



Economic Growth and Labor

The Facts of Growth

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We now turn from the determination of output in the *short and medium run*—where fluctuations dominate—to the determination of output in the *long run*—where growth dominates.

Growth is the steady increase in aggregate output over time.

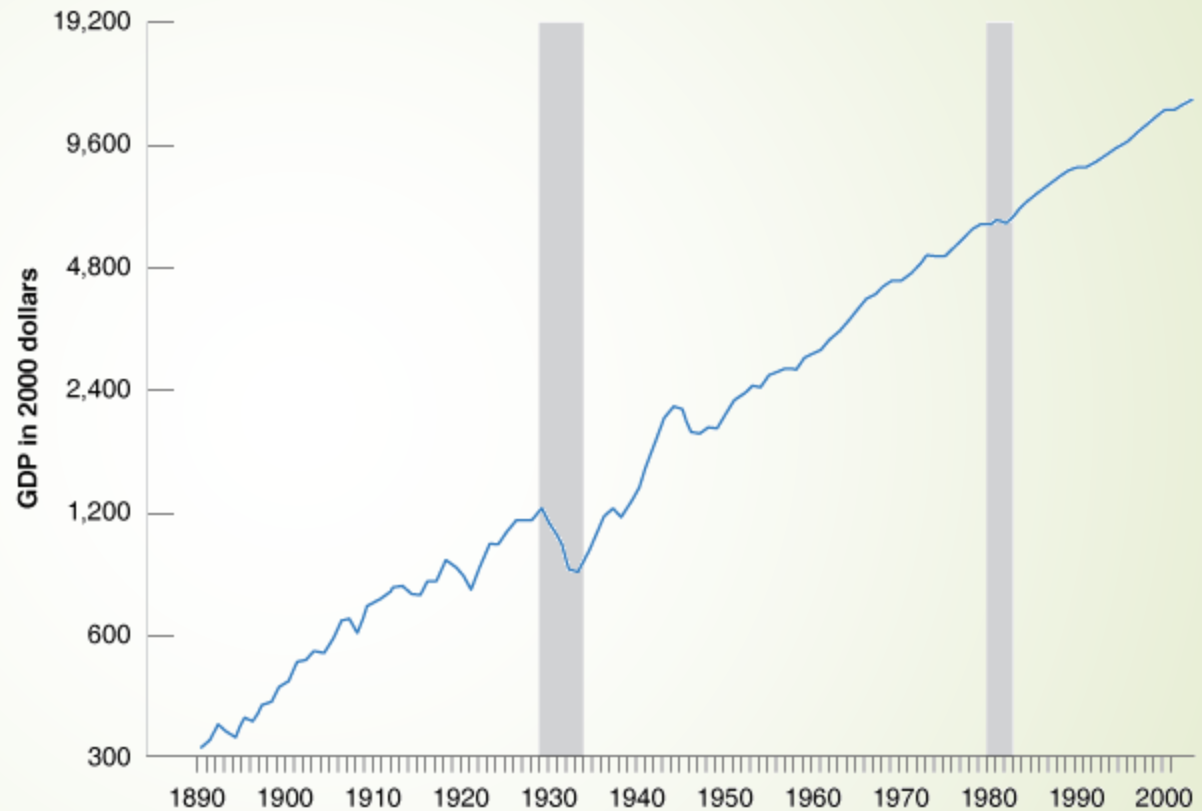
Measuring the Standard of Living

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Figure 1

U.S. GDP Since 1890

Aggregate U.S. output has increased by a factor of 42 since 1890.



The **logarithmic scale** on the vertical axis allows for the same proportional increase in a variable to be represented by the same distance.

Measuring the Standard of Living

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The reason we care about growth is that we care about the **standard of living**.

The variable we want to focus on and compare either over time or across countries is **output per person** rather than *output* itself.

The straightforward method of taking a country's GDP expressed in that country's currency, and then using the current exchange rate to express it in terms of dollars does not always work for two reasons:

- ▶ First, exchange rates can vary a lot.
- ▶ The second reason goes beyond fluctuations in exchange rates. In general, the lower a country's output per capita, the lower the prices of food and basic services in that country.

