount of available land and other natural resources,
A = the level of technology and other factors, such as the effectiveness of management and the social and legal environment,
$f(\ )$ is some unspecified functional form.

In practice, there are a number of specific functional forms that are used to calculate the level of output. One simple but famous one that involves only Y, K, and L is

$$Y = K^{1/2}L^{1/2} = \sqrt{KL}.$$

For example, if $K = 25$ and $L = 100$, $Y = \sqrt{25 \times 100} = \sqrt{2,500} = 50$. This simple production function has several appealing properties, and a slight variant of it fits the aggregate data reasonably well. First, if all the inputs of K and L double, output also will double; that is, if $K = 50$ and $L = 200$, $Y = \sqrt{50 \times 200} = \sqrt{10,000} = 100$. Second, it exhibits diminishing returns to capital (as well as diminishing returns to labor), so that if we hold the level of labor constant and keep adding more capital, output will rise by smaller and smaller increments. Thus, if L remains equal to 100 and K rises from 25 to 26, output rises from 50 to $\sqrt{26 \times 100} = 50.99$ or by 0.99 unit. If K rises by one more unit to 27, output rises to $\sqrt{27 \times 100} = 51.96$ or by only 0.97 unit.

17.5 THE COSTS OF ECONOMIC GROWTH

Both this chapter and Chapter 14 emphasize the positive effects of economic growth on the average person's living standards. But should societies always strive for the highest possible rate of economic growth? The answer is no. Even if we accept for the moment the idea that increased output per person is always desirable, attaining a higher rate of economic growth does impose costs on society.

What are the costs of increasing economic growth? The most straightforward is the cost of creating new capital. We know that by expanding the capital stock we can increase future productivity and output. But, to increase the capital stock, we must divert resources that could otherwise be used to increase the supply of consumer goods. For example, to add more robot-operated assembly lines, a society must employ more of its skilled technicians in building industrial robots and fewer in designing video games. To build new factories, more carpenters and lumber must be assigned to factory construction and less to finishing basements or renovating family rooms. In short, high rates of investment in new capital require people to tighten their belts, consume less, and save more—a real economic cost.

Should a country undertake a high rate of investment in capital goods at the sacrifice of consumer goods? The answer depends on the extent that people are willing and able to sacrifice consumption today to have a bigger economic pie tomorrow. Consumption sacrificed to capital formation, however, is not the only cost of achieving higher growth. In industrialized nations in the nineteenth and early twentieth centuries, periods of rapid economic growth were often times in which many people worked extremely long hours at dangerous and unpleasant jobs. While those workers helped to build today's economies, the costs were great in terms of reduced leisure time and, in some cases, workers' health and safety.

Other costs of growth include the cost of the research and development that is required to improve technology and the costs of acquiring training and skill (human capital). The fact that a higher living standard tomorrow must be purchased at the cost of current sacrifices is an example of the Scarcity Principle: that having more of one good thing usually means having less of another. Because achieving higher economic growth imposes real economic costs, we know from the Cost–Benefit Principle that higher growth should be pursued only if the benefits outweigh the costs.

17.6 PROMOTING ECONOMIC GROWTH

If a society decides to try to raise its rate of economic growth, what are some of the measures that policymakers might take to achieve this objective? Here is a short list of suggestions, based on our discussion of the factors that contribute to growth in average labor productivity and, hence, output per person.

17.6.1 POLICIES TO INCREASE HUMAN CAPITAL

Because skilled and well-educated workers are more productive than unskilled labor, governments in most countries try to increase the human capital of their citizens by supporting education and training programs. In many countries, the government provides public education through high school and grants extensive support to post-secondary schools, including technical schools, colleges, and universities. Some governments also fund job training for unskilled youths and retraining for workers whose skills have become obsolete.

Example 17.2

THE ECONOMIC NATURALIST

Why do almost all countries provide free public education?

All industrial countries provide their citizens free public education through high school, and most subsidize college and other post-secondary schools. Why?

People around the world are so used to the idea of free public education that this question may seem odd. But why should the government provide free education when it does not provide even more essential goods and services such as food or, in some cases, medical care for free? Furthermore, educational services can be, and indeed commonly are, supplied and demanded on the private market, without the aid of the government.

Equilibrium

Why do almost all countries provide free public education?

