CHAPTER

25

Production and Growth

Goals

In this chapter you will

- See how much economic growth differs around the world
- Consider why productivity is the key determinant of a country's standard of living
- Analyze the factors that determine a country's productivity
- Examine how a country's policies influence its productivity growth

Outcomes

After accomplishing these goals, you should be able to

- List the countries with the highest GDP per person and the countries whose GDP per person is growing the fastest
- Explain why production limits consumption in the long run
- List and explain the factors of production
- Explain seven areas of policy action that may influence a country's productivity and growth

Strive for a Five

The information on production and growth presented in the chapter is important for understanding the long-run aggregate supply curves determinates that are described in Chapter 33. The production possibilities frontier/curve explained in Chapter 2 shares the same determinates. The following topics are of specific importance:

- Understand the factors that contribute to long-run economic growth
- Real *GDP* and a nation's standard of living as it pertains to productivity and its determinates:
  1. Human capital
  2. Physical capital
  3. Research and development
  4. Technological innovation
- Growth and public policy

Key Terms

- *Real GDP per person*—The quantity of goods and services available for the average individual in the economy
- *Growth rate*—The annual percentage change in output
- *Productivity*—The quantity of goods and services produced from each unit of labor input
- *Physical capital*—The stock of equipment and structures used to produce output
- *Factors of production*—Inputs used in production, such as labor, capital, and natural resources
- *Human capital*—The knowledge and skills that workers acquire through education, training, and experience
- *Natural resources*—Inputs into production provided by nature
- *Renewable resource*—Natural resource that can be reproduced
- *Nonrenewable resource*—Natural resource that is limited in supply
- *Technological knowledge*—A society's understanding about the best ways to produce goods and services
- *Production function*—The relationship between inputs and outputs from production
- *Constant returns to scale*—A production process where doubling all of the inputs doubles the output
- *Diminishing returns*—When the incremental increase in output declines as equal increments of an input are added to production
- *Catch-up effect*—The property that poorer countries tend to grow more rapidly than richer countries
- *Foreign direct investment*—Capital investment owned and operated by foreigners
- *Foreign portfolio investment*—Capital investment financed with foreign money but operated by domestic residents
- *Externality*—When the actions of one person affect the well-being of a bystander
- *Property rights*—The ability of people to exercise control over their resources
- *Infant-industry argument*—Restricting international trade to protect fledgling domestic industry from foreign competition
- *Inward-oriented policies*—Policies that increase international trade restrictions
- *Outward-oriented policies*—Policies that decrease international trade restrictions

- *Public good*—A good that we may all use at the same time without diminishing another's benefits

Chapter Overview

Context and Purpose

Chapter 25 is the first chapter in a four-chapter sequence on the production of output in the long run. Chapter 25 addresses the determinants of the level and growth rate of output. We find that capital and labor are among the primary determinants of output. In Chapter 26, we address how saving and investment in capital goods affect the production of output, and in Chapter 27, we learn about some of the tools people and firms use when choosing capital projects in which to invest. In Chapter 28, we address the market for labor.

The purpose of Chapter 25 is to examine the long-run determinants of both the level and the growth rate of real GDP per person. Along the way, we will discover the factors that determine the productivity of workers and address what governments might do to improve the productivity of their citizens.

Chapter Review

Introduction There is great variation in the standard of living across countries at a point in time and within a country across time—for example, between the United States and India today, and between the United States of today and the United States of 100 years ago. Growth rates also vary from country to country with East Asia growing quickly and Africa growing slowly. This chapter examines the long-run determinants of both the *level* and the *growth rate* of *real GDP per person*.

Economic Growth around the World

There is great variation across countries in both the *level* of real GDP per person and the *growth rate* of real GDP per person.

- At present, the *level* of real GDP per person in the United States is about 12 times that of India and 6 times that of China.
- However, since the *growth rate* of real GDP per person also varies across countries, the ranking of countries by real GDP per person changes over time. For example, over the past 100 years, the ranking of Japan has risen relative to others because it has had an above average growth rate while the ranking of the United Kingdom has fallen due to its below average growth rate.

