Overview

In this chapter we will examine the determinants of both the level and the growth rate of the production of output in the long run. We will look at the actual growth performance of rich and poor countries over long periods of time and see that capital and labor are among the primary determinants of output and will discover the factors that determine the productivity of workers. We will also examine whether and how government policies can affect economic growth, what governments can do to improve the productivity of workers, as well as examine whether policy can affect the relationship between growth and the environment. Finally, we will examine the neoclassical model of growth and the implications of the convergence hypothesis.

Learning Outcomes

On successful completion of this chapter, you should be in a position to understand:

- how much economic growth differs around the world.
- why productivity is the key determinant of a country’s standard of living.
- the factors that determine a country’s productivity.
- how a country’s policies influence its productivity growth.

Key Points

1. Economic prosperity, as measured by GDP per person, varies substantially around the world. The average income in the world’s richest countries is more than ten times that in the world’s poorest countries. Because growth rates of real GDP also vary substantially, the relative positions of countries can change dramatically over time.

2. The standard of living in an economy depends on the economy’s ability to produce goods and services. Productivity, in turn, depends on the amounts of physical capital, human capital, natural resources, and technological knowledge available to workers.

3. Government policies can try to influence the economy’s growth rate in many ways: encouraging saving and investment, encouraging investment from abroad, fostering education, maintaining property rights and political stability, allowing free trade, controlling population growth, and promoting the research and development of new technologies.

4. The accumulation of capital is subject to diminishing returns: The more capital an economy has, the less additional output the economy gets from an extra unit of capital. Because of diminishing returns, higher saving leads to higher growth for a period of time, but growth eventually slows down as the economy approaches a higher level of capital, productivity, and income. Also because of diminishing returns, the return to capital is especially high in poor countries. Other things equal, these countries can grow faster because of the catch-up effect.
1. **Economic Growth around the World**

Economic growth is defined as the rate of change of real per capita income or output (GDP/GNP). In Chapter 23, we examined how income and output are defined and also looked at some of the insufficiencies of GDP as a measurement of wellbeing, in as much as it does not consider a number of key determinants of wellbeing and happiness (education, health, environmental pollution, crime, etc).

Data on real GDP per capita show that the standard of living around the world varies a great deal between countries. For instance, over the period 1890-2003 Japan has had the largest average annual growth rate, 2.8 percent per year (on average). From $1,280 in 1890, per capital real GDP was $28,620 in 2003. Over the same period, the per capita real GDP in the United States grew from $3,412 in 1890 to 37,500 in 2003, for an average annual growth rate of 2.04%.

Note that a one percentage point change in a country’s growth rate can make a significant difference over several generations. This is due to the powerful effects of compounding which is very important in the process of economic growth.

Because of different growth rates, the ranking of countries by income per person changes over time. For instance, in 1890 the U.K. citizens were twice as rich as Canadians ($4,094 in UK vs. $2,022 for Canada, which was a colony then). Yet, over the twentieth century, Canada grew by an average rate which was only half a percentage point faster than the U.K. The result is that by 2003, Canada's real per capita income, the standard of living in other words, is higher in Canada ($29,740 vs. 27,650 for the UK).