An important argument for free or at least subsidized education is that the private demand curve for educational services does not include all the social benefits of education. (Recall the Equilibrium Principle, which states in part that a market in equilibrium may not exploit all gains achievable from collective action.) For example, the democratic political system relies on an educated citizenry to operate effectively—a factor that an individual demander of educational services has little reason to consider. From a narrower economic perspective, we might argue that individuals do not capture the full economic returns from their schooling. For example, people with high human capital, and thus high earnings, pay more taxes—funds that can be used to finance government services and aid the less fortunate. Because of income taxation, the private benefit to acquiring human capital is less than the social benefit, and the demand for education on the private market may be less than optimal from society's viewpoint. Similarly, educated people are more likely than others to contribute to technological development, and hence to general productivity growth, which may benefit many other people besides themselves. Finally, another argument for public support of education is that poor people who would like to invest in human capital may not be able to do so because of insufficient income.

The Nobel laureate Milton Friedman, among many economists, suggested that these arguments may justify government grants, called educational *vouchers*, to help citizens purchase educational services in the private sector, but they do *not* justify the government providing education directly, as through the public school system. Defenders of public education, on the other hand, argue that the government should have some direct control over education in order to set standards and monitor quality. What do you think? ●

17.6.2 POLICIES THAT PROMOTE SAVING AND INVESTMENT

Average labor productivity increases when workers can utilize a sizable and modern capital stock. To support the creation of new capital, government can encourage high rates of saving and investment in the private sector. Many provisions in the tax code are designed expressly to stimulate households to save and firms to invest. For example, a household can save for retirement by placing funds into various investments (as approved by their respective government) without paying taxes on either the funds deposited or the interest earned on the account. (However, taxes are due when the funds are withdrawn at retirement.) Similarly, firms can benefit from investment tax credits, which reduce the tax bills of firms that invest in new capital.

Government can contribute directly to capital formation through *public investment*, or the creation of government-owned capital. Public investment includes the building of roads, bridges, airports, dams, and, in some countries, energy and communications networks. Highway systems can substantially reduce long-haul transportation costs, improving productivity throughout the economy. Today, the web of computers and communications links we call the Internet is having a similar effect. Many research studies have confirmed that government investment in the *infrastructure*, the public capital that supports private-sector economic activities, can be a significant source of growth.

17.6.3 POLICIES THAT SUPPORT RESEARCH AND DEVELOPMENT

Productivity is enhanced by technological progress, which in turn requires investment in research and development (R&D). In many industries, private firms have adequate incentive to conduct research and development activities. There is no need, for example, for the government to finance research for developing a better underarm deodorant. But some types of knowledge, particularly basic scientific knowledge, may have widespread economic benefits that cannot

be captured by a single private firm. The developers of the silicon computer chip, for example, were instrumental in creating huge new industries, yet they received only a small portion of the profits flowing from their inventions. Because society in general, rather than the individual inventors, may receive much of the benefit from basic research, governments may need to support basic research, as they do through various agencies. Medical and pharmaceutical research are areas that can also benefit immensely from government funding over private funding, since they require a focus on advancing knowledge and finding cures rather than earning profits.

17.6.4 THE LEGAL AND POLITICAL FRAMEWORK

Although economic growth comes primarily from activities in the private sector, the government plays an essential role in providing the framework within which the private sector can operate productively. We have discussed the importance of secure property rights and a well-functioning legal system, of an economic environment that encourages entrepreneurship, and of political stability and the free and open exchange of ideas. Government policymakers also should consider the potential effects of tax and regulatory policies on activities that increase productivity, such as investment, innovation, and risk taking.

17.6.5 THE POOREST COUNTRIES: A SPECIAL CASE?

Radical disparities in living standards exist between the richest and poorest countries of the world (see Table 14.6 in Chapter 14 for some data). Achieving economic growth in the poorest countries is thus particularly urgent. Are the policy prescriptions of this section relevant to those countries, or are very different types of measures necessary to spur growth in the poorest nations?

To a significant extent, the same factors and policies that promote growth in richer countries apply to the poorest countries as well. Increasing human capital by supporting education and training, increasing rates of saving and investment, investing in public capital and infrastructure, supporting research and development, and encouraging entrepreneurship are all measures that will enhance economic growth in poor countries.

