THE 4% SOLUTION

UNLEASHING THE ECONOMIC GROWTH AMERICAN NEEDS

Foreward by George W. Bush

Introduction by James K. Glassman

Edited by Brendan Miniter

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Contents

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Chapter 16

Education Quality and Economic Growth

By Eric A. Hanushek

Since the recession of 2008, the United States has been debating how to restore and enhance the health of its economy. But what has been lost in this short-run focus on stimulus spending and federal deficits is the need to reform the nation's public schools, the engine behind any long-run growth.

An economy's ability to grow over time—its ability to innovate and raise both productivity and real incomes—is strongly tied to the quality of education provided to the vast majority of workers. Skills and intellectual capital are increasingly important in a modern economy, and schools play a central role in the development of valuable skills. We've seen this to be true in the United States as, over the past century, it expanded its economy in large part through expanding the number of people in society who receive a strong, basic education. The economy of the United States today leads the world, in significant part because the vast majority of Americans received an education that gave them an ability to innovate and to adapt to new technologies.

Unfortunately, there is now increasing evidence that the United States is reaching a point where, to achieve rapid growth of its economy, it will need to increase the quality of education it provides to its students. There is little evidence that today the K–12 education system in the United States is in fact competitive internationally or that it can be counted on to fuel future U.S. economic growth. Indeed, as far back as 1983 the United States was given a warning, with a government report, *A Nation at Risk*,[1] that its schools needed reform. Had we undertaken policies after *A Nation at Risk* was published that truly

reformed our schools, we could today be enjoying substantially higher national income. We did not rise to the challenge then, and now it is much more critical that we do so.

Fortunately, the challenge before us is not insurmountable. If we raise education to levels experienced today in, say, Canada, Germany, or Finland, we would dramatically improve our economy and the well-being of our society. To see how, let's first consider the importance of what economists call "human capital," or the stock of valuable knowledge, abilities, and other things possessed by an individual.

HUMAN CAPITAL AND ECONOMIC GROWTH

Economists have devoted considerable attention to understanding how human capital affects a variety of economic outcomes. The underlying notion is that individuals invest in themselves by attending school or otherwise acquiring skills and intellectual abilities. The valuable skills accumulated by these investments over time represent the human capital of an individual. Much like a business investing in machinery (physical capital), an individual can reap economic rewards from making investments in human capital. Acquiring valuable skills allows a worker to become more productive than he would be otherwise and therefore earn higher pay. In the case of public education, parents and public officials essentially act as trustees—they determine many aspects of the initial investment a student makes in his or her human capital (although factors outside school also affect human capital).

Much of the early empirical work on human capital by economists concentrated on the quantity of schooling—the number of years of education students attained. This focus was natural. Through the 20th century the United States adopted a policy of universal education and was rewarded for its investment with high productivity growth. Moreover, quantity of schooling is easily measured, and data on years attained, both over time and across individuals, are readily available and formed the basis for studying the impacts of greater human capital. And the typical study reports that quantity of schooling is highly related both to individual earnings and to economic growth rates. Individuals with more schooling typically earn more than those with less,

and the longer a nation's students stay in school, the more likely it is that its economy will grow.

The early study of human capital, developed during the 1960s and '70s, focused almost entirely on its importance for individuals and their wages in the labor market. Strangely, over much of the period after World War II, economists did not pay as much attention to economic growth as they did to macroeconomic fluctuations. Subsequently, with the revival of the study of economic growth in the 1990s, the role of human capital in determining economic growth became an important issue for macroeconomists. Even as there has been a variety of models and ideas developed to explain differences in growth rates across countries, these models and ideas invariably include (but are not limited to) the importance of human capital.[2]

But quantity of education attained is a very crude measure for the quality of skills students possess, particularly when comparing the human capital of different nations. Few people would be willing to assume that the amount learned during the sixth grade in a rural village in Peru equals that learned in an American sixth grade. Yet that is what is implicitly assumed when empirical analyses focus exclusively on differences in average years of schooling across countries. What's more, in the United States over the past quarter century, high school and college completion rates have been roughly constant. To continue to make gains in skills, and to reap the commensurate economic rewards, the United States will need to focus on what students know as they progress through school and what skills they have upon graduation.

These attributes—what students know, and what knowledge and skills they have that are applicable to the labor market—are the ones that matter in discussions of economic growth. A more educated society can be expected to lead to higher rates of invention; to make everybody more productive (when workers have more skills, companies can more easily introduce better production methods); and to lead to more rapid introduction of new technologies.