Measuring the Standard of Living

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Output per capita equals GDP divided by population.

To compare GDP across countries, we use a common set of prices for all countries. Adjusted real GDP numbers are measures of purchasing power across countries, also called purchasing power parity (PPP) numbers.

Measuring the Standard of Living

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Let me end this section with three remarks before we move on and look at growth:

- What matters for people's welfare is their consumption rather than their income.
- Thinking about the production side, one may be interested in differences in productivity rather than in differences in the standard of living across countries.
- The reason we ultimately care about the standard of living is presumably that we care about happiness.

The Construction of PPP Numbers

These average prices are called *international dollar prices*. Many of the estimates we use in this chapter are the result of “Penn World Tables.” (Penn stands for the University of Pennsylvania, where the project is taking place.) Led by three economists—Irving Kravis, Robert Summers, and Alan Heston—have constructed PPP series not only for consumption (as we just did in our example) but, more generally, for GDP and its components, going back to 1950, for most countries in the world.

Growth and Happiness

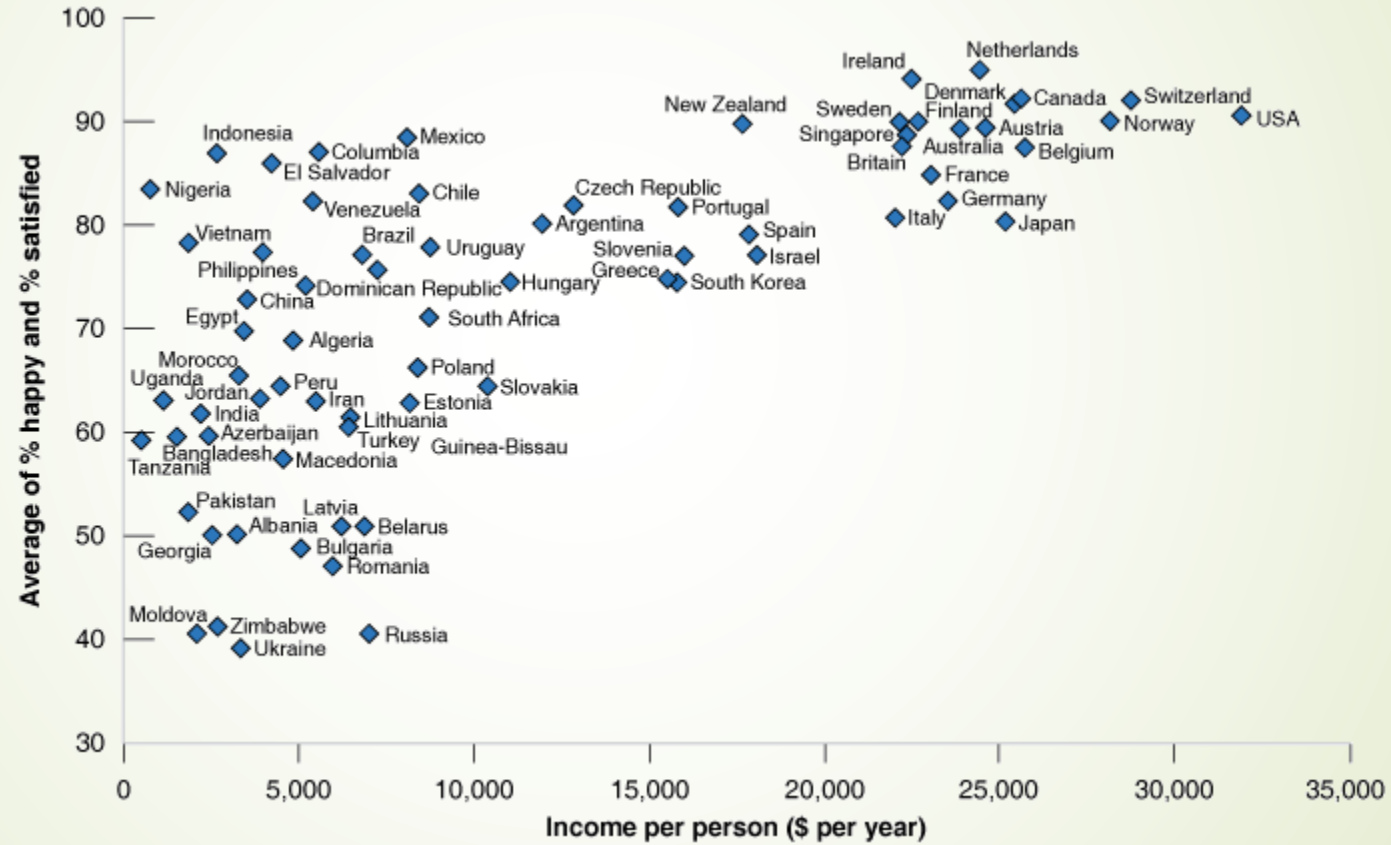


Figure 1 *Happiness and Income per Person across Countries*

