Accounting for Cross-Country Differences In Income Per Capita*

BY AUBHIK KHAN

Living standards, as measured by average income per person, vary widely across countries. Differences in income result in large disparities in spending on goods and services by people living in different economies. What makes some countries rich and others poor? Furthermore, what determines income per person in a country, and why are these factors unevenly allocated across the world? In this article, Aubhik Khan outlines a framework for growth accounting to account for cross-country differences in income. The current consensus is that differences in per capita income across countries don't arise primarily from differences in the quantities of capital or labor, but rather from differences in the efficiency with which these factors are used.

Living standards, as captured by average income per person, vary dramatically across countries. These differences in income result in large disparities in spending on goods and services by people living in different economies. The typical person in a poor country has not only less consumption of food and housing but also less education and poorer health, when compared with a typical person living in a rich country. There are also sharp differences in life expectancy and infant mortality between rich and poor countries, both falling with income per capita.

In an effort to illustrate the magnitude of these differences in income, let's examine real gross domestic product (GDP) per capita using the cross-country data available from the Penn World Tables.[1] For 2004, the most recent year for which this measure exists, there are data on per capita GDP for 82 countries. Aside from Luxembourg, which is anomalous, the richest fifth in this group have an average income per capita of $32,142.[2] The poorest fifth have an average income per capita of only $1,422. Thus, the 16 poorest countries for which we have data for 2004 have an average income that is 23 times less than that of the 16 richest countries. This means that the typical person living in these poorer countries must survive on $4 each day. In the absence of government subsidies, it is difficult to imagine how an individual could buy enough food and shelter in the U.S. to survive with this income.

What makes some countries relatively rich while others are unimaginably poor? More generally, what are the determinants of income per person in an economy, and why are these inputs allocated so unevenly across the world? Why are some countries always at the bottom of the tables, while others rapidly close the gap between themselves and richer nations? We are compelled to ask

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[1] The Penn World Tables, prepared by Alan Heston, Robert Summers, and Bettina Aten, facilitate cross-country comparisons by calculating real GDP per capita for a large set of countries using a common set of international prices. It is widely used for cross-country comparisons because it assigns the same value to any particular commodity or service regardless of country.

[2] Luxembourg is anomalous not only because of its size but also because its income per capita, $54,285, is far beyond that of the rest of the rich world. The next richest country, the United States, has an income per capita of $39,535.

such questions because their answers might give policymakers a chance to implement a dramatic improvement in living standards in poorer countries. Nobel laureate Robert E. Lucas writes: "The consequences for human welfare involved in questions like these are simply staggering: Once one starts to think about them, it is hard to think about anything else."

Economists have studied sources of cross-country differences in income for more than 200 years. In the 1950s, Nobel laureate Robert Solow developed a framework for growth accounting that has been used extensively by economists to account for cross-country differences in income. Researchers in this field have achieved a remarkable degree of consensus that differences in per capita income across countries don't arise primarily because of differences in the quantities of capital or labor but rather because of differences in the efficiency with which these factors are combined. Further research on the underlying sources of these differences has provided further insights.

ACCOUNTING FOR CROSS-COUNTRY DIFFERENCES IN INCOME PER CAPITA

Accounting for cross-country differences in income is a daunting task. Why is one country richer or poorer than another? One could think of a host of reasons involving differences in skills; technologies; economic policies; natural endowments, including land, climate, and the frequency of natural disasters; political stability and human rights; the role of women in the workforce; and many other phenomena.

Whether studying the reasons for changes in Great Britain's income over the course of the Industrial Revolution or why Bangladesh is poorer than Thailand, economists begin by studying production in each country. The total value of all goods and services produced in the nation — real GDP — can be attributed to one of three sources: capital, labor, and total factor productivity. The manner in which differences in the levels of these factors translate into differences in real GDP is determined through the aggregate production function.

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AGGREGATE PRODUCTION FUNCTION

Before describing the production function, let's review the factors of production listed above. At the simplest level of aggregation, capital and labor are arguably always present in the production of any commodity — whether restaurant meals, economics lectures, or other goods and services.

Capital. Capital is the sum of all different types of equipment and structures used in production. Examples of equipment include both ploughs and tractors and both motorcycles and buses. This suggests the first problem in growth accounting, one that affects all of macroeconomics: How do you add up different goods to arrive at a total stock? If we want a single measure of all of the capital in the economy, how many ploughs make a bus? We need a way to assess the value of each commodity. Economists often use market prices as a measure of value. Thus, if a plough costs $1000 and a tractor costs $15,000, an economist would assume that the value of a tractor, as capital, is 15 times the value of a plough. A hypothetical economy that had only ploughs and tractors, 10 of the first and two of the second, would have a total capital stock of $40,000.