The better measurement of human capital for application to economic growth was made possible in the fortuitous development of international cognitive tests by a group of psychometricians. In 1963 and 1964, the International Association for the Evaluation of Education

Achievement (IEA) administered the first of a series of mathematics tests in a voluntary group of countries. These assessments were subject to a variety of problems, including issues of developing an equivalent test across countries with different school structures, curricula, and language; issues of selectivity of the tested populations; and issues of selectivity of the nations that participated. The first tests did not document or even address these issues in any depth. The tests did, however, prove the feasibility of such testing and set in motion a process to expand and improve on the undertaking.

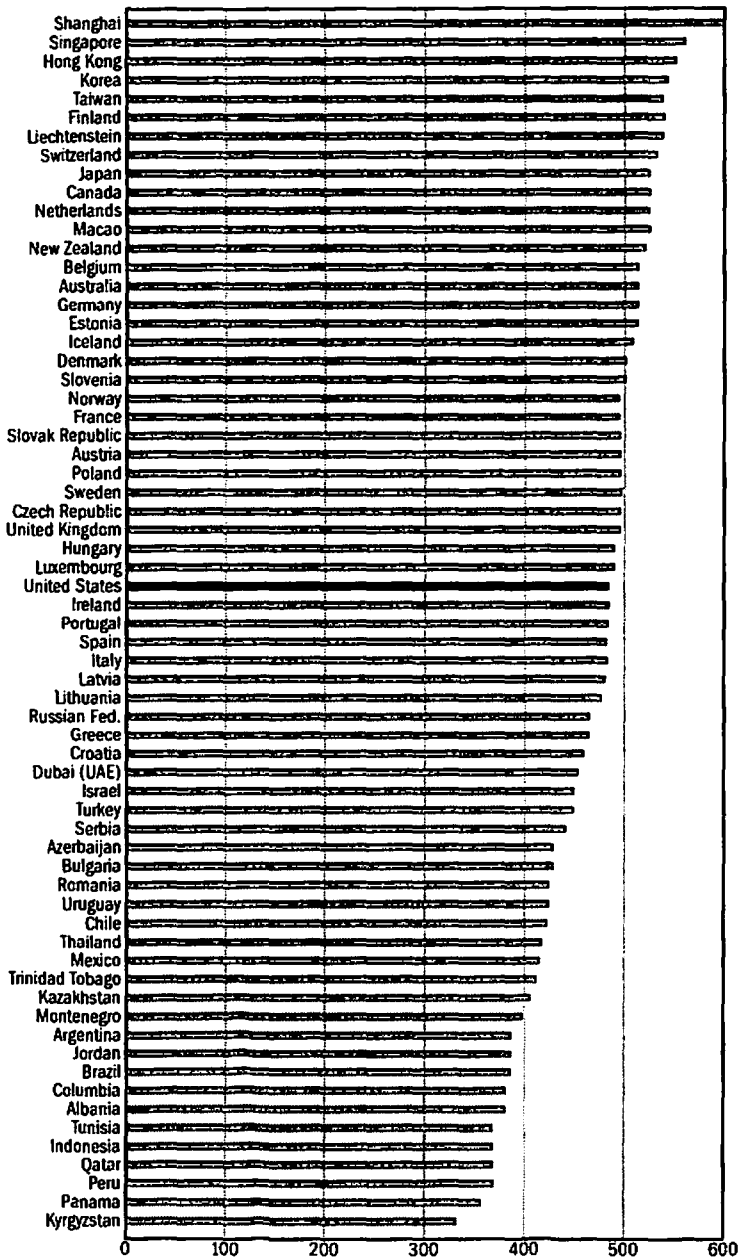
Subsequent testing, sponsored largely by the IEA and the Organisation for Economic Co-operation and Development (OECD), has included both math and science and has expanded on the group of countries that have been tested.[3] In each, the general model has been to develop a common assessment instrument for different age groups of students and to work at obtaining a representative group of students taking the tests. The United States is the only country to participate in all the testing, although relatively little attention has ever been given in the United States to the results.

The world ranking of the United States in terms of student achievement is now easily seen. With the development of the common testing within the OECD through the Programme of International Student Assessment (PISA), it becomes obvious that the United States is lagging badly in terms of student outcomes. Figure 1 shows the U.S. position in mathematics in 2009.

American mathematic achievement is below the OECD average, trailing the highest-achieving countries of the world by a substantial margin. Note, for example, how far the United States trails Canada. Some people have suggested that performance on these assessments has no real impact. But they are very wrong.