Due to economic growth, the average American today enjoys conveniences such as television, air conditioning, cars, telephones, and medicines that the richest American didn't have 150 years ago. Since measures of inflation and output fail to fully capture the introduction of new goods, we overestimate inflation and underestimate economic growth.

Productivity: Its Role and Determinants

A country's standard of living depends directly on the productivity of its citizens because an economy's income is equal to an economy's output. Productivity refers to the quantity of goods and services produced from each unit of labor input. The productivity of a worker is determined by the available physical capital, human capital, natural resources, and technological knowledge. These inputs or *factors of production* are explained below:

- Physical capital per worker (or just capital): Physical capital is the stock of equipment and structures that are used to produce goods and services. Note that these tools and machines are themselves the output from prior human production.
- Human capital per worker: Human capital is the knowledge and skills that workers acquire through education, training, and experience. Note that human capital, like physical capital, is a human-made or produced factor of production.

- Natural resources per worker: Natural resources are inputs provided by nature's bounty, such as land, rivers, and mineral deposits. Natural resources come in two forms: *renewable* and *nonrenewable.*
- Technological knowledge: Technological knowledge is the understanding about the best ways to produce goods and services. Examples of advances in technology are the discovery and application of herbicides and pesticides in agriculture and of the assembly line in manufacturing.

Technological knowledge differs from human capital. Technological knowledge is society's understanding of the best production methods while human capital is the amount of understanding of these methods that has been transmitted to the labor force.

A *production function* establishes the relationship between the quantity of inputs used in production and the quantity of output from production. If a production function has *constant returns to scale,* then doubling all of the inputs doubles output.

In summary, output per worker (labor productivity) depends on physical capital per worker, human capital per worker, natural resources per worker, and the state of technology.

The only factor of production that is not a produced factor is natural resources. Since there is a fixed supply of nonrenewable natural resources, many people have argued that there is a limit to how much the world's economies can grow. So far, however, technological advances have found ways around these limits. Evidence of stable or falling prices of natural resources suggests that we are continuing to succeed at stretching our limited resources.

Economic Growth and Public Policy

Physical capital per worker, human capital per worker, natural resources per worker, and technological knowledge determine productivity. Productivity determines living standards. If a government wishes to raise the productivity and standard of living of its citizens, it should pursue policies that:

- *Encourage saving and investment.* If society consumes less and saves more, it has more resources available to invest in the production of capital. Additional capital increases productivity and living standards. This additional growth has an opportunity cost—society must give up current consumption in order to attain more growth. Investment in capital may be subject to diminishing returns: As the stock of capital rises, the extra output produced by an additional unit of capital declines. Thus, an additional increment of capital in a poor country increases growth more than the same increment in an already rich country. This is known as the catch-up effect because it is easier for a relatively poor country to grow quickly. However, because of diminishing returns to capital, higher saving and investment in a poor country will lead to higher growth only for a period of time, with growth slowing down again as the economy accumulates a higher level of capital stock.
- *Encourage investment from abroad,* by removing restrictions on the ownership of domestic capital and by providing a stable political environment. In addition to using domestic saving to invest in capital, countries can attract investment by foreigners. There are two categories of foreign investment. *Foreign direct investment* is capital investment that is owned and operated by a foreign entity. *Foreign portfolio investment* is capital investment that is financed with foreign money but is operated by domestic residents. Investment from abroad increases a country's GDP more than its GNP because the investing country earns the profits from the investment. The World Bank and the International Monetary Fund help channel foreign investment toward poor countries.
- *Encourage education.* Education is investment in human capital. Education not only increases the productivity of the recipient, it may provide a positive *externality.* An externality occurs when the actions of one person affect the well-being of a bystander. An educated individual may generate ideas that become useful to others. This is an argument for public education. Poor countries may suffer from *brain drain* when their educated workers emigrate to rich countries. Children in very poor countries may

work instead of going to school because the opportunity cost of going to school is too great. Paying parents for sending their children to school may both reduce child labor and increase the education of very poor children.