<table>
<thead>
<tr>
<th>Country</th>
<th>Period</th>
<th>Real GDP per Person at Beginning of Period*</th>
<th>Real GDP per Person at End of Period*</th>
<th>Growth Rate (per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>1890-2000</td>
<td>$1,256</td>
<td>$26,460</td>
<td>2.81%</td>
</tr>
<tr>
<td>Brazil</td>
<td>1900-2000</td>
<td>650</td>
<td>7,320</td>
<td>2.45</td>
</tr>
<tr>
<td>Mexico</td>
<td>1900-2000</td>
<td>968</td>
<td>8,810</td>
<td>2.23</td>
</tr>
<tr>
<td>Canada</td>
<td>1870-2000</td>
<td>1,984</td>
<td>27,330</td>
<td>2.04</td>
</tr>
<tr>
<td>Germany</td>
<td>1870-2000</td>
<td>1,825</td>
<td>25,010</td>
<td>2.03</td>
</tr>
<tr>
<td>China</td>
<td>1900-2000</td>
<td>598</td>
<td>3,940</td>
<td>1.90</td>
</tr>
<tr>
<td>Argentina</td>
<td>1900-2000</td>
<td>1,915</td>
<td>12,090</td>
<td>1.86</td>
</tr>
<tr>
<td>United States</td>
<td>1870-2000</td>
<td>3,347</td>
<td>34,260</td>
<td>1.81</td>
</tr>
<tr>
<td>India</td>
<td>1900-2000</td>
<td>564</td>
<td>2,390</td>
<td>1.45</td>
</tr>
<tr>
<td>Indonesia</td>
<td>1900-2000</td>
<td>743</td>
<td>2,840</td>
<td>1.35</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1870-2000</td>
<td>4,107</td>
<td>23,550</td>
<td>1.35</td>
</tr>
<tr>
<td>Pakistan</td>
<td>1900-2000</td>
<td>616</td>
<td>1,960</td>
<td>1.16</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>1900-2000</td>
<td>520</td>
<td>1,650</td>
<td>1.16</td>
</tr>
</tbody>
</table>

*Real GDP is measured in 2000 dollars.

2. **Productivity: Its Role and Determinants**

Definition of **productivity**: the amount of goods and services produced for each hour of a worker’s time.

A country’s standard of living depends on its ability to produce goods and services.

**Determinants of productivity**

- **Physical Capital**: the stock of equipment and structures that are used to produce goods and services.
• **Human Capital**: the knowledge and skills that workers acquire through education, training, and experience.

• **Natural Resources**: the inputs into the production of goods and services that are provided by nature, such as land, rivers, and mineral deposits.

• **Technological Knowledge**: society’s understanding and know-how of how best to produce goods and services.

**The role of technological knowledge and technological progress**

Here we make the distinction between *inventions* – the discovery of new knowledge, and *innovation* – the incorporation of new knowledge into actual production techniques. Major inventions can lead to spectacular increases in technological knowledge. Major new inventions can also lead to waves of investment and innovation as the ideas are put into practice. *Learning by doing* can tremendously increase output even with non-changing capital. Overall, the amount of invention and innovation appears to be directly linked to the amount of resources devoted to looking for it. Patents are used in order to safeguard intellectual property.

3. **The Production Function**

How do we link output growth, factor accumulation and technological progress?

We do this through the production function.

A production function describes the relationship between the quantity of inputs (or factors of production, or resources) used in production and the quantity of output from production. Normally a production function shows the maximum output available from specified quantities of inputs given the existing technical knowledge. In our examination of this, we assume for simplicity that per capita output *does not* affect population growth.

The production function, denoted as $F(\cdot)$, generally is written like this:

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

where

$Y$ = output,
$L$ = quantity of labor,
$K$ = quantity of physical capital,
$H$ = quantity of human capital,
$N$ = quantity of natural resources.

$A$ = the available production technology.

In other words, growth equals a given level of technical knowledge ($A$) and is a function then of the variable inputs capital, labour, human capital and natural resources ($K$, $L$, $H$ and $N$).

It should be noted that capital *depreciates over time*, with some new investment needed to stop the existing capital stock from shrinking. With a growing labour force, even more capital per worker is needed if capital per worker is to be maintained.

Many production functions have a property called constant returns to scale. This property implies that as all inputs are doubled, output will exactly double. This means that the following must be true:

$$ xY = A \cdot F(xL, xK, xH, xN) $$

where $x = 2$ if inputs are doubled. This also means that if we want to examine output per worker we could set $x = 1/L$ and we would get the following:

$$ Y/L = A \cdot F(1, K/L, H/L, N/L) $$
This shows that output per worker depends on the amount of physical capital per worker \((K/L)\), the amount of human capital per worker \((H/L)\), and the amount of natural resources per worker \((N/L)\).

### 4. Economic Growth and Public Policy

What factors lead to economic growth in the future?