Simple aggregation as described above cannot be directly applied to the measurement of capital because we don't count the quantities of different types of capital existing in an economy. We don't know how many ploughs there are in Great Britain because there is no direct measurement of existing stocks. In contrast, there is direct measurement of flows. We count the output of every firm, and thus we have a good estimate of how many new ploughs are made each year. Thus, while we lack data on the stocks of capital, we do have data on investment in these stocks.

Economists infer a measure of capital stock through the aggregate flow of investment using what is known as the *perpetual inventory method.* In its simplest application, this assumes that all capital goods lose a constant fraction of their value as they deteriorate through use. Known as physical depreciation, this notion captures both breakdowns and obsolescence, not only of machinery but of all forms of capital. The existence of depreciation implies that there must be gross investment to simply maintain the existing capital

stock because some of it is lost each year. A conventional estimate of the average depreciation rate for the United States is around 6 percent.

The capital stock this year is calculated as the sum of the nondepreciated fraction of capital from last year and current gross investment. This method relies on an initial guess for capital, but depreciation reduces the importance of this guess over time. The perpetual inventory method determines the total capital stock existing today as the weighted sum of all past investments, with the weight on past investment declining over time because of depreciation.

Aside from physical capital, economists have also tried to address cross-country differences in intangible capital.[3] Examples include spending on research and development, training employees, creating new businesses and other forms of organizational capital, and the accumulated experience and know-how of productive organizations. Most of these investments in intangible capital are not counted in national income and product accounts. This omission understates the importance of broad capital in production.

Labor. Labor is as diverse as capital. In most studies of cross-country income differences, labor input is measured as the total stock of human capital. Human capital is simply the quality-adjusted stock of workers, just as physical capital is the stock of equipment and structures used in production. The stock of human capital in an economy divided by the number of workers gives an average measure of the skill of the workforce.

This leaves open the issue of how to measure the average level of skills. One common approach is to use cross-country data on the average years of schooling provided by Robert Barro and Jongwha Lee in 1993. However, a person's years of schooling are not a measure of his or her skill but a measure of the quantity of time invested in acquiring skills. To convert years of schooling into a level of human capital, the returns to schooling are often used. This approach, developed by Jacob Mincer and described in his 1974 book, assumes that people with higher levels of human capital are paid higher wages because they are more productive in their jobs and, as a result, more valuable to their employer. By examining the increase in real wages arising from an additional year of schooling, economists can use what are known as *Mincerian regressions* to convert the average years of schooling in a country into a measure of average human capital per worker. Typical estimates of the increase in real wages from an additional year of schooling are about 10 percent.

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Output. After the measurement of inputs, we have to address the measurement of output. The production of different goods and services is summed using market prices, whenever possible, as a measure of their value. This is similar to the approach described to aggregate the capital stock. It allows us to arrive at aggregate measures of total production in economies that produce an amazing diversity of goods and services. In what follows below, we will use per capita GDP, the level of goods and services produced per person, interchangeably with income per person.[4]

Total Factor Productivity. There is one last element in the aggregate production function. Economists have found that two countries with identical levels of capital and labor do not produce identical levels of output. More generally, given the stock of capital and labor, the level of output produced by these inputs varies substantially.[5] This variation exists both over time within a country and across countries at a specific time. This phenomenon is described as variation in *total factor productivity* (TFP). TFP represents the efficiency with which inputs, capital and labor, are used. As such, it is often interpreted as a measure of the effectiveness of the technologies used in an economy. Economies with higher TFP are believed to produce using more efficient technologies that provide

[3] The 2002 book by Stephen Parent and Edward Prescott provides a more extensive discussion of the issues involving the measurement of intangible capital. They conclude that differences in intangible capital cannot, by itself, explain much of the cross-country differences in income.

[4] This is not exactly correct because income per person is actually better represented by gross national product, or GNP, rather than GDP. The difference between these two measures of income per person arises when the citizens of a nation have sources of income from production outside their own nation. Furthermore, in the Penn World Tables, the market prices are actually international prices based on a weighted average of prices calculated for each country.

[5] This is also known as the Solow residual, since it was first isolated by Robert Solow.

more goods and services for any given level of capital and labor.