- *Improve health and nutrition.* Expenditures on the health and nutrition of workers can significantly increase labor productivity. These expenditures are sometimes viewed as an investment in human capital, similar to expenditures on education.
- *Protect property rights and establish political stability. Property rights* refer to the ability of people to exercise control over their resources. For individuals to be willing to work, save and invest, and trade with others by contract, they must be confident that their production and capital will not be stolen and that their agreements will be enforced. Even a remote possibility of political instability creates uncertainty with regard to property rights because a revolutionary government might confiscate property—particularly capital.
- *Encourage free trade.* Free trade is like a technological advance. It allows a country to transform the output from its production into products that another country produces more efficiently. The *infant-industry argument* suggests that developing countries should pursue *inward-oriented policies* by restricting international trade to protect fledgling domestic industry from foreign competition. Most economists disagree with the infant-industry argument and promote *outward-oriented policies* that reduce or eliminate trade barriers. Advantageous natural geography, such as good natural seaports and long coastlines, promotes trade and growth.
- *Encourage research and development.* Most of the increase in the standard of living is due to an increase in technological knowledge that comes from research and development. After a time, knowledge is a *public good* in that we all can use it at the same time without diminishing another's benefits. Research and development might be encouraged with grants, tax breaks, and patents to establish temporary property rights to an invention. Alternatively, it might be encouraged by simply maintaining property rights and political stability.
- *Address population growth.* Population growth may affect productivity in both positive and negative ways. Rapid population growth may *stretch natural resources* across more people. Thomas Malthus (1766–1834) argued that population growth will always rise to the limit imposed by the food supply, causing mankind to live forever in poverty. Any attempt to alleviate poverty will simply cause the poor to have more children, returning them to subsistence living. Malthus' predictions have not come true because he underestimated the ability of technological progress to expand the food supply. Rapid population growth *dilutes the capital stock* (both physical and human capital) by spreading it across more workers. Educated women tend to have fewer children because the opportunity cost of having children increases as opportunities grow. However, a larger population may *promote technological progress*. Throughout history, most technological progress has come from larger population centers where there are more people who are able to discover things and exchange ideas.

Helpful Hints

1. A simple example more clearly defines the factors of production. The simpler the production process, the easier it is to separate and analyze the factors of production. For example, suppose output is "holes dug in the ground." Then the production function is:

$$Y = A\ F(L, K, H, N)$$

where Y is the number of holes dug, A is technological knowledge, L is labor, K is physical capital, H is human capital, and N is natural resources. If we have more workers, there is an increase in L and Y would increase. If we have more shovels, there is an increase in K and Y would increase. If workers are educated so that more of them dig with the spaded end of the shovel as opposed to digging with the handle, there is an increase in H and Y would increase. (Note: The number of workers and

the number of shovels is unchanged.) If our country has softer soil so that digging is easier here, N is larger and, therefore, Y is larger. Finally, if we discover that it is more productive to dig after it rains rather than during a drought, there is an increase in A and Y should increase.

Self-Test

Multiple-Choice Questions

1. If one wants to know how the material well-being of the average person has changed over time in a given country, one should look at the
   a. level of real GDP.
   b. growth rate of nominal GDP.
   c. growth rate of real GDP.
   d. growth rate of real GDP per person.
   e. growth rate of nominal GDP per person.

2. The quantity of goods and services produced from each unit of labor input is called
   a. standard of living.
   b. productivity.
   c. capitalized quantity.
   d. the knowledge base.
   e. GDP per capita.

3. Perry accumulated a lot of mathematical skills while in high school, college, and graduate school. Economists include these skills as part of Perry's
   a. standard of learning.
   b. technological knowledge.
   c. physical capital.
   d. human capital.
   e. natural resources.

4. The notion that our ability to conserve natural resources is growing more rapidly than their supplies are dwindling is supported by the fact that
   a. most economists do not regard the availability of natural resources as a determinant of productivity.
   b. the quantity of natural resources does not enter into any production function.
   c. the quality of natural resources does not enter into any production function.
   d. inflation-adjusted prices of natural resources are stable or falling over time.
   e. inflation-adjusted prices of natural resources are rising over time.

5. Which of the following is a correct way to measure productivity?
   a. Divide the number of hours worked by the quantity of output.
   b. Divide the quantity of output by the number of hours worked.
   c. Divide the quantity of output by the quantity of physical capital.
   d. Divide the change in the quantity of output by the change in the number of hours worked.
   e. Divide real GDP by the change in the population.