However, to a much greater degree than in richer countries, most poor countries need to improve the legal and political environment that underpins their economies. For example, many developing countries have poorly developed or corrupt legal systems, which discourage entrepreneurship and investment by creating uncertainty about property rights. Taxation and regulation in developing countries are often heavy-handed and administered by inefficient bureaucracies, to the extent that it may take months or years to obtain the approvals needed to start a small business or expand a factory. In many poor countries, excessive government regulation or government ownership of companies prevents markets from operating efficiently to achieve economic growth. For example, government regulation, rather than the market, may determine the allocation of bank credit or the prices for agricultural products. Structural policies that aim to ameliorate these problems are important preconditions for generating growth in the poorest countries. But probably most important—and most difficult, for some countries—is establishing political stability and the rule of law. Without political stability, domestic and foreign savers will be reluctant to invest in the country, and economic growth will be difficult if not impossible to achieve.

Can rich countries help poor countries to develop? Historically, richer nations have tried to help by providing financial aid through loans or grants from individual countries (foreign aid) or by loans made by international agencies such as the World Bank. Experience has shown, however, that financial aid to countries

that do not undertake structural reforms, such as reducing excessive regulation or improving the legal system, is of limited value. To make their foreign aid most effective, rich countries should help poor countries achieve political stability and undertake the necessary reforms to the structure of their economies.

17.7 ARE THERE LIMITS TO GROWTH?

Earlier in this chapter, we saw that even relatively low rates of economic growth, if sustained for a long period, will produce huge increases in the size of the economy. This fact raises the question of whether economic growth can continue indefinitely without depleting natural resources and causing massive damage to the global environment. Does the basic truth that we live in a finite world of finite resources imply that, ultimately, economic growth must come to an end?

The concern that economic growth may not be sustainable is not a new one. An influential 1972 book, *The Limits to Growth*,[5] reported the results of computer simulations that suggested that unless population growth and economic expansion were halted, the world would soon be running out of natural resources, drinkable water, and breathable air. This book, and later works in the same vein, raise some fundamental questions that cannot be done full justice here. However, in some ways its conclusions are misleading.

One problem with the "limits to growth" thesis lies in its underlying concept of economic growth. Those who emphasize the environmental limits on growth assume implicitly that economic growth will always take the form of more of what we have now—more smoky factories, more polluting cars, more fast-food restaurants. If that were indeed the case, then surely there would be limits to the growth the planet can sustain. But growth in real GDP does not necessarily take such a form. Increases in real GDP also can arise from new or higher-quality products. For example, not too long ago tennis rackets were relatively simple items made primarily of wood. Today they are made of newly invented synthetic materials and designed for optimum performance using sophisticated computer simulations. Because these new high-tech tennis rackets are more valued by consumers than the old wooden ones, their introduction increased real GDP. Likewise, the introduction of new pharmaceuticals has contributed to economic growth, as have the expanded number of TV channels, digital sound, and Internet-based sales. Thus, economic growth need not take the form of more and more of the same old stuff; it can mean newer, better, and perhaps cleaner and more efficient goods and services.

A second problem with the "limits to growth" conclusion is that it overlooks the fact that increased wealth and productivity expand society's capacity to take measures to safeguard the environment. In fact, the most polluted countries in the world are not the richest but those that are in a relatively early stage of industrialization. At this stage, countries must devote the bulk of their resources to basic needs—food, shelter, health care—and continued industrial expansion. In these countries, clean air and water may be viewed as a luxury rather than a basic need. In more economically-developed countries, where the most basic needs are more easily met, extra resources are available to keep the environment clean. Thus, continuing economic growth may lead to less, not more, pollution.

A third problem with the pessimistic view of economic growth is that it ignores the power of the market and other social mechanisms to deal with scarcity. During the oil-supply disruptions of the 1970s, newspapers were filled with headlines about

[5] Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, and William W. Behrens III, *The Limits to Growth* (New York: New American Library, 1972).

the energy crisis and the imminent depletion of world oil supplies. Yet 30 years later, the world's known oil reserves are actually *greater* than they were in the 1970s.[6]

Today's energy situation is so much better than was expected 30 years ago because the market went to work. Reduced oil supplies led to an increase in prices that changed the behavior of both demanders and suppliers. Consumers insulated their homes, purchased more energy-efficient cars and appliances, and switched to alternative sources of energy. Suppliers engaged in a massive hunt for new reserves, opening up major new sources in Latin America, China, and the North Sea. In short, market forces helped society respond effectively to the energy crisis.

