DEVELOPMENT ECONOMICS

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Chapter 4

Economic Growth

When you have completed your study of this chapter, you will be able to

1. Understand what are the determinants of economic growth.
2. Understand the Neoclassical Solow growth model and the endogenous growth model.
3. Understand the determinants of growth as explained by the empirical evidence.

INTRODUCTION

- *Economic growth* measures only growth in economic production.
- *Economic development* measures overall improvements in living standards and in the quality of life.
- Economic development cannot take place without economic growth.
- What are the *determinants* of economic growth?
- Why are some countries rich and others poor?
- *Capital accumulation* only explains part of the differences in economic growth across countries.
- Recently, economist have been paying special attention to the role of determinants like *geography and institutions*.

GROWTH AND FACTORS OF PRODUCTION

Factors of Production

- A firm generates output by combining *factors of production* (e.g. labor, capital, land) to produce output.
- To what extent do more primary factors such as *labor* and *capital* allow for more production?
- *Intermediate inputs*, like raw materials, are not part of the *"value added"* by a firm. More specifically, to avoid double counting, *value added* is defined as the value of output minus the value of inputs.
- *GDP* (the most common measure of production in an economy) equals the sum of value added across the economy.
- To a large extent, the *productivity* of each factor depends on the quantity of the other factor.
- *Factor abundance* is the relative availability of the different factors of production. Which factor of production is more abundant in developed economies? In developing economies?

THE NEO-CLASSICAL SOLOW GROWTH MODEL

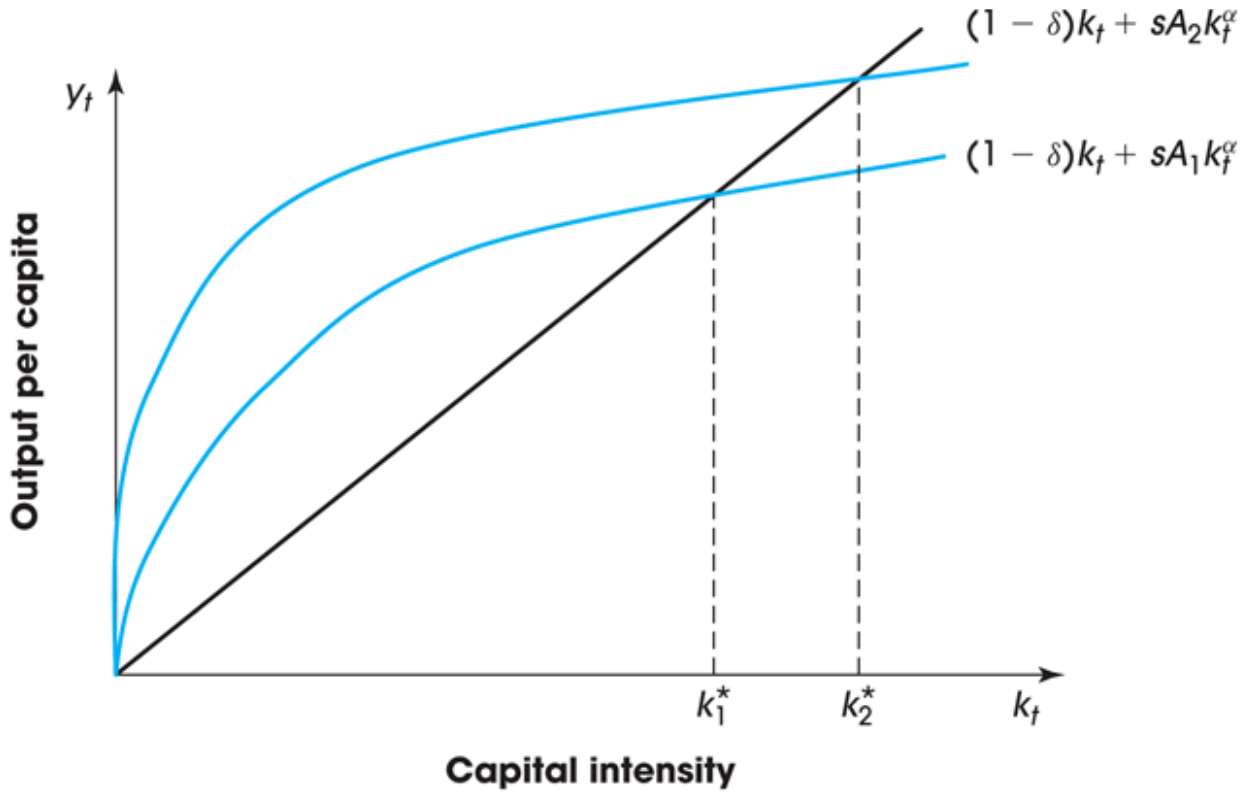
– Technological Progress and the Steady State