Beginning with recent work by Dennis Kimko and me,[4] a variety of analyses goes beyond simple school attainment and delves into quality of schooling.[5] This early work incorporates the information about international differences in mathematics and science knowledge that has been developed through testing over the past five decades. And it finds that school quality has a remarkable impact on differences in economic growth.

Figure 1. PISA Mathematics Achievement, 2009



The analysis of economic growth is quite straightforward. The available test scores are combined into a single composite measure of quality, referred to alternately as the quality of human capital or simply as cognitive skills. The simplest growth analysis considers statistical models that explain differences in growth rates across nations. The basic statistical models, which include the initial level of income of a country, the quantity of schooling, and quality of human capital measured by math and science tests, explain the vast majority of the variation in economic growth across countries.

Most important, the cognitive skills of the labor force as measured by math and science scores are extremely important in an economic sense. One standard deviation difference on test performance (100 points on the PISA assessment) is related to a 2 percentage point difference in annual growth rates of gross domestic product per capita. Moreover, adding other factors potentially related to growth, including aspects of fundamental economic institutions, international trade, private and public investment, and political instability, leaves the effects of cognitive skills unchanged.

The relationship between math and science test scores and growth is extraordinarily important. If the United States could rise to the level of Germany (approximately one-quarter standard deviation on PISA), past history suggests that the U.S. long-term growth rate would increase by 0.5 percentage points. Rising to the level of Canada would imply an annual long-term growth rate that is approximately 0.8 percentage points higher. The impact of such changes is hard to overstate.

The implications of such a difference in growth rates can be seen by tracing out what happens to U.S. gross domestic product (GDP). In an article for *Economic Policy* in July 2011, Ludger Woessmann and I provide some indication of what would happen to GDP if it were possible to boost the achievement of the population. In particular, we calculate the time path of the annual growth rate engendered by education reform designed to move students from their current performance to a given new level. This pattern of economic outcomes represents the confluence of three separate dynamic processes: 1) Changes in schools lead to the progressive improvement in student achievement until students fully reach the new steady-state level of achievement; 2) students with

better skills move into the labor force and the average skills of workers increase as new, higher-achieving workers replace retiring workers; and 3) the economy responds to the progressive improvement of the average skill level of the workforce. Based on the historical pattern of growth rates, we project the future development of GDP with and without the education reform. Finally, we determine the total present value of the reform by calculating the discounted values of increases in GDP after reform.

These projections of the growth relationship vividly show the importance of achievement. We simulate the impact on the U.S. economy (and other OECD economies) of a series of scenarios representing different school improvement programs: 1) moving to the level of Germany or Australia (a gain of 25 points or one-fourth standard deviation on the PISA tests); 2) movement up to the level of Finland, the world leader on PISA; and, 3) movement of all U.S. students to a level of basic skills (400 points on PISA generally Level 1). In each, for the sake of illustration, it is assumed that the United States takes twenty years to reach new achievement levels, and the labor force quality reflects the average achievement of those in the labor force at each point in time. The simulations presume that the cognitive skills-growth relationship observed across the past half-century hold into the future, and this permits estimating how much higher GDP would be with added achievement compared to the current levels.

The implications for the economy with these differences are truly astounding. Economic growth is projected over an eighty-year period (the expected life of somebody born today), and then the present value of the gains is calculated (where the future gains are discounted at 3% per year).[6]

A 25-point improvement (something obtained within the past decade by a number of other countries in the world) would have a present value of $44 trillion for the United States (and $123 trillion for the entire OECD). Reaching the performance levels of Finland would add $112 trillion in present value to the U.S. economy. Just bringing everybody up to basic skills (400 points on PISA)—something akin to achieving the goals of No Child Left Behind—would yield a striking $86 trillion.

To put these gains into perspective, the current U.S. economy has a GDP of $16 trillion. The recession of 2008 cost the United States something on the order of $3 trillion in lost output, and the amount of stimulus applied to move out of recession was $1 trillion. In other words, the prospective gains from improving our schools dwarf the economic issues currently occupying all of the policy attention. This is not, of course, an argument for ignoring the current economic slowdown. But it is an argument for heeding the importance of education as a long-run growth issues.

Another way to get a perspective on these increases is to consider the added GDP relative to the accumulated GDP over the same period but without improvements in cognitive skills. Moving to the level of Finland would yield 16% higher GDP over the eighty-year period of the projections. Achieving proficiency as under NCLB would yield a 12% higher value of output over the period.