Growth and Happiness

Economists take for granted that higher output per capita means higher utility and increased happiness. The evidence on direct measures of happiness, however, points to a more complex picture.

Table 1 Distribution of Happiness in the United States Over Time (Percent)

	1975	1996
Very happy	32	31
Pretty happy	55	58
Not too happy	13	11

Table 2 Distribution of Happiness in the United States Across Income Groups (Percent)

Income Level	Top Quarter	Bottom Quarter
Very happy	37	16
Pretty happy	57	53
Not too happy	6	31

Growth in Rich Countries since 1950

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Table 3 The Evolution of Output per Person in Four Rich Countries since 1950

	Annual Growth Rate Output per Person (%)	Real Output per Person (2000 dollars)		
	1950–2004	1950	2004	2004/1950
France	3.3	5,920	26,168	4.4
Japan	4.6	2,187	24,661	11.2
United Kingdom	2.7	8,091	26,762	3.3
United States	2.6	11,233	36,098	3.2
Average	3.5	6,875	28,422	3.9

Table 3 yields two main conclusions:

- There has been a large increase in output per person.
- There has been convergence of output per person across countries.

Growth in Rich Countries since 1950

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The Large Increase in the Standard of Living since 1950

Real output per capita has increased by a factor of 3.2 since 1950 in the United States, by a factor of 4.4 in France, and by a factor of 11.2 in Japan.

These numbers show what is sometimes called the *force of compounding*.

