

Growth and the World Economy

Convergence

- A. This hypothesis indicates that gaps in output per capita, Y/N , among countries narrows over time.
- B. Convergence in the Solow growth model.
 - 1. Suppose all countries have the same the production function:

$$Y = A \times K^{1/3} \times N^{2/3}.$$

- 2. Divide the production function by N to get:

$$Y/N = A \times (K/N)^{1/3}.$$

- 3. If A is the same for all countries then countries with
 - a. high levels of K/N have high levels of Y/N . (rich)
 - b. low levels of K/N have low levels of Y/N . (poor)

4. Example: The U.S. and Japan in 1950
- a. In 1950, output per capita, Y/N , was 5 times higher in the U.S. than in Japan.
 - b. Assume the U.S. is at its steady-state K/N while Japan is below its steady-state K/N (see Figure 6.1).
 - c. In the short run, Y/N will grow faster in Japan than the U.S. as K/N in Japan increases to its steady state.
 - d. In the long run (when K/N in Japan is at its steady state), the growth rate of Y/N will be the same in both countries.
 - e. Does the data support this theory?
 1. In 2000, Y/N was only 1.3 times higher in the U.S. than in Japan.
 2. The output gap between U.S. and Japan has narrowed tremendously.

C. Do other countries converge?

1. Testing the convergence hypothesis

a. If true, countries with low levels of Y/N should have higher output growth rates.

b. The test equation

$$\% \Delta(Y/N) = a + b \times [Y/N(i)]$$

where $\% \Delta(Y/N)$ is percent change in output per capita, $[Y/N(i)]$ is the initial level of output per capita, and a and b are estimated coefficients.

c. If $b < 0$, then convergence exists.

2. How well does the convergence hypothesis work?
 - a. There is strong evidence of convergence among industrialized countries since 1960 (see the top of Figure 6.3).
 - b. There is no evidence of convergence among all countries since 1960 (see the bottom of Figure 6.3).

D. Example: Calculating differences between rich and poor countries.

Suppose the production function for the U.S. and India is

$$Y = A \times K^{0.4} \times N^{0.6}.$$

If output per capita, Y/N , is 15 times larger in the U.S. than in India and technology, A , is the same for both countries, how much larger is capital per capita, K/N , in the U.S. than in India.

Answer: Divide the production function by N to get:

$$Y/N = A \times (K/N)^{0.4}.$$

Since $[Y/N]_{US}/[Y/N]_I = 15$ and $A_{US} = A_I$, we get

$$[A_{US}([K/N]_{US})^{0.4}]/[A_I([K/N]_I)^{0.4}] = 15$$

$$[K/N]_{US}/[K/N]_I = 15^{(1/0.4)}$$

$$[K/N]_{US}/[K/N]_I = 871.4$$

Hence, K/N is 871.4 times larger in the U.S. than in India.

Long-Run Convergence and Steady-State Growth

A. Convergence or divergence in the long run: Results since 1900.

1. There is strong evidence of convergence among industrialized countries (see the top of Figure 6.4).
2. There is strong evidence of divergence among all countries (see the bottom of Figure 6.4).
3. Income inequality, the gap between the rich and poor, has increased over the last century.

B. Steady-state growth

1. The constant steady-state growth hypothesis holds for the U.S. and Canada.
 - a. The average growth rate for the U.S. is 1.8% before 1929 and 2.0% afterwards.

- b. Canada's average growth rates before and after 1929 are nearly identical.
2. The constant steady-state growth hypothesis does not hold for most other countries.
 - a. The average growth rate for the U.K. is 1.1% before 1918 and 1.5% afterwards.
 - b. The average growth rate for Japan is 1.9% before 1944 and 3.8% afterwards.
 - c. See Figure 6.6.
 - d. In Sweden and Finland, the post-WWI average growth rates are about 85% higher than the pre-WWI rates.
 - e. In France and Germany, the post-WWII average growth rates are about 160% higher than the pre-WWII rates.