In general, shortages in any resource will trigger price changes that induce suppliers and demanders to deal with the problem. Simply extrapolating current economic trends into the future ignores the power of the market system to recognize shortages and make the necessary corrections. Government actions spurred by political pressures, such as the allocation of public funds to preserve open space or reduce air pollution, can be expected to supplement market adjustments.

Despite the shortcomings of the "limits to growth" perspective, most economists would agree that not all the problems created by economic growth can be dealt with effectively through the market or the political process. Probably most important, global environmental problems, such as the possibility of global warming or the ongoing destruction of rainforests, are a particular challenge for existing economic and political institutions. Environmental quality is not bought and sold in markets and thus will not automatically reach its optimal level through market processes (recall the Equilibrium Principle). Nor can local or national governments effectively address problems that are global in scope. Unless international mechanisms are established for dealing with global environmental problems, these problems may become worse as economic growth continues.

Why is the air quality so poor in Mexico City?

Developing countries like Mexico, which are neither fully industrialized nor desperately poor, often have severe environmental problems. Why?

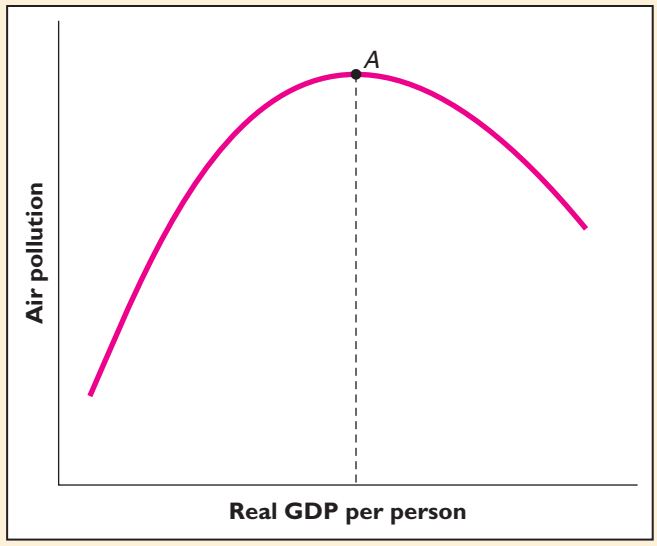
One concern about economic growth is that it will cause ever-increasing levels of environmental pollution. Empirical studies show, however, that the relationship between pollution and real GDP per person is more like an inverted U (see Figure 17.9). In other words, as countries move from very low levels of real GDP per person to "middle-income" levels, most measures of pollution tend to worsen, but environmental quality improves as real GDP per person rises even further. One study of the relationship between air quality and real GDP per person found that the level of real GDP per person at which air quality is the worst—indicated by point *A* in Figure 17.9—is roughly equal to the average income level in Mexico.[7] And indeed, the air quality in Mexico City is exceptionally poor, as any visitor to that sprawling metropolis can attest.

That pollution may worsen as a country industrializes is understandable, but why does environmental quality improve when real GDP per person climbs to very high levels? There are a variety of explanations for this phenomenon. Compared to middle-income economies, the richer economies are relatively more concentrated in "clean," high-value services like finance and software production as opposed to pollution-intensive industries like heavy manufacturing. Rich economies are also more likely to have the expertise to develop sophisticated and cost-effective antipollution

[6] Recent increases in oil prices have again stoked concerns.

[7] Gene M. Grossman and Alan B. Krueger, "Environmental Impacts of a North American Free Trade Agreement," in Peter Garber, ed., *The Mexico–U.S. Free Trade Agreement* (Cambridge, MA: MIT Press, 1993). See also Grossman and Krueger, "Economic Growth and the Environment," *Quarterly Journal of Economics*, May 1995, pp. 353–78; and World Bank, *World Development Report: Development and the Environment*, 1992.

FIGURE 17.9
The Relationship between Air Pollution and Real GDP per Person.
Empirically, air pollution increases with real GDP per person up to a point and then begins to decline. Maximum air pollution (point *A*) occurs at a level of real GDP per person roughly equal to that of Mexico.



technologies. But the main reason the richer economies tend to be cleaner is the same reason that the homes of rich people are generally cleaner and in better condition than the homes of the poor. As income rises above the level necessary to fulfill basic needs, more resources remain to dedicate to "luxuries" like a clean environment (the Scarcity Principle). For the rich family, the extra resources will pay for a cleaning service; for the rich country, they will pay for pollution control devices in factories and on automobiles. Indeed, antipollution laws are generally tougher and more strictly enforced in rich countries than in middle-income and poor countries. ◆