TFP is not directly measured. Instead, its level is determined by dividing GDP by a benchmark level of output, that is, the level of output that would exist if TFP were one.

But how do we know the level of output when TFP is one? This is where the aggregate production function enters the analysis, providing a benchmark measure of output from the factors of production: capital and labor. Many forms of the production function have been used in economics, but growth accounting usually uses the Cobb-Douglas production function. (See *The Cobb-Douglas Production Function*.)

Permanent increases in an economy's TFP are thought of as technological progress. This is because such a change implies that the economy can produce more output using the same stocks of physical and human capital. In other words, the economy is using a new, more productive technology.

In truth, aside from differences in the level of technology, TFP differs across countries for many other reasons. Differences in other factors of production, not directly measured, are just one such reason. Thus, the levels of raw materials and energy used in production are implicitly captured by TFP. If two countries have the same capital and labor, but the first has twice the level of raw materials and energy as the second, then TFP will be higher in the first country than in the second. As we shall learn below, much recent research into growth accounting focuses on the causes of differences in TFP.

CROSS-COUNTRY DIFFERENCES IN INCOME

Economists are primarily interested in explaining differences in income per person, or, more formally, real GDP per capita. It is, of course, no mystery if a country twice the size of another produces twice as much. All else equal, this would arise simply because one country had twice the number of people, and thus twice the workers, of the other. There need be no difference in TFP or capital per worker. The question of why one country contains twice the people compared with another country may still be of interest to social scientists. However, the more limited goal of growth accounting is to explain differences in income per person.

A simple reshuffling of the aggregate production function allows us to attribute production per person to either capital per person, TFP, or the average level of human capital in an economy. In this way, we can use the aggregate production function described above to break down cross-country differences in income and, as a result, to begin to answer the primary

The Cobb-Douglas Production Function

When computing the level of output that will be produced given a stock of capital and level of labor hours, economists often apply a relationship known as the Cobb-Douglas production function. If Y is used to denote output, K is the variable that represents capital, and L stands for labor, the Cobb-Douglas production function is the relationship:

$$Y = AK^{\alpha}L^{1-\alpha}$$

Here α is a coefficient between 0 and 1 that captures the percentage change in output that results from an additional unit of capital. It is also known as capital's share. Similarly, in the above version of the Cobb-Douglas function, labor's share is $1-\alpha$. The sum of shares is then equal to 1, which implies that if we increase both capital and labor by some proportion, output will also rise by that same proportion.

The share term, α, is calculated using data on either the income earned by capital or the income earned by labor. Under the assumption that factors of production are paid competitively, the share of total production that is paid to labor will equal $1-\alpha$.

If there is imperfect competition, and firms have monopoly power, then $1-\alpha$ will exceed the share paid to workers. However, provided we have a measure of firms' markups of price over cost, we can still use labor income data to derive the coefficient, α.

Given the direct measurement of output, Y, the capital stock, K, the stock of human capital, L, and the coefficient α, the level of TFP is given by A. It is the fraction of output that cannot be explained by the stock of capital and labor.

The form of the Cobb-Douglas production function implies that, in competitive markets, the share of income paid to capital and labor will be constant. This is broadly supported by empirical evidence showing that, over long periods of time, there has been little change to the share of income paid to labor and capital.

question of economic development: Why are some countries richer than others?

Differences in TFP Explain Most of the Variation in Income. The tangible wealth of a nation is contained in its physical capital; intangible wealth lies in human capital and in TFP. A reader may have believed that most of the differences in income per person across countries may be explained by differences either in the quantity of physical capital per worker or in the skills of the workforce. However, the startling finding from growth accounting over the past decade is that the majority of cross-country differences in income per person arise through differences in TFP. Most researchers believe that measurable inputs such as physical and human capital explain less than half of the difference in income. Rather, it is the level of technology used that explains the majority of this difference. While the list of researchers who have made important contributions to this debate is lengthy, three influential papers are the 1997 work by Peter Klenow and Andrés Rodriguez-Clare, the 1998 lecture by Edward C. Prescott given at the University of Pennsylvania, and the 1999 study by Robert Hall and Chad Jones. Across these studies TFP is found to explain between 50 and 75 percent of the observed differences in income per capita.