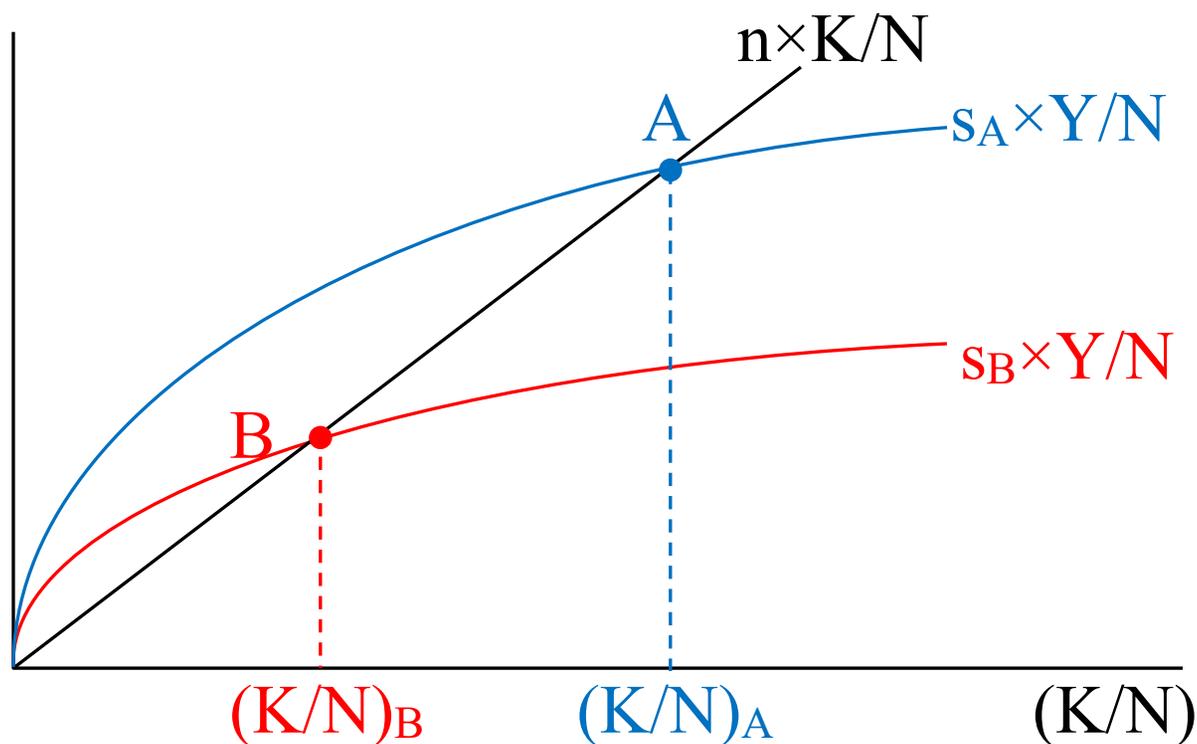
Augmented Solow Growth Model

A. Convergence or Conditional Convergence

1. The convergence hypothesis states that two countries move toward the same steady-state Y/N .
2. Two countries with different savings rates or population growth rates have different steady-state levels of K/N and Y/N .