Scarcity

RECAP	ECONOMIC GROWTH: DEVELOPMENTS AND ISSUES

- Economic growth has substantial costs, notably the sacrifice of current consumption that is required to free resources for creating new capital and new technologies. Higher rates of growth should be pursued only if the benefits outweigh the costs.
- Policies for promoting economic growth include policies to increase human capital (education and training); policies that promote saving and capital formation; policies that support research and development; and the provision of a legal and political framework within which the private sector can operate productively. Deficiencies in the legal and political framework (for example, official corruption or poorly defined property rights) are a special problem for many developing countries.
- Some have argued that finite resources imply ultimate limits to economic growth. This view overlooks the facts that growth can take the form of better, rather than more, goods and services; that increased wealth frees resources to safeguard the environment; and that political and economic mechanisms exist to address many of the problems associated with growth. However, these mechanisms may not work well when environmental or other problems arising from economic growth are global in scope.

SUMMARY

- Over the past two centuries, the industrialized nations saw enormous improvements in living standards, as reflected in large increases in real GDP per person. Because of the power of compound interest, relatively small differences in growth rates, if continued over long periods, can produce large differences in real GDP per person and average living standards. Thus, the rate of long-term economic growth is an economic variable of critical importance. **LO1**

- Real GDP per person is the product of average labor productivity (real GDP per employed worker) and the share of the population that is employed. Growth in real GDP per person can occur only through growth in average labor productivity, in the share of the population that is working, or both. In the past four decades, as in most periods, the main source of the increase in real GDP per person was rising average labor productivity. **LO2**

- Among the factors that determine labor productivity are the talents, education, training, and skills of workers, or human capital; the quantity and quality of the physical capital that workers use; the availability of land and other natural resources; the application of technology to the production and distribution of goods and services; the effectiveness of entrepreneurs and managers; and the broad social and legal environment. Because of diminishing returns to capital, beyond a certain point expansion of the capital stock is not the most effective way to increase average labor productivity. Economists generally agree that new technologies are the most important single source of improvements in productivity. **LO3**

- Economic growth has costs as well as benefits. Prominent among them is the need to sacrifice current consumption to achieve a high rate of investment in new capital goods; other costs of growing more quickly include extra work effort and the costs of research and development. Thus, more economic growth is not necessarily better; whether increased economic growth is desirable depends on whether the benefits of growth outweigh the costs. **LO4**

- Among the ways in which government can stimulate economic growth are by adopting policies that encourage the creation of human capital; that promote saving and investment, including public investment in infrastructure; that support research and development, particularly in the basic sciences; and that provide a legal and political framework that supports private-sector activities. The poorest countries, with poorly developed legal, tax, and regulatory systems, are often in the greatest need of an improved legal and political framework and increased political stability. **LO5**

- Are there limits to growth? Arguments that economic growth must be constrained by environmental problems and the limits of natural resources ignore the fact that economic growth can take the form of increasing quality as well as increasing quantity. Indeed, increases in output can provide additional resources for cleaning up the environment. Finally, the market system, together with political processes, can solve many of the problems associated with economic growth. On the other hand, global environmental problems, which can be handled neither by the market nor by individual national governments, have the potential to constrain economic growth. **LO6**

KEY TERMS

average labor productivity (502)
compound interest (501)
diminishing returns to capital (510)
entrepreneurs (512)
human capital (507)

REVIEW QUESTIONS

1. What has happened to real GDP per person over the past century? What implications does this have for the average person? Are the implications different for countries in different regions (e.g., Germany versus Morocco)? **LO1**

2. Why do economists consider growth in average labor productivity to be the key factor in determining long-run living standards? **LO2**

3. What is *human capital*? Why is it economically important? How is new human capital created? **LO3**
4. You have employed five workers of varying physical strength to dig a ditch. Workers without shovels have zero productivity in ditchdigging. How should you assign shovels to workers if you don't have enough shovels to go around? How should you assign any additional shovels that you obtain? Using this example, discuss (a) the relationship between the availability of physical capital and average labor productivity and (b) the concept of diminishing returns to capital. **LO3**
5. Discuss how talented entrepreneurs and effective managers can enhance average labor productivity. **LO3**
6. What major contributions can the government make to the goal of increasing average labor productivity? **LO5**
7. Discuss the following statement: "Because the environment is fragile and natural resources are finite, ultimately economic growth must come to an end." **LO6**

