

## MODULE 38: PRODUCTIVITY AND GROWTH

The purpose of this module is to further explore the relationship between productivity and growth. Economists estimate aggregate production functions to empirically measure the impact of additional investments in physical capital, human capital, and technology on long-term economic growth.

### Student learning objectives:

- How changes in productivity are illustrated using an aggregate production function.
- How growth has varied among several important regions of the world and why the **convergence hypothesis** applies to economically advanced countries.

### Key Economic Concepts For This Module:

- The aggregate production function is a graphical way of measuring how physical capital per worker, human capital per worker, and technology are combined to produce real GDP per worker.
- There are diminishing returns to increasing physical capital per worker.
- The importance of natural resources has diminished in a nation's economic growth, though destruction of the natural resources is widely accepted as not conducive to strong growth.
- History tells us that the formula for a nation's economic success is complicated and not easy for economists to predict.

### Common Student Difficulties:

- If students have not had microeconomics, the concept of diminishing returns is foreign to them. Use an example that is familiar to them. Does the first hour of studying for an exam produce more or less additional benefit (a higher test score) than the 10<sup>th</sup> hour of studying for the same exam?
- Students can get bogged down in multiple case-studies. If you fear that the class will overlook the key points while trying to memorize what has happened in Argentina, then skip this section and focus on the material that will be tested on the AP Macro exam. While the details are not testable, the case studies are used to illustrate the important (and testable) concepts presented in this module.

## In-Class Presentation of Module and Sample Lecture

Suggested time: This module can be covered in one one-hour class session.

- I. Productivity and Growth
  - A. Accounting for Growth: The Aggregate Production Function
  - B. What About Natural Resources?
- II. Success, Disappointment, and Failure
  - A. East Asia's Miracle
  - B. Latin America's Disappointment
  - C. Africa's Troubles

### I. Productivity and Growth

#### A. Accounting for Growth: The Aggregate Production Function

We saw from the previous module that productivity is higher, other things equal, when workers are equipped with more physical capital, more human capital, better technology, or any combination of the three.

Economists make use of tons of macroeconomic data to statistically estimate the nation's **aggregate production function**, which shows how productivity depends on the quantities of physical capital per worker and human capital per worker as well as the state of technology.

**Example** Barry Bosworth and Susan Collins of the Brookings Institution estimated (using data from China and India) the following aggregate production function:

$$\text{GDP per worker} = T \times (\text{Physical capital per worker})^{0.4} \times (\text{Human capital per worker})^{0.6}$$

$T$ : an estimated level of technology

There is an important microeconomic concept that also applies to the aggregate production function.

Diminishing returns to physical capital: all else equal, as physical capital is increased, aggregate output increases by a smaller amount.

**Example** Office typists are given better and better laptop computers.

| Physical Capital per Worker | Real Output per Typist |
|-----------------------------|------------------------|
| \$0                         | \$0                    |
| \$1000                      | \$4000                 |
| \$2000                      | \$7000                 |
| \$3000                      | \$9000                 |
| \$4000                      | \$10,000               |

The increase in real output per typist is initially high, an increase of \$4000.

But if better computers are provided, a doubling of physical capital per worker, real output increases but not by double.

The pattern continues. Another \$1000 of physical capital per worker is added to the office, but real output per typist rises at a slower and slower rate.

Note: Have the students plot these five points from the table in a graph that shows the aggregate production function rising at a slower rate. The graph shows the diminishing returns as a flattening of the upward sloping curve.

It is very important to stress the “all else equal” assumption above. If the typists also were given training to increase their average words per minute, then a doubling of the physical capital per worker may indeed provide a doubling of the real output per worker. We have to hold technology and human capital constant to see the impact of a change in physical capital on aggregate output.

Note: This may be where the instructor decides to stop in-depth coverage of this module. The AP Macroeconomics exam will not cover growth accounting or the specific growth rates of Asia, South America and Africa. The ideas presented below can be useful for understanding the testable material.

In reality, everything is changing at once. Economists try to estimate the impact different factors have on growth with a technique called **growth accounting**.

When other important factors, like human capital or technology, increase, the aggregate production function shifts upward. This tells us that, for any given level of physical capital per worker, total production has increased. Economists try to measure higher total factor productivity: the amount of output that can be produced with a given amount of factor inputs. So when total factor productivity increases, the economy can produce more output with the same quantity of physical capital, human capital, and labor.