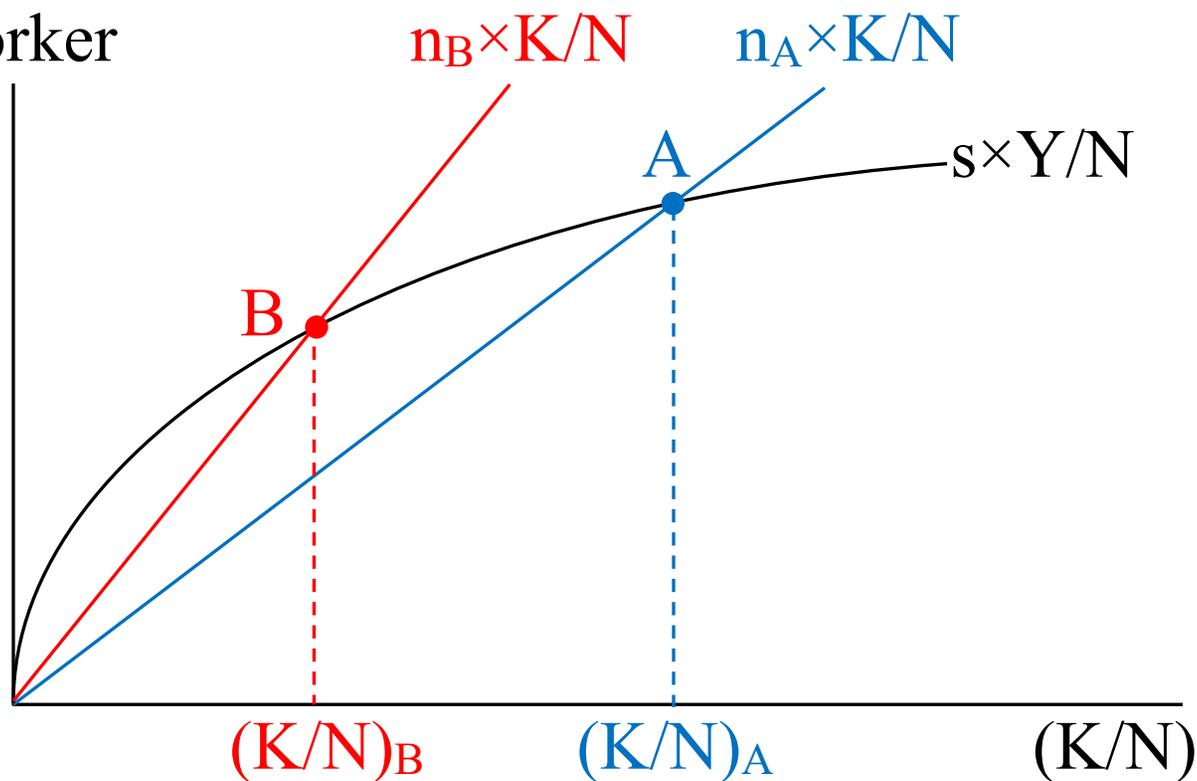
- a. If the savings rate in Country **A**, s_A , is higher than in Country **B**, s_B , then the steady-state K/N and Y/N in Country **A** are higher than in Country **B**.

Savings per
worker

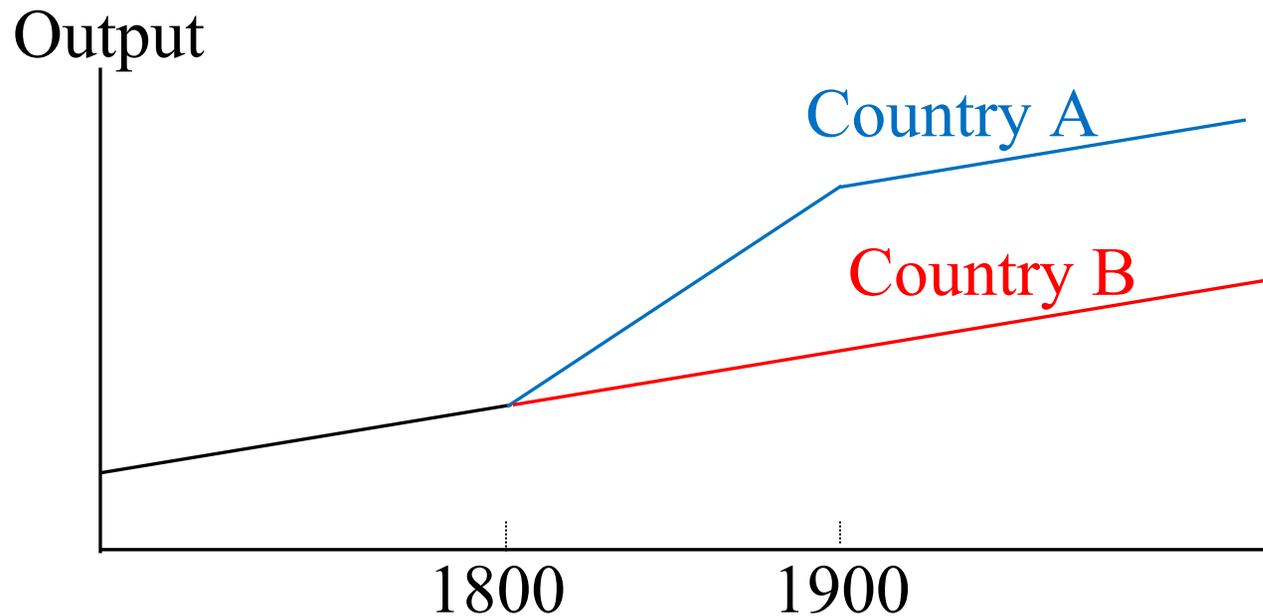


- b. If the population growth rate in Country **A**, n_A , is lower than in Country **B**, n_B , then steady state K/N and Y/N in Country **A** are higher than in Country **B**.

