

Macroeconomics Final Exam Practice Problems: Convergence

(The attached PDF file has better formatting.)

Background: Convergence is a malleable concept. In the nineteenth century, the Western European nations were more successful than Asian or African countries. Some Europeans presumed they were innately superior to Asians or Africans.

In later decades, as third world countries developed, fewer people believed in the innate superiority of Europeans. Instead, they presumed that natural advantages of Europe made these nations successful: accessible coasts for shipping, fertile agricultural land, or even religious (Protestant) systems that fit well with capitalism.

In the first half of the twentieth century, European civilization produced two world wars. In the 1950's, 1960's, and 1970's, several countries in Asia, Europe, the Americas, and the Middle East developed rapidly. Differences were ascribed to historical happenstance. Low income countries would grow quickly by imitating the economies of advanced countries.

Some economists adopted a theory of absolute convergence. Countries were inherently similar, and eventually all would achieve the same economic level. The emergence of African nations after World War II and the rapid rise of Asian economies in the 1960's and 1970's seemed to support this theory. Japan's ability to duplicate or exceed the characteristics of Western economies seemed proof of the theory.

In recent years, some parts of the world (such as Asia) have moved closer or caught up to developed countries and some parts (such as Africa and the Middle East) are falling further behind. Barro presumes that each country has a steady state level, but countries may differ. He suggests that political, legal, and cultural attributes affect the steady state income of the economy. For example, a culture that does not allow women to work may never reach the per capital income of Western economies.

Exam problems test absolute convergence, conditional convergence, and their attributes with scenarios. Focus on the following items:

- When absolute convergence occurs and when only conditional convergence occurs.
- How convergence relates to income inequality.
- What attributes cause faster or slower growth rates.

**** Exercise 1.1: Conditional Convergence**

Conditional convergence means a country's long-term expected economic growth rate $g(y, y^*)$ is a function of its *steady state* income per worker (y^*) and its *current* income per worker (y).

- A. What is the sign of $\partial g(y, y^*)/\partial y$, the partial derivative of the growth rate with respect to y ?
- B. What is the sign of $\partial g(y, y^*)/\partial y^*$, the partial derivative of the growth rate with respect to y^* ?

Part A: For a given steady state income per worker, as the current income per worker rises, the growth rate decreases. As the current income per worker approaches the steady state income per worker, the growth rate slows.

Part B: For a given current income per worker, as the steady state income per worker rises, the growth rate increases. As the current income per worker becomes further away from the steady state income per worker, the growth rate quickens.

Jacob: Can one also write the long-term economic growth rate in terms of capital per worker?

Rachel: The signs of the partial derivatives are the same if we use capital per worker instead of income per worker.

**** Exercise 1.2: Conditional Convergence**

Suppose the rate of conditional convergence is 10% per annum for all countries. (Barro assumes a rate of 2% to 2.5%; we use 10% to simplify the arithmetic.) The 10% is the mean reversion rate. If steady state output is y^* and current output is y , the expected growth rate is $10\% \times (y^* - y) / y$.

Illustration: If steady state real GDP is \$20,000 per worker and current real GDP is \$16,000 per worker, the expected growth rate is $10\% \times (\$20,000 - \$16,000) / \$16,000 = 2.50\%$.

Countries W, Y, and Z have the following current and steady state real GDP per worker at 1/1/20X2. (Output per worker = real GDP per worker).

Country	Current Output	Steady State Output
W	20,000	28,000
Y	30,000	40,000
Z	30,500	31,000

- A. What is Country W's growth rate in 20X2 and its real GDP per worker at 12/31/20X2?
- B. What is Country Y's growth rate in 20X2 and its real GDP per worker at 12/31/20X2?
- C. What is Country Z's growth rate in 20X2 and its real GDP per worker at 12/31/20X2?

Part A: Country W's growth rate in 20X2 is $10\% \times (\$28,000 - \$20,000) / \$20,000 = 4.00\%$. Its real GDP per worker at 12/31/20X2 is $\$20,000 \times 1.040 = \$20,800$.