### **B. What About Natural Resources?**

Other things equal, countries with abundant natural resources, such as highly fertile land or rich mineral deposits, have higher real GDP per capita than less fortunate countries. For example, oil rich nations like Kuwait. Yet some nations with huge oil reserves (Nigeria) are not wealthy.

Natural resources were very important for economic growth when there were vast territories that remained undeveloped. As North America became more populous, the fertile farmland and timber and mineral resources played a huge role in the growth of the U.S. and Canada.

However, once the arable land was planted and the natural resources were harvested, the role of natural resources diminished and the role of physical capital, human capital and technology increased.

Clearly, a nation that overexploits or pollutes its natural resources cannot enjoy much long-run growth, but the actual possession of many natural resources has become less important in the aggregate production function.

## **II. Success, Disappointment, and Failure**

Growth rates differ widely across the regions of the globe. Why? The authors present three case-studies.

### **A. East Asia’s Miracle**

Since 1975, the whole region of East Asia has increased real GDP per capita by 6% per year, three times America’s historical rate of growth.

How have the Asian countries achieved such high growth rates?

The answer is that all of the sources of productivity growth have been firing on all cylinders.

- Very high savings rates. The percentage of GDP that is saved nationally in any given year, have allowed the countries to significantly increase the amount of physical capital per worker.
- Very good basic education has permitted a rapid improvement in human capital.
- And these countries have experienced substantial technological progress.

The East Asian experience demonstrates that economic growth can be especially fast in countries that are playing catch - up to other countries with higher GDP per capita.

On this basis, many economists have suggested a general principle known as the convergence hypothesis. It says that differences in real GDP per capita among countries tend to narrow over time because countries that start with lower real GDP per capita tend to have higher growth rates.

### **B. Latin America's Disappointment**

Since about 1920, growth in Latin America has been disappointing.

The fact that South Korea is now much richer than Argentina would have seemed inconceivable a few generations ago.

Why has Latin America stagnated?

Comparisons with East Asian success stories suggest several factors.

- The rates of savings and investment spending in Latin America have been much lower than in East Asia, partly as a result of irresponsible government policy that has eroded savings through high inflation, bank failures, and other disruptions.
- Education—especially broad basic education—has been underemphasized: even Latin American nations rich in natural resources often failed to channel that wealth into their educational systems.
- And political instability, leading to irresponsible economic policies, has taken a toll.

### **C. Africa's Troubles**

Real GDP per capita in sub-Saharan Africa actually fell 13 percent from 1980 to 1994, although it has recovered since then. The consequence of this poor growth performance has been intense and continuing poverty.

What explains it?

Several factors are probably crucial.

- Perhaps first and foremost is the problem of political instability. In the years since 1975, large parts of Africa have experienced savage civil wars (often with outside powers backing rival sides) that have killed millions of people and made productive investment spending impossible.
- The threat of war and general anarchy has also inhibited other important preconditions for growth, such as education and provision of necessary infrastructure.
- Property rights are also a problem. The lack of legal safeguards means that property owners are often subject to extortion because of government corruption, making them averse to owning property or improving it. This is especially damaging in a country that is very poor.

While many economists see political instability and government corruption as the leading causes of underdevelopment in Africa, some—most notably Jeffrey Sachs of Columbia University and the United Nations—believe the opposite. They argue that Africa is politically unstable because Africa is poor. And Africa's poverty, they go on to claim, stems from its extremely unfavorable geographic conditions—much of the continent is landlocked, hot, infested with tropical diseases, and cursed with poor soil.

- In poor countries, worker productivity is often severely hampered by malnutrition and disease. In particular, tropical diseases such as malaria can only be controlled with an effective public health infrastructure, something that is lacking in much of Africa.
- Economists are studying certain regions of Africa to determine whether modest amounts of aid given directly to residents for the purposes of increasing crop yields, reducing malaria, and increasing school attendance can produce self - sustaining gains in living standards.

## **In-Class Activities and Demonstrations**

At this point in the semester, the students might enjoy a video segment or two that discusses economic growth in one nation or another. The instructor can search the PBS NewsHour website for phrases like “economic growth” and many video reports are found in the search.

<http://www.pbs.org/newshour/video/>

The instructor can also search for specific developing nations like Brazil, Nigeria, Peru or even members of the European Union.

Before, there was no change in technological progress.