Growth in Rich Countries since 1950

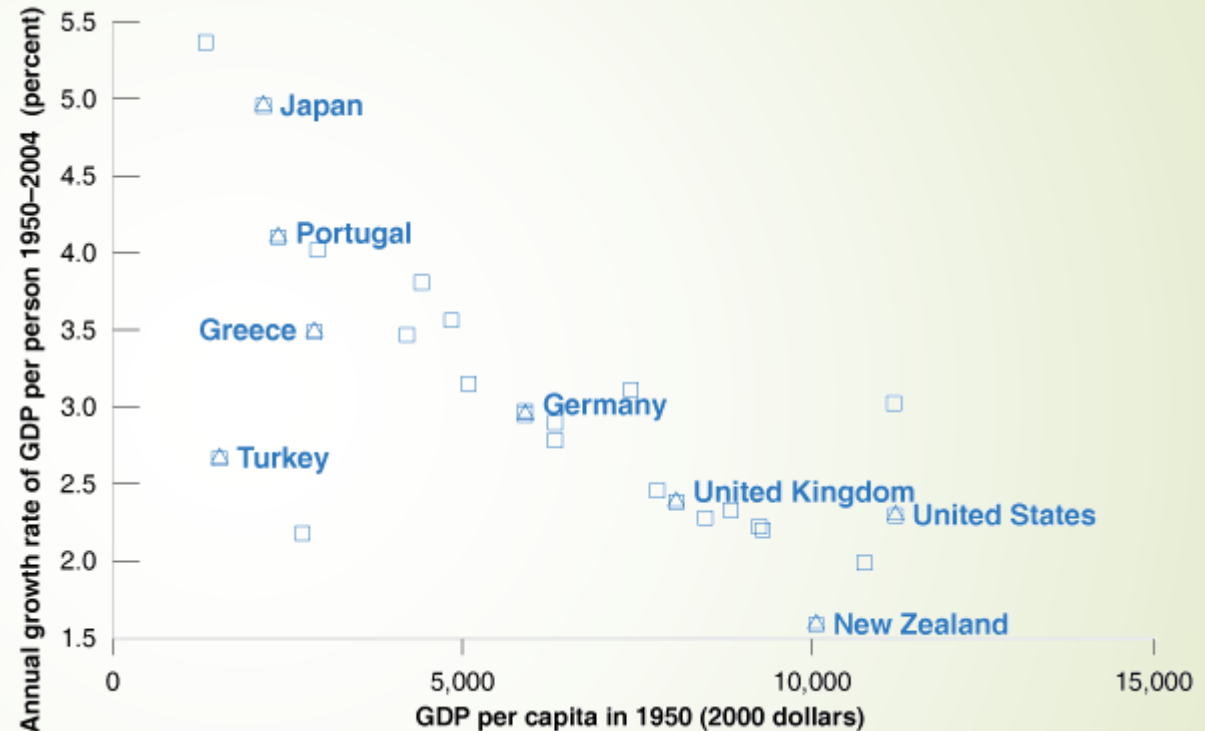
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The Convergence of Output per Person since 1950

■ Figure 2

Growth Rate of GDP per Person since 1950 versus GDP per Person in 1950, OECD Countries

Countries with lower levels of output per person in 1950 have typically grown faster.



The **convergence** of levels of output per capita across countries is not specific to the four countries we are looking at, it also extends to the set of OECD countries.

A Broader Look at Growth Across Time and Space

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Looking at Growth Across Two Millennia

There is agreement among economic historians about the main economic evolutions over the last 2,000 years:

- ▶ From the end of the Roman Empire to roughly the year 1500, there was essentially no growth of output per person in Europe.
- ▶ From about 1500 to 1700, growth of output per person turned positive, about 0.1% per year. It increased to 0.2% per year from 1700 to 1820.
- ▶ This period of stagnation of output per person is often called the *Malthusian era*. Europe was in a **Malthusian trap**, unable to increase its output per person.
- ▶ On the scale of human history, the growth of output per capita is a recent phenomenon.