- What drives per capita growth in the steady state?

- Figure 4.3: An increase in TFP from A_1 to A_2 (represented by an *upward shift in the production function*) acts to increase capital intensity, and, therefore, output per person.
- Absent new *TFP shocks*, the economy will settle into a new steady styate at k^*_2
- In the Solow Model, these *positive shocks to TFP* are usually thought of as *exogenous.*
- The possibility of *new technology diffusion* increases the growth potential of developing economies.

THE NEO-CLASSICAL SOLOW GROWTH MODEL

Figure 4.3. Technological Progress in the Solow Model.



Technological progress in the economy leads to a shift from A_1 to A_2, which leads to an increase in steady state capital intensity from k_1^* to k_2^*.

THE NEO-CLASSICAL SOLOW GROWTH MODEL

The Effect of Different Savings Rates

- An increase in the savings rate leads to an increase in per capita output in the steady state.
- Historically, many *high-savings Asian economies* also grew rapidly. High investment rates also encourage *adoption of new technology.*
- On the other hand, China, the Soviet Union, and other *centrally-planned economies* invested at a high rate, but growth sputtered as *government directed investment was often wasted.*
- In general, economists agree that while high rate of savings and investment is important, the *efficiency of investment* is just as important.

THE NEO-CLASSICAL SOLOW GROWTH MODEL

– Differences in Human Capital

- *Human capital* is the skills, talents, and knowledge embodied in the people (i.e. education).
- Modify the Solow Model to incorporate h, the level of human capital (*average years of schooling* for instance):

$$Y_t = AK_t^{\alpha}(hL_t)^{1-\alpha} = (Ah^{1-\alpha})K_t^{\alpha}L_t^{1-\alpha} \qquad (23)$$

- And the steady state income per capita increases:

$$y^* = \left[(h^{1-\alpha})A\right]^{\frac{1}{1-\alpha}}\left(\frac{s}{n+\delta}\right)^{\frac{\alpha}{1-\alpha}} = hA^{\frac{1}{1-\alpha}}\left(\frac{s}{n+\delta}\right)^{\frac{\alpha}{1-\alpha}} \qquad (24)$$

- Differences in *human capital can explain much cross-country variation* in growth and development, and human capital is a better predictor than investment rates.
- However, education does not account for a large part of growth variation, and some highly educated nations lag in development.
- Moreover, like most factors, the *direction of causality* between human capital and economic growth is unclear.