From a policy point of view, these calculations underscore the need for aggressive (and successful) policies aimed at improving achievement and skills. From a research point of view, the ability to uncover such fundamental relationships highlights the enormous value of the underlying large-scale international surveys.

WHY HAS U.S. GROWTH BEEN SO STRONG?

The United States has been at best mediocre in mathematics and science ability. Some people find this anomalous. How could math and science ability be important in light of the strong U.S. growth over a long period of time? The answer is that a variety of factors clearly work to overcome any deficits in quality. It is important to highlight some issues that are central to thinking about future policies.

Almost certainly the most important factor sustaining the growth of the U.S. economy is the openness and fluidity of its markets. The United States maintains generally freer labor and product markets than most countries in the world, along with clear and enforceable property rights. The government generally has less regulation on firms (both in terms of labor regulations and in terms of overall production), and trade unions are less extensive than those in many other countries.

Even broader, the United States has less intrusion of government in the operation of the economy—not only less regulation but also lower tax rates and minimal government production through nationalized industries. These factors encourage investment, permit the rapid development of new products and activities by firms, and allow U.S. workers to adjust to new opportunities. While identifying the precise importance of these factors is difficult, a variety of analyses suggest that such market differences could be very important explanations for differences in growth rates.[7]

Additionally, over the 20th century, the expansion of the education system in the United States outpaced that of other countries around the world.[8] The United States pushed to open secondary schools to all citizens. With this came a move to expand higher education with the development of land grant universities, the GI Bill, and direct grants and loans to students. In comparison with other nations of the world, the U.S. labor force has been better educated, even after allowing for the lesser achievement of its graduates. In other words, more schooling with less learning each year has yielded more human capital than found in other nations that have less schooling but learn more in each of those years.

The analysis of growth rates across countries considered the quality of elementary and secondary schools in the United States. It did not include any measures of the quality of U.S. colleges. However, by most evaluations, U.S. colleges and universities rank at the very top in the world. The quality of U.S. colleges and universities has undoubtedly helped foster high growth through an expanded science and engineering base.

The high quality of U.S. colleges and universities has contributed in an additional way. By attracting an ever-increasing number of foreign students, the United States has implicitly taken advantage of the high-quality elementary and secondary education provided abroad. A significant proportion of these foreign students have stayed in the United States after finishing college and thereby contributed to the growth of the U.S. economy. (Other highly trained immigrants have also come to the United States and contribute to the American economy.)

While the United States has benefited from these factors in the past, its advantages in terms of attracting highly skilled immigrants and college students are evaporating. As other countries have improved their economic institutions, the United States is losing out in the competition for highly productive workers. Perhaps no place is this as evident as China, which has removed a variety of very bad economic policies to unleash spectacular growth over two decades. But similar improvements are found around the world.

Other nations, both developed and developing, have also rapidly expanded their schooling systems, and many now surpass the United States. Currently, the United States falls just slightly below the OECD average secondary school completion rate. And overall students in the United States are not completing more schooling that students in many other countries, even when college attendance is taken into account. As economic conditions elsewhere in the world improve, highly skilled workers no longer uniformly seek to emigrate to the United States. Instead they find productive opportunities in their home countries and in other nations around the globe.

Thus it appears unlikely that the United States will continue to dominate other countries in innovation and in human capital unless it can improve the quality of the education it offers students. The raw material for U.S. colleges is the graduates of our elementary and secondary schools. And as has been frequently noted, many American students arrive at college unprepared for the coursework ahead of them and therefore have to take remedial classes. This lack of preparedness makes American colleges and universities less effective at producing highly skilled workers than they would be otherwise, while also making it more likely that foreign-born students will make up a greater proportion of our science and engineering graduates.

IMPROVING QUALITY: THE ROLE OF TEACHERS

A *Nation at Risk* issued a call in 1983 for improved schooling, but this call went unheeded.[9] Of course, over the past three decades American schools have introduced new programs, pursued different visions of improvement, and spent considerably more on education.[10] But student

performance has remained essentially flat. One simple lesson we've learned over the past three decades is that *how* money is spent is much more important than how *much* money is spent.[11]

It is now widely recognized that teacher quality is the most important aspect of schools. A variety of studies has shown the impact of teacher quality. These studies, relying on observed differences in student achievement, provide consistent estimates of the impact of effective and ineffective teachers (Hanushek and Rivkin, 2010).