A Broader Look at Growth Across Time and Space

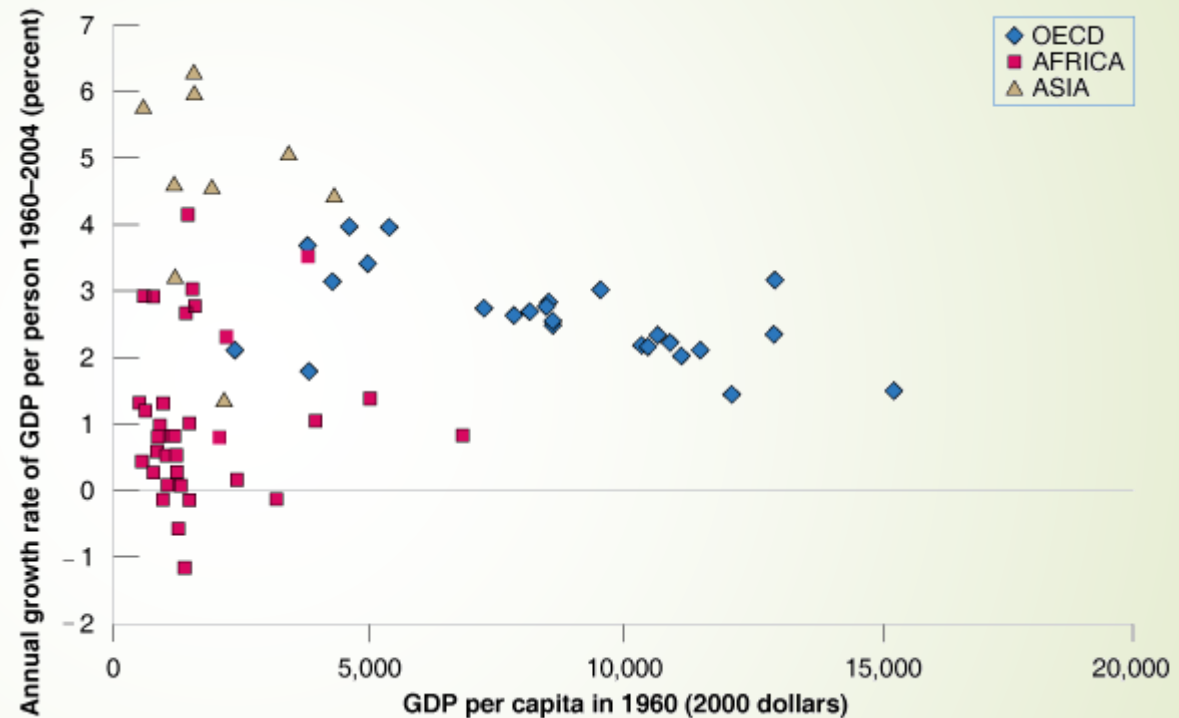
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Looking at Growth Across Many Countries

Figure 3

Growth Rate of GDP per Person since 1960 versus GDP per Person in 1960 (2000 dollars) for 70 Countries

There is no clear relation between per person the growth rate of output since 1960 and the level of output per person in 1960.



A Broader Look at Growth Across Time and Space

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Looking at Growth Across Many Countries

Looking at patterns by groups yields three main conclusions:

1. Nearly all OECD countries start at high levels of output per person (say, at least one-third of the U.S. level in 1960), and there is clear evidence of convergence.
2. Convergence is also visible for most Asian countries: All the countries with growth rates above 4% over the period are in Asia. Starting in the 60's a group of countries sometimes called the **four tigers**: Singapore, Taiwan, Hong Kong, and South Korea started catching up to the high output of Japan. (Economies with high growth rates but low output per person are often called **emerging economies**.)
3. Convergence is certainly not the rule in Africa.

Thinking about Growth: A Primer

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To think about the facts presented in the previous sections, we use the framework of analysis developed by Robert Solow, from MIT, in the late 1950s. Particularly:

- What determines growth?
- What is the role of capital accumulation?
- What is the role of technological progress?

Thinking about Growth: A Primer

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The Aggregate Production Function

The aggregate production function is a specification of the relation between aggregate output and the inputs in production.

$$Y = F(K, N)$$

Y = aggregate output.

K = capital—the sum of all the machines, plants, and office buildings in the economy.

N = labor—the number of workers in the economy.

The function F , which tells us how much output is produced for given quantities of capital and labor, is the *aggregate production function*.

Thinking about Growth: A Primer

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The Aggregate Production Function

The aggregate production function depends on the state of technology. The higher the state of technology, the higher for a given K and a given N .

$$Y = F(K, N)$$

The *state of technology* is a set of blue prints defining the range of products and the techniques available to produce them.

Thinking about Growth: A Primer

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Returns to Scale and Returns to Factors

Constant returns to scale is a property of the economy in which, if the scale of operation is doubled—that is, if the quantities of capital and labor are doubled—then output will also double.

$$2Y = F(2K, 2N)$$

Or more generally, for any number x ,

$$xY = F(xK, xN)$$

Thinking about Growth: A Primer

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Returns to Scale and Returns to Factors

Decreasing returns to capital refers to the property that increases in capital lead to smaller and smaller increases in output as the level of capital increases.

Decreasing returns to labor refers to the property that increases in labor, given capital, lead to smaller and smaller increases in output as the level of labor increases.