THE NEO-CLASSICAL SOLOW GROWTH MODEL

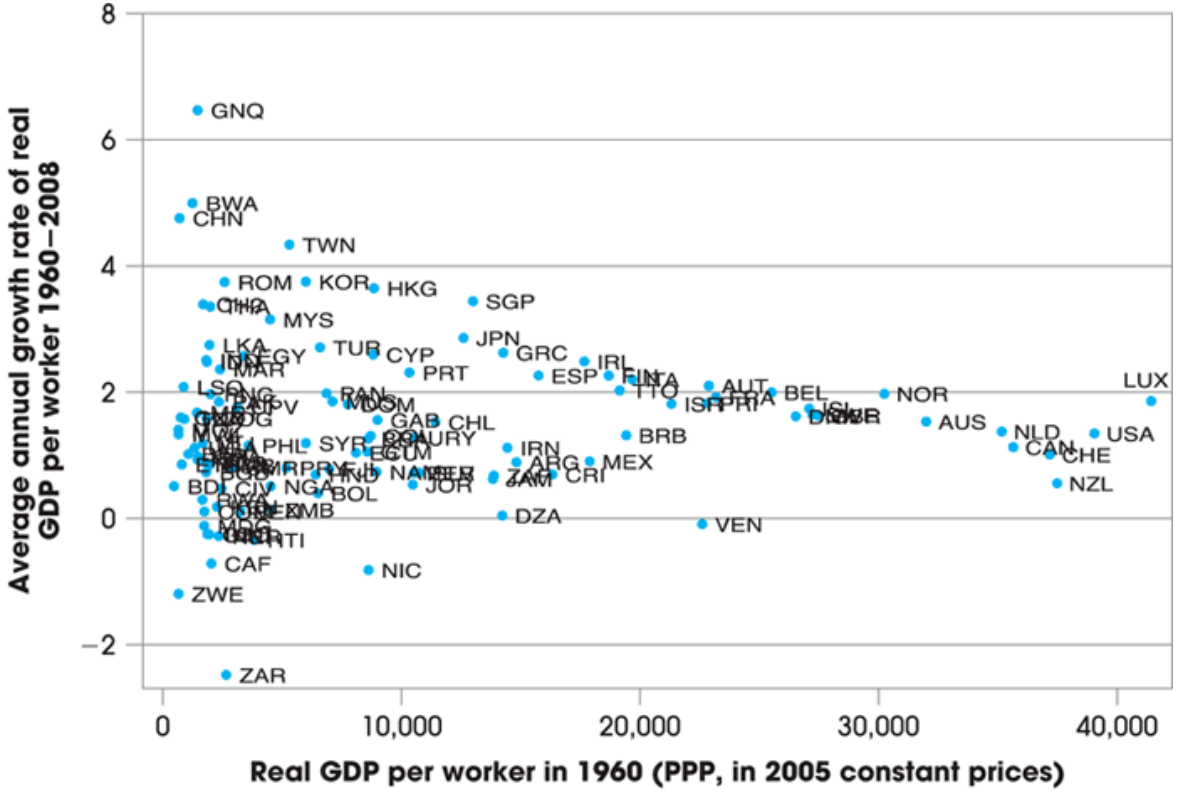
– Income Convergence

- The most important prediction of the Solow model is *income convergence:* poor countries should *catch-up* in terms of income per capita to rich countries.
- Assumes *all else being equal* (savings, depreciation, but especially similar production functions i.e., technology)
- A *greater marginal product of capital (return)* means that poor countries have the potential to grow faster than rich countries.

- There is *not much evidence of this convergence* in the data (Figure 4.4). Results, at best, are mixed. Some countries have successfully converged, others have drifted further behind.
- Most variation appears to be embodied in TFP (technology development and adoption) which is *exogenous to the Solow Model*. How can we *endogenously* explain differences in technological change across countries?

THE NEO-CLASSICAL SOLOW GROWTH MODEL

Figure 4.4. Growth of Income Per Worker (1960–2008) and 1960 Initial GDP Per Worker.



There is no negative relation between GDP per capita in 1960 and growth of GDP per capita between 1960 and 2008. If there were convergence, countries that were poorer in 1960 would have had higher rates of growth. On the contrary, poorer countries have had volatile growth, with some experiencing a lower growth than rich countries and some having a higher growth.

Source: Alan Heston, Robert Summers, and Bettina Aten, Penn World Table Version 7.0, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, May 2011: http://pwt.econ.upenn.edu/php_site/pwt_index.php.

ENDOGENOUS GROWTH THEORY

Endogenous growth theory suggests that growth is generated by *endogenous technical change* resulting from innovation.

Boundless Knowledge-Based Growth

- Assuming constant technological change, *potential for growth can be boundless* surmounting even limits to resources.
- Technology depends on *knowledge*, and the more knowledge there is in an economy, the higher the growth rate.
- Unlike human capital, human *knowledge* is not embodied in people but can be *transmitted across time and space.*
- Technology and knowledge develop through *economic incentives* communicated through *the market* and, sometimes, through government policy.
- Knowledge can *spillover, grow and accumulate indefinitely*. It is only constrained by the number of people producing it.