PROBLEMS

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1. Richland's real GDP per person is $10,000, and Poorland's real GDP per person is $5,000. However, Richland's real GDP per person is growing at 1 percent per year and Poorland's is growing at 3 percent per year. Compare real GDP per person in the two countries after 10 years and after 20 years. Approximately how many years will it take Poorland to catch up to Richland? **LO1**
2. Calculate how much higher labor productivity will be in the year 2030 (relative to 2010) if: **LO1**
   a. productivity continues to grow by 3.1 percent per year.
   b. productivity growth falls to 1.4 percent per year, its average rate during the period 1973–1995. (*Note*: You do not need to know the actual values of average labor productivity in any year to solve this problem.)
3. The "graying of America" will substantially increase the fraction of the population that is retired in the decades to come. To illustrate the implications for U.S. living standards, suppose that over the 46 years following 2006 the share of the population that is working returns to its 1960 level, while average labor productivity increases by as much as it did during 1960–2006. Under this scenario, what would be the net change in real GDP per person between 2006 and 2052? The following data will be useful: **LO2**

	Average labor productivity	Share of population employed
1960	$44,216	36.4%
2006	$88,204	48.1%

4. Here are data for Germany and Japan on the ratio of employment to population in 1979 and 2003:

	1979	2008
Germany	0.33	0.43
Japan	0.48	0.52

Using data from Table 17.1, find average labor productivity for each country in 1979 and in 2008. How much of the increase in output per person in each

country over the 1979–2008 period is due to increased labor productivity? To increased employment relative to population? **LO2**

5. Johara has just completed high school and is trying to determine whether to go to college for two years or go directly to work. Her objective is to maximize the savings she will have in the bank five years from now. If she goes directly to work, she will earn $20,000 per year for each of the next five years. If she goes to college, for each of the next two years she will earn nothing—indeed, she will have to borrow $6,000 each year to cover tuition and books. This loan must be repaid in full three years after graduation. If she graduates from college, in each of the subsequent three years, her wages will be $38,000 per year. Johara's total living expenses and taxes, excluding tuition and books, equal $15,000 per year. **LO3**
   a. Suppose, for simplicity, that Johara can borrow and lend at 0 percent interest. On purely economic grounds, should she go to college or work?
   b. Does your answer to part a change if she can earn $23,000 per year with only a high school diploma?
   c. Does your answer to part a change if Johara's tuition and books cost $8,000 per year?
   d.* Suppose that the interest rate at which Johara can borrow and lend is 10 percent per year, but other data are as in part a. Savings are deposited at the end of the year they are earned and receive (compound) interest at the end of each subsequent year. Similarly, the loans are taken out at the end of the year in which they are needed, and interest does not accrue until the end of the subsequent year. Now that the interest rate has risen, should Johara go to college or go to work?

6. The Good'n'Fresh Grocery Store has two checkout lanes and four employees. Employees are equally skilled, and all are able to either operate a register (checkers) or bag groceries (baggers). The store owner assigns one checker and one bagger to each lane. A lane with a checker and a bagger can check out 40 customers per hour. A lane with a checker only can check out 25 customers per hour. **LO3**
   a. In terms of customers checked out per hour, what is total output and average labor productivity for the Good'n'Fresh Grocery Store?
   b. The owner adds a third checkout lane and register. Assuming that no employees are added, what is the best way to reallocate the workers to tasks? What is total output and average labor productivity (in terms of customers checked out per hour) now?
   c. Repeat part b for the addition of a fourth checkout lane, and a fifth. Do you observe diminishing returns to capital in this example?

7. Hani, Karim, and Reda are housepainters. Hani and Karim can paint 100 square feet per hour using a standard paintbrush, and Reda can paint 80 square feet per hour. Any of the three can paint 200 square feet per hour using a roller. **LO3**
   a. Assume Hani, Karim, and Reda have only paintbrushes at their disposal. What is the average labor productivity, in terms of square feet per painter-hour, for the three painters taken as a team? Assume that the three painters always work the same number of hours.
   b. Repeat part a for the cases in which the team has one, two, three, or four rollers available. Are there diminishing returns to capital?
   c. An improvement in paint quality increases the area that can be covered per hour (by either brushes or rollers) by 20 percent. How does this technological

*Problems marked with an asterisk (*) are more difficult.

improvement affect your answers to part b? Are there diminishing returns to capital? Does the technological improvement increase or reduce the economic value of an additional roller?