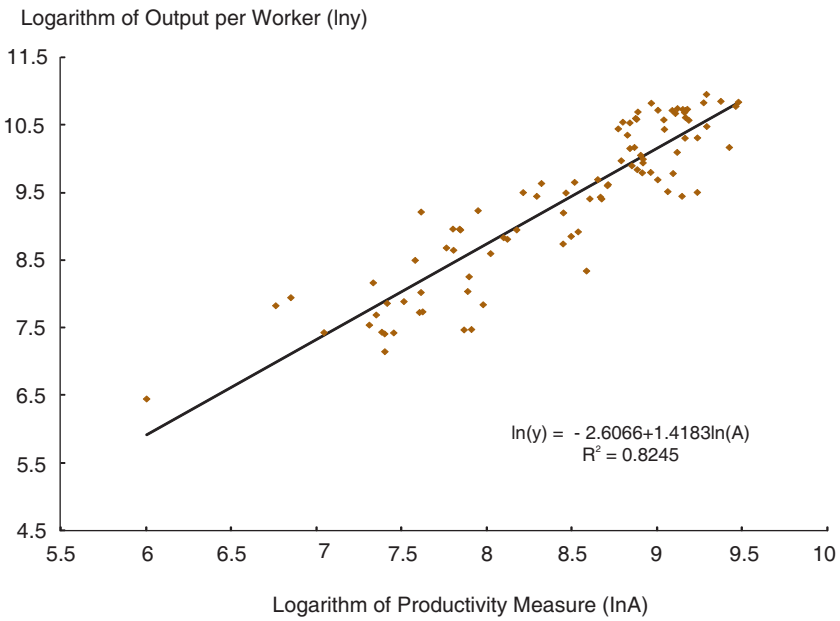
The figure, which is derived using data made available by Francesco Caselli, shows the relationship between TFP and income per capita in 1996. As explained by Hall and Jones, who derived a similar figure using 1988 data, the figure shows that the differences in income across countries is very similar to the corresponding differences in total factor productivity — that fraction of output that cannot be explained by capital and labor. The correlation between output per worker and total factor productivity exceeds 80 percent.

Differences in Capital and Labor Are Less Striking. If differences in technology, as captured by TFP, are the primary determinant of differences in income, physical and human capital are less important explanatory variables. It is certainly true that richer economies have more capital per worker. However, the extent of the cross-country variation in capital per worker is not large enough to explain most of the observed differences in income. To see this, we again use the data set developed by Francesco Caselli for his chapter in the *Handbook of Economic Growth.* Across the 94 countries in his sample, the richest 20 percent had income per capita that was almost 22 times that of the poorest 20 percent. However, after he adjusted for the importance of capital in production, the differences in the ratio of capital to output across these two groups of countries was somewhat less than two-fold.

Still there is more capital used in richer countries, and the underlying reasons for this are an important issue. However, this does not appear to be because savings or investment rates are higher in richer countries. As shown by Chang-Tai Hsieh and Peter Klenow in their 2007 paper, when measured using domestic prices, savings rates do not vary systematically with average income. Instead, it appears that poorer countries are less efficient at producing investment goods relative to goods used for consumption.

It's also true that richer countries have higher levels of skills per worker. However, the Mincerian approach to calculating skills does not lead to cross-country variation in the stocks of human capital, which suggests a much larger role for human capital in explaining income differences than that found for physical capital.

FIGURE



Source: Data set from Francesco Caselli "Accounting for Cross Country Differences in Income," and available at http://personal.lse.ac.uk/casellif/.

Returning again to the data used by Francesco Caselli, the ratio of average human capital in the richest fifth of nations, relative to that in the poorest fifth, was about two, very similar in size to differences in capital.

Adding It All Up. The apparent unimportance of measurable inputs leads to the following conclusion. In general, to explain why one country is poorer than another, you must explain why it has lower TFP. How large are these differences in TFP? The data used by Francesco Caselli suggest that the ratio of TFP between the richest and the poorest 20 percent of countries is more than five-fold. When taken alongside differences in physical and human capital, this explains the difference in overall GDP per capita.