ENDOGENOUS GROWTH THEORY

– Knowledge as a Non-Rival Good

- Knowledge is a *non-rival good* and can still be consumed by the seller even after it is sold.
- Knowledge is also an *excludable good.* A seller can exclude others from its consumption.
- Enforced *property rights* (such as patents and copyrights), for example, prevent access to knowledge.
- Such exclusions can be important because people and firms need to have an incentives *(monopoly rents)* to invest in research and development.
- *Imperfect competition is necessary* to encourage growth. (Recall that the Solow model assumes perfect competition.)
- A *balance* must be struck between granting temporary *monopoly rights and promoting competition* over the long run.

ENDOGENOUS GROWTH THEORY

– Basic Equations of the Romer Model

- Labor is divided between the productive sector (Y) and the research sector (A):

$$L_t = L_{Yt} + L_{At} \qquad (25)$$

where human capital is the *stock of knowledge* at time t (A_t) times productive labor L_{yt} at time t.

- The production function:

$$Y_t = K_t^{\alpha}(A_t L_{Yt})^{1-\alpha} \qquad (26)$$

- Since knowledge (A_t) depends on the allocation of labor to research, it is *endogenous* to the model and can vary over time.
- The increment of knowledge is given by the stock of knowledge multiplied by the labor force in the research sector and a parameter that can represent, say, the *efficiency of research:*

$$g_{At} = \Delta A_t / A_{t-1} = \delta L_{At}$$

$$\Delta A_t = A_{t-1}\delta L_{At}$$

ENDOGENOUS GROWTH THEORY

– The Romer Model versus the Solow Model

- In the Romer Model, *imperfect competition is necessary* for innovation and growth, while the Solow model assumes perfect competition.
- *Innovation is endogenous* in the Romer model, depending on stock of knowledge and the R&D needed to build that knowledge. Innovation is exogenous in the Solow model.
- Romer predicts that rich countries should grow faster than poor countries because of a higher stock of knowledge (i.e., *divergence*). Solow predicts that countries with low capital intensity should grow faster (convergence).
- Note the basic Romer model *ignores possibilities of trade and technology transfer* between rich and poor countries.
- Are the protection of *intellectual property rights (IPR)* beneficial for poor countries?

EMPIRICAL ANALYSIS OF ECONOMIC GROWTH

What drives the main differences in economic growth between rich and poor countries?

- Output per worker (*labor productivity*) is highly correlated with long-term growth.
- Table 4.1: In 1988 Canada's productivity was about 94% of the U.S. level. The *capital-output ratio* (K/Y) and *TFP* (A) level were about the same between the countries. Most of the difference is explained by lower *human capital ratio* (H/L) in Canada.
- The same is generally true with West European economies.
- Between the developed and developing economies *differences in TFP seems to be the main factor.*
- What drives this difference in TFP?
- *Geography (Sachs) or Institutions (North)?*
- The growing consensus is that *countries with stronger institutions develop faster.*

EMPIRICAL ANALYSIS OF ECONOMIC GROWTH

Table 4.1. Decomposition of Productivity Differences (Ratios to the United States).

		Contribution from		
Country	Y/L	$(K/Y)^{\alpha/(1-\alpha)}$	H/L	A
United States	1.000	1.000	1.000	1.000
Canada	0.941	1.002	0.908	1.034
Italy	0.834	1.063	0.650	1.207
West Germany	0.818	1.118	0.802	0.912
France	0.818	1.091	0.666	1.126
United Kingdom	0.727	0.891	0.808	1.011
Hong Kong	0.608	0.741	0.735	1.115
Singapore	0.606	1.031	0.545	1.078
Mexico	0.433	0.868	0.538	0.926
Argentina	0.418	0.953	0.676	0.648
USSR	0.417	1.231	0.724	0.468
India	0.086	0.709	0.454	0.267
China	0.060	0.891	0.632	0.106
Kenya	0.056	0.747	0.457	0.165
Zaire (today Congo)	0.033	0.499	0.408	0.160
Average, 127 Countries	0.296	0.853	0.565	0.516
Standard Deviation:	0.268	0.234	0.168	0.325

Differences in measures of accumulation of physical and human capital explain only a small part of the differences in output per worker between the poorest countries in the world and the United States. The largest discrepancy is explained by differences in total factor productivity.