#### Saving and Investment

Because capital is a produced factor of production, a society can change the amount of capital that it has. However, there is an opportunity cost of doing so: if resources are used to produce capital goods, fewer goods and services are produced for current consumption. Countries that devote a large share of GDP to investment tend to have high growth rates.

**Diminishing returns:** the property whereby the benefit from an extra unit of an input declines as the quantity of the input increases. This is shown in Figure 25.1.

![Figure 25.1: Diminishing returns to Capital](image)

As the capital stock rises, the extra output produced from an additional unit of capital will fall. Thus, if workers already have a large amount of capital to work with, giving them an additional unit of capital will not increase their productivity by much. In the long run, a higher saving rate leads to a higher level of productivity and income, but not to higher growth rates in these variables.

**Catch-Up Effect:** This describes an important implication of diminishing returns, whereby countries that start off poor tend to grow more rapidly than countries that start off rich. When workers have very little capital to begin with, an additional unit of capital will increase their productivity by a great deal. This helps explain why South Korea had a growth rate more than three times larger than the United States even though both countries devoted a similar share of GDP to investment.

#### Investment from Abroad

Saving by domestic residents is not the only way for a country to invest in new capital. Investment in the country by foreigners can also occur. Foreign direct investment occurs when a capital investment is owned and operated by a foreign entity. Foreign portfolio investment occurs when a capital investment is financed with foreign money but operated by domestic residents.
Some of the benefits of foreign investment flow back to foreign owners. But the economy still experiences an increase in the capital stock, which leads to higher productivity and higher wages.

**Education**

Investment in human capital also has an opportunity cost. When students are in class, they cannot be producing goods and services for consumption. In less-developed countries, this opportunity cost is considered to be high; as a result, children often drop out of school at a young age.

Because there are positive externalities in education, the effect of lower education on the economic growth rate of a country can be large. Many poor countries also face a “brain drain”—the best educated often leave to go to other countries where they can enjoy a higher standard of living.

**Property Rights and Political Stability**

Protection of property rights and promotion of political stability are two other important ways that policymakers can improve economic growth. There is little incentive to produce products if there is no guarantee that they cannot be taken. Contracts must also be enforced. Countries with questionable enforcement of property rights or an unstable political climate will also have difficulty in attracting foreign (or even domestic) investment.

**Free Trade**

Some countries have tried to achieve faster economic growth by avoiding transacting with the rest of the world. However, we know that trade allows a country to specialize in what it does best and thus consume beyond its production possibilities. When a country trades wheat for steel, it is as well off as it would be if it had developed a new technology for turning wheat into steel. The amount a nation trades is determined not only by government policy but also by geography.

**Research and Development**

The primary reason why living standards have improved over time has been due to large increases in technological knowledge. Knowledge can be considered to be a public good.

Many governments now encourage and promote the creation of new technological information by providing research grants and providing tax incentives for firms engaged in research.

In the United States, from 1959 to 1973, output per hour worked grew at a rate of 3.2 percent per year. From 1973 to 1995, productivity grew by only 1.5 percent per year. Productivity accelerated again in 1995, growing by 2.6 percent per year over the next six years.

**Population Growth**

Thomas Malthus (an English minister and early economic thinker) argued that an ever-increasing population meant that the world was doomed to live in poverty forever. However, he failed to understand that new ideas would be developed to increase the production of food and other goods, including pesticides, fertilizers, mechanized equipment, and new crop varieties.

High population growth reduces GDP per worker because rapid growth in the number of workers forces the capital stock to be spread more thinly. Countries with a high population growth have large numbers of school-age children, placing a burden on the education system. Some countries have already instituted measures to reduce population growth rates. Policies that foster equal treatment for women should raise economic opportunities for women leading to lower rates of population.

Promoting Technological Progress. Some economists have suggested that population growth has driven technological progress and economic prosperity. In a 1993 journal article, economist Michael Kremer provided evidence that increases in population lead to technological progress.