Savings per
worker



3. How do savings rates and population growth rates impact testing for convergence?
- a. Suppose **Country A** and **Country B** were at their steady-state levels of Y/N and had the same savings rate and population growth rates prior to 1800.
 - b. If **Country A**'s savings rate increases or population growth rate decreases in 1800 then **Country A** will have a higher growth rate along its transition path. Once the new steady-state K/N and Y/N are reached in 1900, then **Country A** and **Country B** will grow at the same rate.



- c. Testing for convergence: if the data starts at 1900, you would find no evidence of convergence; if, on the other hand, the data starts in 1800, you would find divergence.

4. Conditional convergence suggests that countries converge to their own steady-state K/N and Y/N after controlling for their savings and population growth rates.

a. Is there conditional convergence ($b < 0$)?

$$\begin{aligned} \% \Delta(Y/N) &= a + b \times Y/N(i) \\ &+ [\text{savings and population growth rates}] \end{aligned}$$

where $\% \Delta(Y/N)$ is percent change in output per capita, $Y/N(i)$ is the initial level of output per capita, and a and b are estimated coefficients.

b. The estimates for b are negative for a sample of 98 countries which indicates there is conditional convergence in the world when savings and population growth rates are controlled for.

c. Since most industrialized countries have similar savings and population growth rates, the previous finding of convergence among these countries is sensible.

B. Human capital

1. Controlling for savings and population growth rates only explains 59% of the difference in Y/N among 98 countries.
2. Another factor that influences Y/N is human capital (i.e. schooling and on-the-job training).
3. Secondary school enrollment rates are a proxy for human capital.
4. Conditional convergence?

$$\% \Delta(Y/N) = a + b \times [Y/N(i)]$$

+ [savings and population growth rates and secondary school enrollment rates]

Result: b is larger negative number which implies faster conditional convergence when human capital is included.

5. Savings and population growth rates and human capital explain 78% of the difference in Y/N among 98 countries.

C. Variables that impact the growth rate of Y/N

1. Savings rate is positively related to growth.
2. Population growth rate is negatively related to growth
3. Human capital (ex. secondary school enrollment) is positively related to growth.
4. Political variables impact growth.
 - a. Rule of law, political rights, and civil liberties are positively related to growth.
 - b. Revolutions, military coups, and wars are negatively related to growth.
5. Freer trade is positively related to growth.
6. Real exchange rate distortions and large black-market premiums are negatively related to growth.
7. Distance from the equator is positively related to growth.

Geography, Institutions, and Growth

- A. Distance from the equator is positively correlated to income per capita.
1. Countries far from the equator are relatively rich while countries close to the equator are relatively poor.
 2. See Figure 6.8.
 3. Does geography directly affect Y/N or does it work indirectly through social institutions?
- B. Social infrastructure
1. This is the institutions and government policy that enable individuals to accumulate skills and firms to accumulate capital and produce output.
 2. There is a positive relationship between social infrastructure (i.e., government quality and openness to trade) and output per capita (see Figure 6.9).

3. This measure of social infrastructure can explain most of the remaining variation in Y/N in a sample of 98 countries.
4. Social infrastructure is related to geography because most countries far from the equator were especially influenced by Western European institutions (that are favorable toward production) while countries near the equator were less influenced.

C. Geography hypothesis

1. This hypothesis says most differences in Y/N can be explained by geographical, climatic, and ecological differences.
2. Technologies for food productions, health, and energy are ecologically specific in ways that favor temperate areas (far from the equator) over tropical areas (near the equator).
3. An ecological divide limits the degree to which technological innovation can spread from temperate areas to tropical areas.

4. This causes a convergence among temperate countries but a divergence among temperate and tropical countries.

D. Institutions

1. This hypothesis states differences in social infrastructure and institutions cause differences in economic performances.
2. The low mortality rates in temperate areas encouraged European settlement with institutions such as private property rights and checks on government activities.
3. The higher mortality rates in tropical areas encouraged Europeans to limit settlement and the establishment of European institutions and instead they focused on the transfer of natural resources to the home country.
4. According to this hypothesis, these early institutions persisted and have an important effect on institutions today.