Thinking about Growth: A Primer

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Output per Worker and Capital per Worker

Constant returns to scale implies that we can rewrite the aggregate production function as:

$$\frac{Y}{N} = F\left(\frac{K}{N}, \frac{N}{N}\right) = F\left(\frac{K}{N}, 1\right)$$

The amount of *output per worker*, Y/N depends on the amount of capital per worker, K/N .

As capital per worker increases, so does output per worker.

Thinking about Growth: A Primer

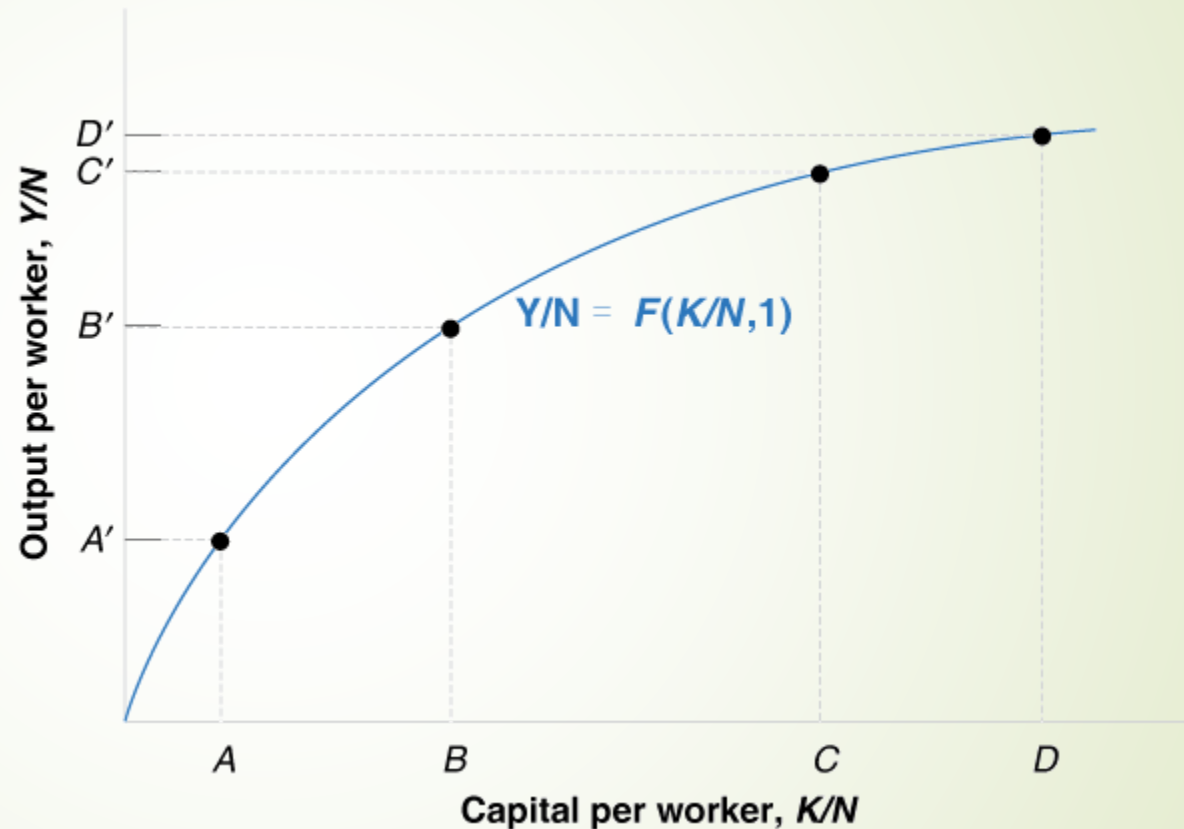
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Output per Worker and Capital per Worker

Figure 4

Output and Capital per Worker

Increases in capital per worker lead to smaller and smaller increases in output per worker.



Thinking about Growth: A Primer

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The Sources of Growth

- Increases in output per worker (Y/N) can come from increases in capital per worker (K/N).
- Or they can come from improvements in the state of technology that shift the production function, F , and lead to more output per worker given capital per worker.