8. Hayat's Hatchery raises fish. At the end of the current season she has 1,000 fish in the hatchery. She can harvest any number of fish that she wishes, selling them to restaurants for $5 apiece. Because big fish make little fish, for every fish that she leaves in the hatchery this year, she will have two fish at the end of next year. The price of fish is expected to be $5 each next year as well. Hayat relies entirely on income from current fish sales to support herself. **LO3**
   a. How many fish should Hayat harvest if she wants to maximize the growth of her stock of fish from this season to next season?
   b. Do you think maximizing the growth of her fish stock is an economically sound strategy for Hayat? Why or why not? Relate to the text discussion on the costs of economic growth.
   c. How many fish should Hayat harvest if she wants to maximize her current income? Do you think this is a good strategy?
   d. Explain why Hayat is unlikely to harvest either all or none of her fish, but instead will harvest some and leave the rest to reproduce.

9. Discuss the following statement, using concrete examples where possible to illustrate your arguments: "For advances in basic science to translate into improvements in standards of living, they must be supported by favorable economic conditions." **LO3, LO5**

■ ANSWERS TO IN-CHAPTER EXERCISES ■

17.1 If the United States had grown at the Japanese rate for the period 1870–2008, real GDP per person in 2008 would have been $(\$2{,}445) \times (1.0251)^{138} = \$74{,}820$. Actual GDP per person in the United States in 2008 was $31,178, so at the higher rate of growth, output per person would have been $\$74{,}820/\$31{,}178 = 2.4$ times higher. **LO1**

17.2 As before, Hala can wrap 4,000 candies per week, or 100 candies per hour. Jana can wrap 500 candies per hour, and working 40 hours weekly she can wrap 20,000 candies per week. Together Hala and Jana can wrap 24,000 candies per week. Since they work a total of 80 hours between them, their output per hour as a team is 24,000 candies wrapped per 80 hours = 300 candies wrapped per hour, midway between their hourly productivities as individuals. **LO3**

17.3 Because Jana can wrap 300 candies per hour by hand, the benefit of giving Jana the machine is 500 – 300 = 200 additional candies wrapped per hour. Because Hala wraps only 100 candies per hour by hand, the benefit of giving Hala the machine is 400 additional candies wrapped per hour. So the benefit of giving the machine to Hala is greater than giving it to Jana. Equivalently, if the machine goes to Jana, then Hala and Jana between them can wrap 500 + 100 = 600 candies per hour, but if Hala uses the machine, the team can wrap 300 + 500 = 800 candies per hour. So output is increased by letting Hala use the machine. **LO3**

17.4 Now, working by hand, Hala can wrap 300 candies per hour and Jana can wrap 500 candies per hour. With a machine, either Hala or Jana can wrap 800 candies per hour. As in Exercise 17.3, the benefit of giving a machine to Hala

(500 candies per hour) exceeds the benefit of giving a machine to Jana (300 candies per hour), so if only one machine is available, Hala should use it.

The table analagous to Table 17.2 now looks like this:

Relationship of capital, output, and productivity in the candy-wrapping factory

Number of machines (*K*)	Candies wrapped per week (*Y*)	Total hours worked (*N*)	Average hourly labor productivity (*Y*/*N*)
0	32,000	80	400
1	52,000	80	650
2	64,000	80	800
3	64,000	80	800

Comparing this table with Table 17.2, you can see that technological advance has increased labor productivity for any value of *K*, the number of machines available.

Adding one machine increases output by 20,000 candies wrapped per week, adding the second machine increases output by 12,000 candies wrapped per week, and adding the third machine does not increase output at all (because there is no worker available to use it). So diminishing returns to capital still hold after the technological improvement. **LO3**

17.5 Although the individual worker is the same person as he was in Bangladesh, by going to the United States he gains the benefit of factors that enhance average labor productivity in that country relative to his homeland. These include more and better capital to work with, more natural resources per person, more advanced technologies, sophisticated entrepreneurs and managers, and a political-legal environment that is conducive to high productivity. It is not guaranteed that the value of the emigrant's human capital will rise (it may not, for example, if he speaks no English and has no skills applicable to the U.S. economy), but normally it will.

Since increased productivity leads to higher wages and living standards, on economic grounds the Bangladeshi worker has a strong incentive to emigrate to the United States if he is able to do so. **LO3**