There has often been some confusion about the effects of specific teacher characteristics with the overall contribution of teachers. The consistent finding over four decades of research—frequently called education production function research in economics—has been that the most commonly used indicators of quality differences are not closely related to achievement gain, leading some to question whether teacher quality really matters.[12] The two most commonly used indicators of teacher quality are experience and graduate education. These two measures have little or no relationship with the effectiveness of teachers. (The one exception to this general statement is that teachers typically become more effective over the first couple of years of experience, even though subsequent experience does little to change teacher effectiveness.)

These findings about teacher experience and teacher degrees are particularly important because these factors are the primary determinants of teacher salaries. As a result, teacher salaries are essentially unrelated to effectiveness in the classroom. The research also demonstrates that just raising teacher salaries will not solve the teacher quality problem, because such increases in salaries go to both effective and ineffective teachers—thus encouraging ineffective as well as effective teachers to stay in teaching.

Recent research has not relied on the measurement of specific teacher characteristics. Instead it has focused on the estimation of the value added by a teacher. Effectively this research attempts to uncover the independent impact of the teacher (as opposed to families, peers, neighborhoods, and the like) on student achievement. Heuristically, it looks at whether the average growth in achievement of one teacher's students is greater than that for other teachers. In other words,

value-added estimates for teachers are a performance-based measure to describe which teacher has been effective and which has not. Using administrative databases, some covering all the teachers in a state, such research provides strong support for the existence of substantial differences in teacher effectiveness.

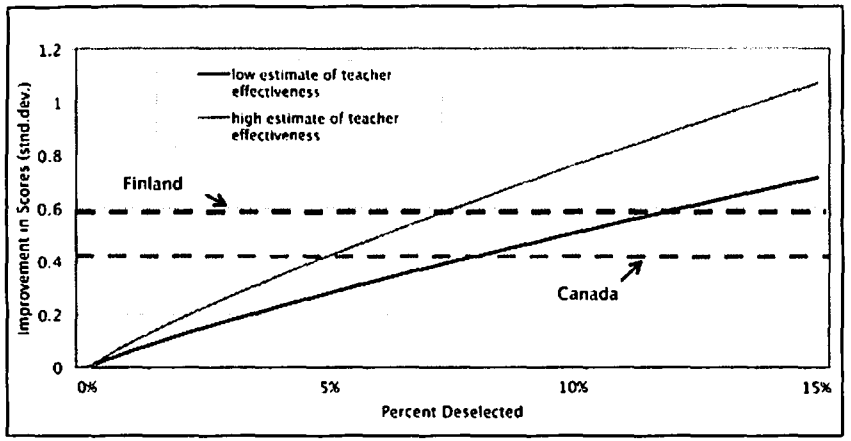
Although this approach circumvents the need to identify specific teacher characteristics related to quality, it has introduced additional complications and has sparked an active research debate on the measurement and subsequent policy use of estimated teacher value-added. For the purposes of this discussion, however, we are not so much interested in identifying and measuring effectiveness of individual teachers—the source of much of the current policy controversy. We simply want to build on the implications of having a wide variation in teacher effectiveness, something that is less subject to controversy. Moreover, the analysis indicates that much of the variation in teacher effectiveness is found within schools, and does not simply reflect "good" and "bad" schools or disadvantaged schools or inner-city schools.[13]

Starting with the estimates of the difference in effectiveness of teachers, it is possible to project the long-term economic impact of policies that would focus attention on the lowest-quality teachers from U.S. classrooms. Consider what would happen if the very lowest-performing teachers could be replaced by "average teachers." Based on the estimates of variations in teacher quality identified in the research and calculating the impact through a cycle of K–12 instruction, we can see that modifying the stock of teachers could dramatically change U.S. achievement.[14] While there is some uncertainty about the precise variation in teacher effectiveness, the figure below provides an indication of what the overall impact could be (based on the range of available estimates of the importance of teacher quality).

From this figure, replacing the least effective 5–8% of all teachers with an average teacher would bring the United States to a level of student achievement equivalent to that in Canada. Replacing teachers performing in the bottom 7–12% of teachers would bring the United States to the level of the highest-performing countries in the world, such as Finland.

The previous estimates of economic impacts of achievement then

Figure 2. Alternative Estimates of How Removing Ineffective Teachers Affects Student Achievement



Source: Hanushek (2011).

underscore the economic ramifications of altering the quality of teachers. Approaching Finland's achievement would, by the historical pattern of economic growth, yield a gain in present value of more than $100 trillion over eighty years.