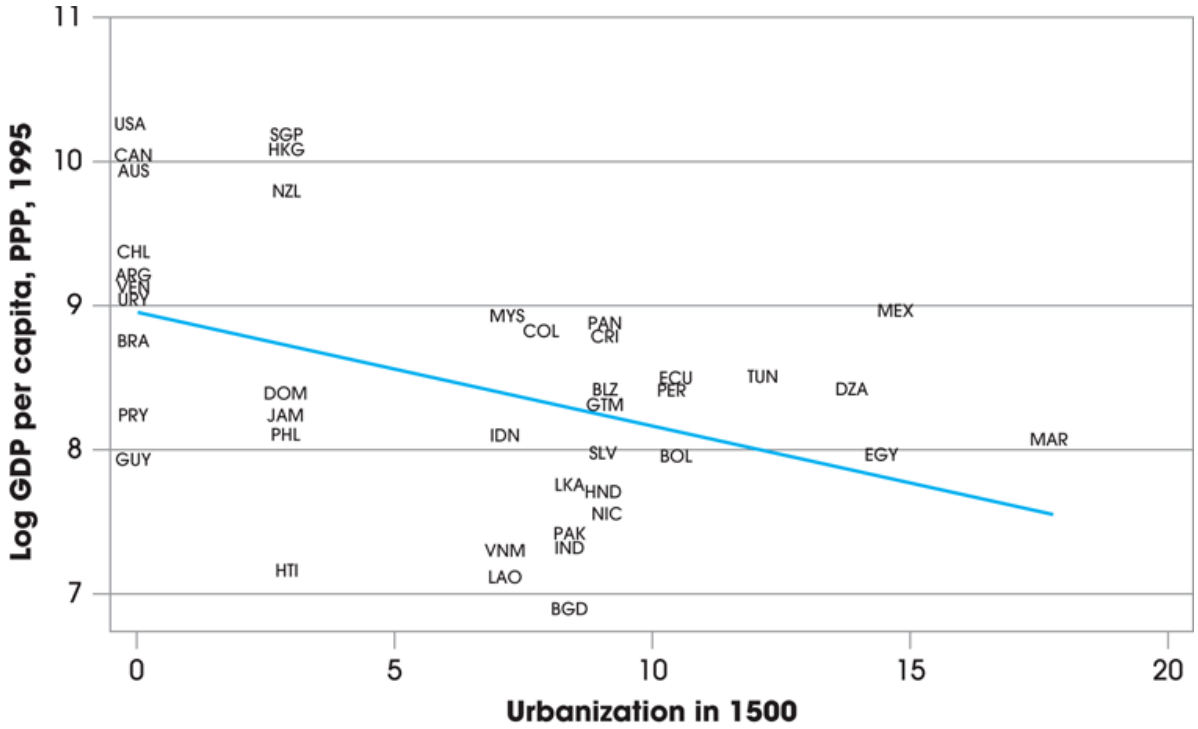
Source: Robert E. Hall and Charles I. Jones, "Why Do Some Countries Produce So Much More Output per Worker than Others?" *The Quarterly Journal of Economics* 114, no. 1 (1999): 91.

EMPIRICAL ANALYSIS OF ECONOMIC GROWTH

- Two geographic factors influencing growth: *distance from the equator and geographical isolation*
- Rich countries tend to be located in temperate zones, poor countries in the tropics:
  - tropical *disease* (malaria, sleeping sickness),
  - intense *heat* makes hard labor (farming, construction) difficult,
  - *rainfall volatility* affects agricultural productivity and flooding.
- Landlocked areas tend to be underdeveloped:
  - *lower population density* means less challenges and cooperation in using resources,
  - lack of access to trade and outside influences (e.g., *high transportation cost*).
- Societies in tropics have not always been poor (e.g., Egypt, Aztecs, Inca, etc.) Acemoglu, Johnson, and Robinson found negative correlation between *urbanization in 1500 (proxy for development)* and income per capita now.