Remember that the ratio of per capita income between the richest and poorest 20 percent of countries is about 20. The Cobb-Douglas production function gives us an accounting identity that breaks this difference down into the product of three other ratios: (i) capital divided by output and adjusted for a term reflecting capital's share of production, (ii) labor, and (iii) TFP. Their values are (i) 1.85, (ii) 2.06, and (iii) 5.36 and their product is $1.85 \times 2.06 \times 5.36 = 20.4$.[6]

Subsequent work re-examining the sources of cross-country income differences has largely confirmed the original findings that TFP explains most of the difference we see. In reaching this consensus, economists have carefully tried to address problems that might arise from errors present in the measurement of inputs and output. These efforts have led to better measures of schooling and more precise calculations of human capital. There have also been corrections for the quality of goods and services produced in rich and poor countries. The implications of different aggregate production functions, other than the conventional Cobb-Douglas, have been studied. Researchers have also corrected for different levels of market versus home production across countries. In poorer economies, more goods and services are produced at home, using time-intensive methods of production, than in the marketplace. Omitting the value of such home production, which is not included in national accounts, exaggerates the income disparity between rich and poor countries. This research is summarized in the survey by Francesco Caselli and in Peter Klenow's 2006 plenary address to the Society for Economic Dynamics.

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EXPLAINING DIFFERENCES IN TFP

As I've described above, a consensus has developed on the primary importance of cross-country differences in TFP for explaining differences in income per capita. However, the accounting methodology used to arrive at this consensus has presented a problem. Since TFP is inferred as a residual and not directly measured as physical or human capital are, attributing differences in income to differences in TFP does not completely answer the question of why countries differ. All we have really found is that these differences cannot be attributed to measured differences in physical or human capital. They lie somewhere else. Economists have started to examine the causes of differences in TFP across countries.

Looking Behind the Aggregate Production Function. An important early contribution to this research was made by Stephen Parente and Edward C. Prescott, who, in their 1999 paper, described how the adoption of more productive technologies may be hampered because groups of people have vested interests in protecting existing, but less productive, technologies. Following their work, a large body of research has arisen. Some of this work looks inside the production function for the economy. This research seeks to examine how factors affecting the production decisions of individual firms add up to differences in output at the aggregate level. Instead of attempting a full survey of this literature, I mention two recent examples.

One interesting line of research studies how taxes and other distortions, such as employment protection policies, can reduce TFP. For example, in their paper, Diego Restuccia and Richard Rogerson study the effect of taxes and subsidies that favor some firms relative to others. They find that such policies lead to too much capital and labor being used by some plants that benefit

[6] The reason that there is a small difference between the product of these ratios, which is 20.4, and the ratio of per capita GDP between the poorest and richest 20 percent of economies, which is 21.82, is somewhat technical. This discrepancy, a result of something known as Jensen's inequality, arises because the product of the average of the ratios is not equal to the average of the product of the ratios.

from subsidies. By moving capital and labor from productive plants to unproductive plants, such policies can lead to a reduction of between 30 and 50 percent in an economy's TFP. This research provides an example of how TFP is not necessarily determined by technological know-how alone but is also affected by economic policies.

Amartya Lahiri and Kei-Mu Yi also emphasize the role of economic policies in explaining the different economic performance of two Indian states, West Bengal and Maharashtra. Economic development in these two states poses an interesting puzzle. In 1960 West Bengal's GDP per capita exceeded that of Maharashtra, but by 1993 its GDP was barely two-thirds that of Maharashtra. Lahiri and Yi use this case study as a means to get behind the aggregate production function. In their model, there are separate production functions for agriculture, manufacturing, and services. They conclude that West Bengal has fallen behind Maharashtra because TFP in manufacturing and services has grown more slowly. Returning to our language above, there has been less technological progress in West Bengal. Lahiri and Yi suggest that growth in TFP has been lower in West Bengal because labor and industrial regulations have hindered growth in business TFP. In general, policies that stifle innovation or the adoption of new, more efficient technologies slow TFP growth. This, in turn, reduces the growth of income per capita.

Re-examining the Role of Human Capital. Recently, researchers have begun to question the importance of TFP. In two separate papers, Rodolfo Manuelli and Ananth Seshadri and, separately, Andres Erosa, Tatyana Koreshkova, and Diego Restuccia have argued that human capital has not been properly measured in existing studies.

They have two main insights. The first is that human capital investment in a country is not independent of the level of TFP. Second, they argue that human capital investment requires not only years of schooling but also goods and services such as schools and teachers. This, in turn, suggests that years of schooling are an incomplete measure of human capital because the quality of the human capital is neglected.

Households make educational investments based on the returns to education, and these investments involve not only the time spent in school but also real goods devoted to education. This implies that the standard Mincerian approach to inferring the stock of human capital may understate cross-country differences. These authors argue that a different approach to measuring human capital, one where households explicitly undertake schooling decisions that vary across countries in response to the economic environment, leads to much larger differences in quality-adjusted human capital across countries. This, in turn, reduces the direct role of TFP. Indeed, they find that cross-country differences in human capital are the leading source of differences in income. However, it remains true that these differences in human capital are driven by differences in TFP. It's just that the required differences in TFP become far smaller.