Thinking about Growth: A Primer

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The Sources of Growth

We can think of growth as coming from capital accumulation and from technological progress—the improvement in the state of technology.

These two factors play very different roles in the growth process:

- ▶ Capital accumulation *by itself* cannot sustain growth. Saving rate is the proportion of income that is saved.
- ▶ Sustained growth requires sustained technological progress. The economy's rate of growth of output per person is eventually determined by the economy's rate of technological progress.

Thinking about Growth: A Primer

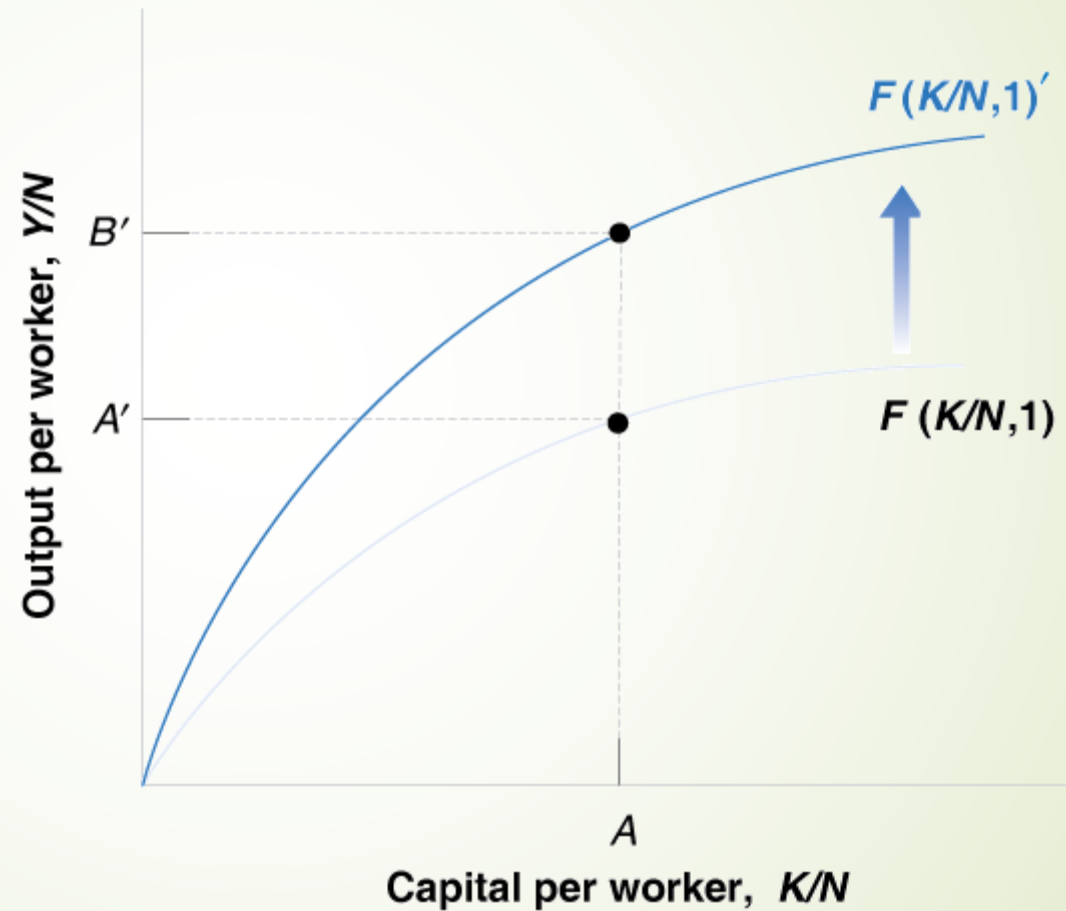
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The Sources of Growth

Figure 5

The Effects of an Improvement in the State of Technology

An improvement in technology shifts the production function up, leading to an increase in output per worker for a given level of capital per worker.





Thank YOU for attention

End