6. Which of the following correctly defines productivity?
   a. Output per unit of input.
   b. Input per unit of output.
   c. GDP per capita.
   d. Unemployment rate divided by the inflation rate.
   e. Inflation rate divided by the unemployment rate.

7. Which of the following best states economists' understanding of the facts concerning the relationship between natural resources and economic growth?
   a. A country with no or few domestic natural resources is destined to be poor.
   b. Differences in natural resources have virtually no role in explaining differences in standards of living.
   c. Some countries can be rich mostly because of their natural resources and countries without natural resources need not be poor, but they can never have very high standards of living.
   d. Abundant domestic natural resources may help make a country rich, but even countries with few natural resources can have high standards of living.
   e. No country can be rich unless its natural resources are relatively abundant.

8. If your firm's production function has constant returns to scale, and if you doubled all your inputs, then your firm's output would
   a. not change.
   b. increase, but by less than double.
   c. double.
   d. more than double.
   e. be cut in half.

9. By saving more, a country
   a. has more resources for capital goods. The increase in capital raises productivity.
   b. has more resources for capital goods. The increase in capital reduces productivity.
   c. has fewer resources for capital goods. The decrease in capital raises productivity.
   d. has fewer resources for capital goods. The decrease in capital reduces productivity.
   e. has more resources for capital goods. However, the increase in capital has no effect on productivity.

10. When a society decides to increase its quantity of physical capital, the society
    a. can avoid the usual need to face trade-offs.
    b. is apparently not very concerned about its rate of economic growth in the future.
    c. is in effect deciding to consume fewer goods and services in the present.
    d. is in effect deciding to save less of its current income in the present.
    e. is in effect deciding to consume more goods and services in the present.

11. Investment in
    a. physical capital, unlike investment in human capital, has an opportunity cost.
    b. physical capital, like investment in human capital, has an opportunity cost.
    c. human capital is particularly attractive because it involves no externalities.
    d. human capital has been shown to be relatively unimportant, relative to investment in physical capital, for a country's long-run economic success.
    e. physical capital, like investment in human capital, has no opportunity cost.

12. Accumulating capital
    a. requires that society sacrifice consumption goods in the present.
    b. allows society to consume more in the present.
    c. decreases saving rates.
    d. involves no trade-offs.
    e. diminishes a countries ability to experience economic growth.

Free Response Questions

1. Use the following data on U.S. real GDP to compute real GDP per person for each year. Then use these numbers to compute the percentage increase in real GDP per person from 1987 to 2005.

Year	Real GDP (2000 prices)	Population
1987	$6,435,000 million	243 million
2005	$11,092,000 million	296.6 million

2. Why is productivity related to the standard of living? In your answer, be sure to explain what productivity and standard of living mean. Make a list of things that determine labor productivity.

Solutions

Multiple-Choice Questions

1. d TOP: Standard of living
2. b TOP: Productivity
3. d TOP: Human capital
4. d TOP: Natural resources
5. b TOP: Productivity
6. a TOP: Productivity
7. d TOP: Natural resources | Economic growth
8. c TOP: Constant return to scale
9. a TOP: Saving | Productivity
10. c TOP: Investment
11. b TOP: Physical capital | Human capital
12. a TOP: Capital | Saving

Free Response Questions

1. Real GDP per person in 1987 was \$6,435,000/243 = about \$26,481. Income per person in 2005 was \$11,092,000/296.6 = about \$37,397. Income per person grew by (37,397 - 26,481)/26,481 = about 41.2 percent.

TOP: Real GDP | Economic growth

2. The standard of living is a measure of how well people live. Income per person is an important dimension of the standard of living and is positively correlated with other things such as nutrition and life expectancy that make people better off. Productivity measures how much people can produce in an hour. As productivity increases, people can produce more (and use less to produce the same amount) and so their standard of living increases.

   The factors that determine labor productivity include the amounts of physical capital (equipment and structures), human capital (knowledge and skills), and natural resources available to workers, as well as the state of technological knowledge in society.

TOP: Productivity | Standard of living