CONCLUSION

Economists account for cross-country differences in income per person using the method known as growth accounting. It breaks down real GDP per capita into capital per worker, human capital per worker, and the level of technology, or TFP. TFP is the level of output that remains to be explained after accounting for the role of physical and human capital. Measuring the levels of these inputs across countries, we find that most of the cross-country variation in income per person is attributable to differences in TFP. Poorer economies are poorer not because they have less capital and lower skills per worker but because they use these inputs less efficiently than wealthier economies.

Many things can affect a nation's TFP. For example, economic policies, such as taxes or subsidies, may impede the efficient distribution of capital and labor across firms, which will lower TFP. Alternatively, they may prevent the adoption of the most efficient technologies and thus lower TFP. However, to the extent that the technology is much more readily transferable across countries than physical or human capital, why would one country suffer the loss in output associated with using an inferior technology? If, instead, TFP differs because of policies that hinder the growth of business, why allow such policies to persist when the gains to correcting them are so large?

REFERENCES

Barro, Robert J., and Jongwha Lee. "International Comparisons of Education Attainment," *Journal of Monetary Economics* 32 (1993), pp. 363-94.

Caselli, Francesco. "Accounting for Cross-Country Income Differences," in P. Aghion and S. Durlauf (eds.), *Handbook of Economic Growth*, North Holland (2005).

Erosa, Andres, Tatyana Koreshkova, and Diego Restuccia. "How Important Is Human Capital? A Quantitative Theory Assessment of World Income Inequality," Working Papers tecipa-280, University of Toronto, Department of Economics (2007).

Hall, Robert, and Chad Jones. "Why Do Some Countries Produce So Much More Output per Worker Than Others?" *Quarterly Journal of Economics*, 114 (1999), pp. 83-116.

Heston, Alan, Robert Summers, and Bettina Aten. Penn World Table Version 6.2, Center for International Comparisons of Production, Income, and Prices at the University of Pennsylvania (September 2006); (http://pwt.econ.upenn.edu).

Hsieh, Chang-Tai, and Peter J. Klenow. "Relative Prices and Relative Prosperity," *American Economic Review*, 97 (2007), pp. 562-85.

Klenow, Peter K. "Income Differences Across Countries," plenary address to the Society for Economic Dynamics, July 6, 2006, Vancouver, Canada (available at www.klenow.com/KlenowSED.pdf).

Klenow, Peter, and Andrés Rodriguez-Clare. "The Neoclassical Revival in Growth Economics: Has It Gone Too Far?" in National Bureau of Economic Research *Macroeconomics Annual*, Cambridge, MA: MIT Press (1997).

Lahiri, Amartya, and Kei-Mu Yi. "A Tale of Two States: Maharashtra and West Bengal," Federal Reserve Bank of Philadelphia Working Paper 06-16/R (April 2008); available at http://www.philadelphiafed.org/research-and-data/publications/working-papers/2006/wp06-16.pdf.

Lucas, Robert E., Jr. "On the Mechanics of Economic Development," *Journal of Monetary Economics*, 22 (1988), pp. 3-42. Reprinted as Chapter 1 in *Lectures on Economic Growth*, Cambridge, MA: Harvard University Press (2002).

Manuelli, Rodolfo, and Seshadri, Ananth. "Human Capital and the Wealth of Nations," Working Paper, University of Wisconsin-Madison (April 2007).

Mincer, Jacob. *Schooling, Experience, and Earnings*. New York: Columbia University Press (1974).

Parente, Stephen L., and Edward. C. Prescott. "Monopoly Rights: A Barrier to Riches," *American Economic Review*, 89 (1999), pp. 1216-33.

Parente, Stephen L., and Edward C. Prescott. *Barriers to Riches*. Cambridge, MA: MIT Press (2000).

Prescott, Edward C. "Needed: A Theory of Total Factor Productivity," *International Economic Review*, 39 (1998), pp. 529-49.

Restuccia, Diego, and Richard Rogerson. "Policy Distortions and Aggregate Productivity with Heterogeneous Plants," *Review of Economic Dynamics*, 4 (October 2008), pp. 707-20.

Solow, Robert M. "Technical Change and the Aggregate Production Function," *Review of Economics and Statistics*, 39 (1957), pp. 312-20.