5. **Theories of Growth and Capital Accumulation**

Post-war theories of economic growth associated with the work of Roy Harrod, and Evsey Domar (the Harrod-Domar thesis), and Robert Solow, who amended their approach to remove some of its initial
instability. It is known as neo-classical growth theory as it looks at long term potential output (assuming potential and actual output are equal). The ‘equilibrium’ for this growth theory, is long-run steady-state growth.

**Potential Output:** This is the output the economy can produce if all factors of production (the variable inputs in the production function we examined above) were fully utilized. Referring to the Production Possibilities Frontier, potential output refers to the combination of output on any point on the PPC.

**Capital widening:** The extension of capital to wider sections of the workforce.

**Capital deepening:** The increasing the amount of capital each worker has at their disposal.

The growth theories assume that labour grows at a constant rate \( (n) \) and that a constant fraction of income \( (s) \) is saved. Aggregate capital formation, is that part of output not consumed.

In a growing economy, capital widening and capital deepening takes place. This involves extra investment per person the faster the population grows \( (n) \), and the more capital investment per person \( (k) \) that has to be provided. Thus we construct line \( nk \) in Figure 25.2 below. The line \( nk \) shows the investment per person that maintains capital per person while labour grows.

**Figure 25.2: The Neoclassical Growth Model**

![Graph showing the relationship between output per worker and capital per worker]

The curve \( y \) represents output per person, while \( sy \) represents both savings and investment per person. (It represents savings per person, but savings are equal to investment). The line \( y \) is curved, as by adding more capital per person, diminishing marginal returns set in, as shown in Figure 25.1. The steady state equilibrium (represented by \( nk \)) must be where \( sy \) crosses \( nk \), given that \( nk \) is the investment per person needed to keep labour constant by making capital grow as fast as labour. Thus \( k^* \) is the steady state capital per person and \( y^* \) is the steady state output per person. Remember that the vertical axis is output per person.

Why does the economy converge to the steady state? This is easily shown since if capital per worker is low, then the economy is to the left of the steady state, in which case per capita saving and investment \( sy \) exceeds \( nk \), the per capita investment needed to keep capital in line with growing labour. Thus capital per person rises.
**Business Cycles**

We know that some of the goals of economic systems are: economic stability, low and stable inflation, real growth in output/income, low unemployment, etc. There is not always agreement among economists about what, if anything, governments can do to promote economic stability/growth.

Real GDP growth in the United States has averaged 3% per year in the 20th century. But the growth rate was certainly not stable over this period. For some periods the economy was growing at 6% per year, while at other periods real GDP was contracting, the rate of change was negative. The fluctuations in real GDP growth is what we call the **business cycle**. The term **business cycle** does NOT mean that there is anything regular about the business cycle. Fluctuations are random and unpredictable. Periods of expansion and contraction vary quite a bit. Expansions have lasted from two years to eight years, recessions from 6-18 months. Since 1991, the U.S is undergoing the longest expansion in its history, with only a brief and mild recession in March 2001.

But, how does the economy fluctuate and change over time, as it contracts and expands, going through the business cycle?

**Expansion** - Low unemployment, strong retail sales, rising stock market, strong and positive growth in real output, strong car and housing markets, etc.

**Contraction/recession** - High unemployment, weak retail sales, declining stock market, low or neg. growth in real output, falling car/housing sales.

**Recession** - Usually defined as two or more consecutive quarters of negative real GDP growth.

**Depression** - Prolonged and severe recession lasting years. UN was 20-25% for most of the 1930s.

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**The Business Cycle**

*The business cycle: short-term fluctuations of total output around its trend path*

Trend output grows steadily as productive potential increases.

- Actual output fluctuates around this trend.
  - A – slump
  - B – recovery phase has begun
  - C – Boom
  - D – recession under way
  - E – slump again

The **trend path of output** is the smooth path of long run output once its short term fluctuations are averaged out. (Actual output fluctuates around this hypothetical trend path). The **business cycle** is the short term fluctuation of total output around its trend path. (We outline this in Figure 31-1, comparing the business cycle and the trend path) The **output gap** is the deviation of actual output from potential output.