Part B: Country Y's growth rate in 20X2 is $10\% \times (\$40,000 - \$30,000) / \$30,000 = 3.33\%$. Its real GDP per worker at 12/31/20X2 is $\$30,000 \times 1.0333 = \$30,667$.

Part C: Country Z's growth rate in 20X2 is $10\% \times (\$31,000 - \$30,500) / \$30,500 = 0.16\%$. Its real GDP per worker at 12/31/20X2 is $\$30,500 \times 1.00167 = \$30,551$.

**** Exercise 1.3: Convergence and Fertility Rates**

An economist examining convergence among developing countries finds that economic growth stimulates greater education of women and lower birth rates: an increase in GDP per capita leads to a decline in the fertility rate. All countries benefit from modern medicine. Infant mortality, infectious diseases, and mortality rates decline in all the countries, whether or not the fertility rate declines.

- A. How does decreasing mortality with no change in the fertility rate affect capital per worker?
- B. How does the effect of economic development on fertility rates affect convergence?
- C. How does the effect of economic development on fertility rates affect observed patterns in Africa and the Middle East?

Part A: New capital must support new workers, and the capital per worker ratio may decline.

Part B: If development leads to lower fertility rates, conditional convergence may not occur, since countries that grow rapidly and have lower birth rates may grow even more rapidly in later years.

Part C: Endogenous population growth may help explain why Africa and the Middle East have lagged behind and not converged with North America, western Europe, and Asia. Economic development leads to better education and work opportunities for women and lower fertility rates, which leads to faster development.

**** Exercise 1.4: Convergence**

An economist finds convergence among the states of the U.S. but not among the countries of Africa.

How do each of the following affect convergence in the U.S. vs in Africa?

- A. Educational and legal systems.
- B. Currency and taxes.
- C. Labor mobility.

Part A: U.S. states have similar public education, laws, and court systems; African countries do not. The similarity among U.S. states leads to similar steady state income per worker, which leads to convergence.

Part B: U.S. states have the same currency and federal taxes; African countries do not. Different currencies and tax rates may cause different steady state income per worker, preventing convergence.

Part C: Labor moves easily across U.S. states but not between African countries. If job opportunities are better in one state, workers move there. Workers and businesses are now leaving California and Illinois and moving to Texas and Florida. States don't want to lose their workers, so this labor mobility helps deter excessive state regulation that prevents convergence.

**** Exercise 1.5: Income Inequality**

The removal of trade barriers, reduction in transportation costs, and better education enable skilled workers in developing countries, such as China and India, to perform jobs formerly done in North America and Western Europe. Western countries now out-source skilled and unskilled jobs to China, India, and other Asian nations.

China and India were the world's most technologically advanced nations in the fifteenth through seventeenth centuries. They have highly intelligent populations, strong support for civil law, economic freedoms, and widespread education. Their steady state income per worker is the same as that of the Western world.

Countries focus on industries and professions where they have comparative advantages. Educated young people, skilled workers, and urban residents in China and India get high paying jobs. Some farm workers retain the same work; other farm workers get only partial benefit from global trade.

In Western countries, some firms benefit from lower costs, and consumers benefit from lower prices. Some worker who lose their jobs switch to better paying jobs; other workers who lose their jobs remain unemployed.

What are the effects of globalization on each of the following?

- A. Absolute poverty levels in China and India.
- B. Income inequality in China and India.
- C. Income inequality in North America and Western Europe
- D. Income inequality between nations of the world: that is, between (i) North America and Western Europe and (ii) China and India.
- E. Income inequality among the entire world's population

Part A: International trade helps all parties, raising income and reducing poverty.

Part B: Educated workers in China and India benefit much; rural workers benefit least. Income inequality may increase or decrease.

Part C: Some firms and workers benefit; others lose. Income inequality in North America and Western Europe may increase or decrease.

Part D: North America, Western Europe, China, and India have similar steady state income levels, so absolute convergence occurs and income inequality between nations decreases.

Part E: The average income inequality among the world's population probably also decreases, but we can not say for sure.