EMPIRICAL ANALYSIS OF ECONOMIC GROWTH

Figure 4.5. Log GDP Per Capita in 1995 among Former European Colonies and Urbanization Rate in 1500.



There is a negative correlation between economic development in 1500 (represented by urbanization rates measured by historians) and modern economic development as measured by log GDP per capita in 1995. If geography were the main cause of underdevelopment, we should, instead, see a positive correlation.

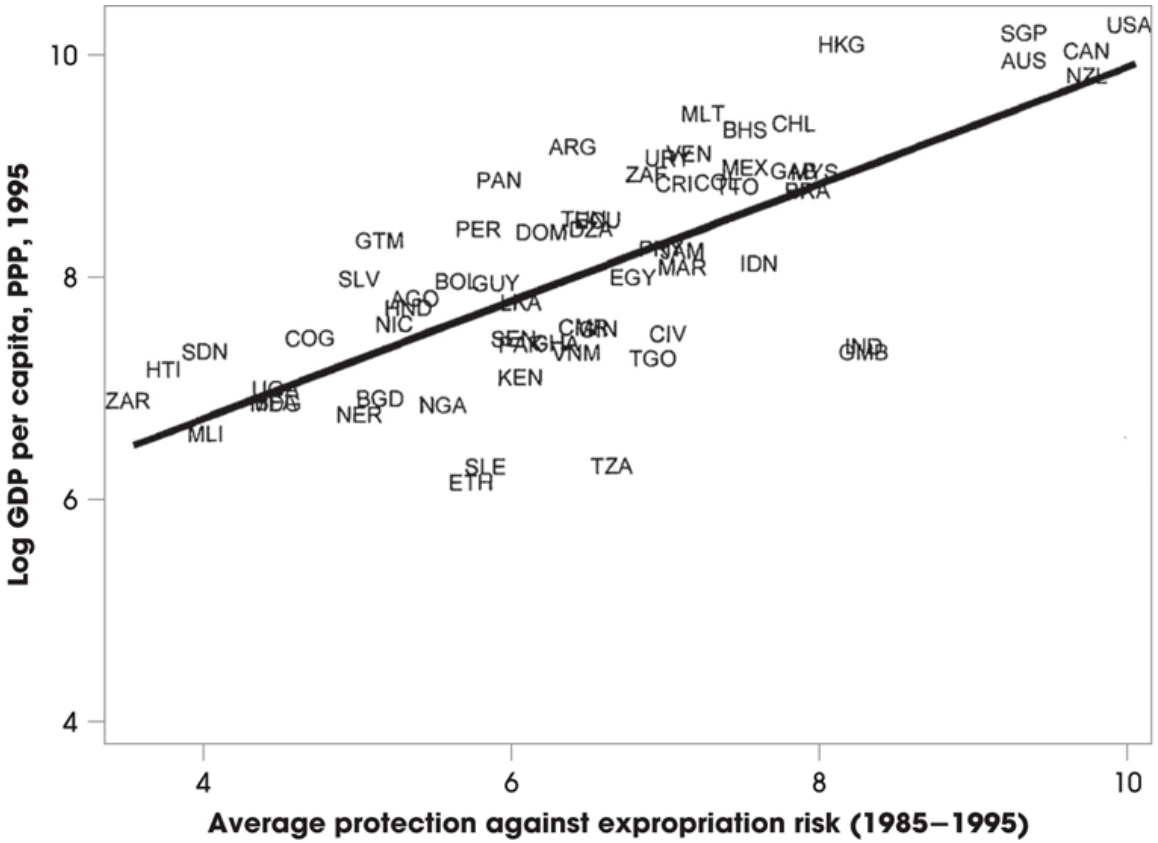
Source: Daron Acemoglu, Simon Johnson, and James A. Robinson, "Reversal of Fortune: Geography and Institutions in the Making of Modern World Income Distribution," *The Quarterly Journal of Economics* 117, no. 4 (November 2002): 1231–1294.