The appropriate policies to achieve these changes in teacher quality are beyond this discussion. Suffice it to say that the rewards for improvement are enormous. The economic benefits of reforming America's public schools far exceed the potential gains of a short-term focus on flattening out business cycles and from recovering from recession.

□ □ □

In February 1990, in an unprecedented meeting of the nation's governors with President George H. W. Bush, an ambitious set of goals was set for America's schools. One of those goals was that by 2000, "U.S. students will be first in the world in mathematics and science achievement." By 1997, as it was evident that this goal was not going to be met, President Clinton, in his State of the Union speech, returned to the old model of substituting quantity for quality: "We must make the thirteenth and fourteenth years of education—at least two years of college—just as universal in America by the twenty-first century as a

high school education is today."[15] The quality goal, while perhaps more difficult to meet, appears to be a better approach than reverting to our past practice of emphasizing just quantity of schooling.

Research underscores the long-run importance of high achievement of our students and our future labor force. Higher achievement is associated both with greater individual productivity and earnings and with faster growth of the nation's economy. It no longer appears wise or even feasible to rely on more years of low-quality schooling.

64 Isaac Ehrlich and Jinyoung Kim, "Has Social Security Influenced Family Formation and Fertility in OECD Countries?" NBER Working Paper 12869, January 2007.

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CHAPTER SIXTEEN: Education Quality and Economic Growth

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2 Barro, Robert J., and Xavier Sala-i-Martin, *Economic Growth,* 2nd ed. (Cambridge, MA: MIT Press, 2004).

Easterly, William, *The Elusive Quest for Growth: An Economists' Adventures and Misadventures in the Tropics* (Cambridge, MA: MIT Press, 2002).

Barro and Sala-i-Martin (2004) review recent analyses. Some have questioned the precise role of schooling in growth. Easterly (2002), for example, notes that education without other facilitating factors such as functioning institutions for markets and legal systems may not have much impact. He argues that World Bank investments in schooling for less developed countries that do not ensure that the other attributes of modern economics are in place have been quite unproductive. As discussed later in the chapter, schooling clearly interacts with other factors, and these other factors have been important in supporting U.S. growth. Nonetheless, school quality and the cognitive skills of the population remain extremely important.

3 Eric A. Hanushek and Ludger Woessmann, "Do Better Schools Lead to More Growth? Cognitive Skills, Economic Outcomes, and Causation," NBER Working Paper 14633, National Bureau of Economic Research, Cambridge, MA, January 2009.

4 Eric A. Hanushek and Dennis D. Kimko, "Schooling, Labor Force Quality, and the Growth of Nations," *American Economic Review* 90, no. 5 (December 2000): 1184–1208.

5 Ibid.; Eric A. Hanushek and Ludger Woessmann, "The Role of Cognitive Skills in Economic Development," *Journal of Economic Literature* 46, no. 3 (September 2008): 607–68.

The initial work in Hanushek and Kimko (2000) has now been expanded in a number of directions; see Hanushek and Woessmann (2008).

6 The present value gives added weight to economic gains closer to today compared with those in the future. It is easiest to interpret the present value as the amount of money that, invested at an assumed return of 3% per year, could produce the projected GDP pattern over time.

7 See, for example, Krueger (1974); World Bank (1993); Parente and Prescott (1994, 1999).

Anne O. Krueger, "The Political Economy of the Rent Seeking Society," *American Economic Review* 64, no. 3 (June 1974): 291–303.

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8 Claudia Goldin and Lawrence F. Katz, *The Race Between Education and Technology* (Cambridge, MA: Harvard University Press, 2008).

9 National Commission on Excellence in Education (1983).

10 See the various analyses in Peterson (2003).

Paul E. Peterson, ed., *Our Schools and Our Future: Are We Still at Risk?* Stanford, CA: Hoover Institution Press.

11 Hanushek (2003). The other general finding that goes along with this is that class size has little consistent impact on student achievement, even though class size reduction has been extremely popular over this period.

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12 Eric A. Hanushek and Steven G. Rivkin, "Teacher Quality," in *Handbook of the Economics of Education,* edited by Eric A. Hanushek and Finis Welch (Amsterdam: North Holland, 2006): 1051–78.

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14 For a detailed analysis of the impact of teacher effectiveness, see Hanushek (2011).

Eric A. Hanushek and Ludger Woessmann, "How Much Do Educational Outcomes Matter in OECD Countries?" *Economic Policy* no. 67 (July 2011): 1–65.

15 William J. Clinton, "State of the Union Address, Washington, DC, 1997.

CHAPTER EIGHTEEN: Immigration and Growth

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