EMPIRICAL ANALYSIS OF ECONOMIC GROWTH

- Douglass North wrote (modern) seminal analysis arguing that *institutions* are key to understanding why some countries developed earlier than others.
- Since then, much empirical analysis has shown a *strong causal link from institutional quality to long term growth.*
- Another paper by Acemoglu, et. al. shows that protection from *expropriation risk* enhances growth (Figure 4.6).
- Used *instrumental variable technique* to establish causation. *Extractive or predatory institutions* established where settler mortality was high (e.g., Peru, Mexico, Congo, etc.) while more efficient institutions established where settler mortality was low (e.g., North America, New Zealand, etc.).
- Most of the current research in development economies tries to understand the role of institutions and their effects.

EMPIRICAL ANALYSIS OF ECONOMIC GROWTH

Figure 4.6. Average Protection against Risk of Expropriation and Log GDP Per Capita.

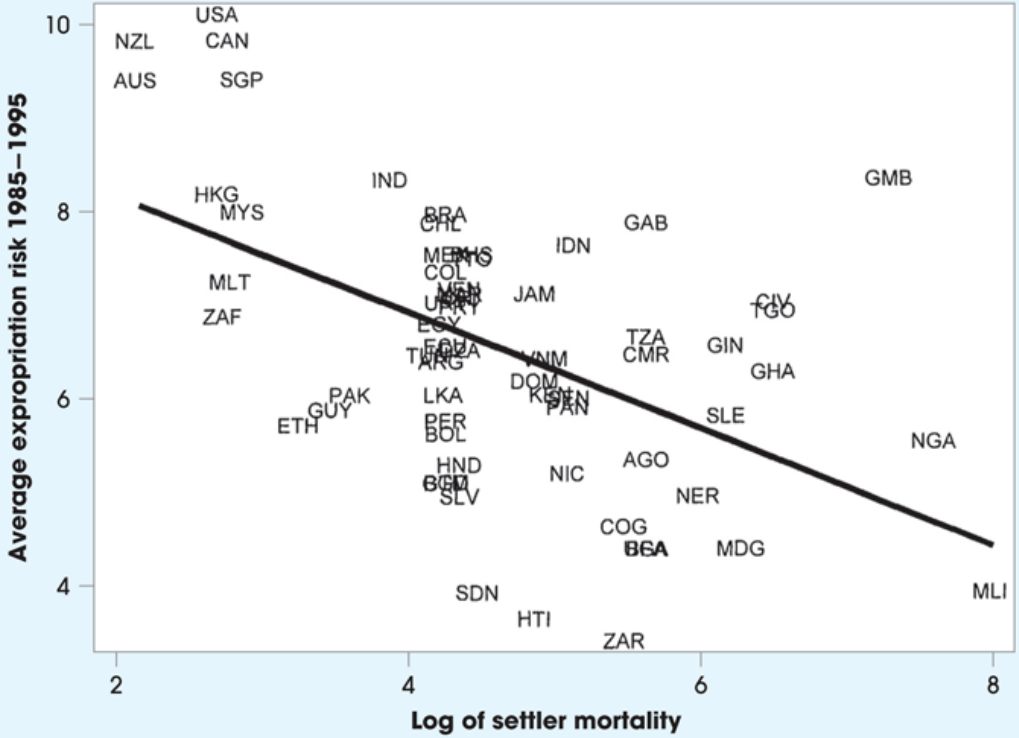


Countries in which economic agents are better protected against the risk of expropriation, an indicator of the quality of institutions, have a higher level of economic development as measured by log GDP per capita.

Source: Daron Acemoglu, Simon Johnson, and James A. Robinson, "The Colonial Origins of Comparative Development: An Empirical Investigation," *American Economic Review* 91, no. 5 (2001): 1380. Printed with permission of American Economics Association.

EMPIRICAL ANALYSIS OF ECONOMIC GROWTH

Figure 4.7. A Negative Correlation between Settler Mortality and Protection Against Expropriation.



The early mortality of European colonial settlers several hundred years ago is negatively correlated with the quality of institutions at the end of the 20th century.

Source: Acemoglu, Johnson, Robinson, "The Colonial Origins of Comparative Development: An Empirical Investigation," 2001: 1384. Printed with permission of American Economics Association.