

# U.S. Math Performance in Global Perspective

**How well does  
each state  
do at producing  
high-achieving  
students?**

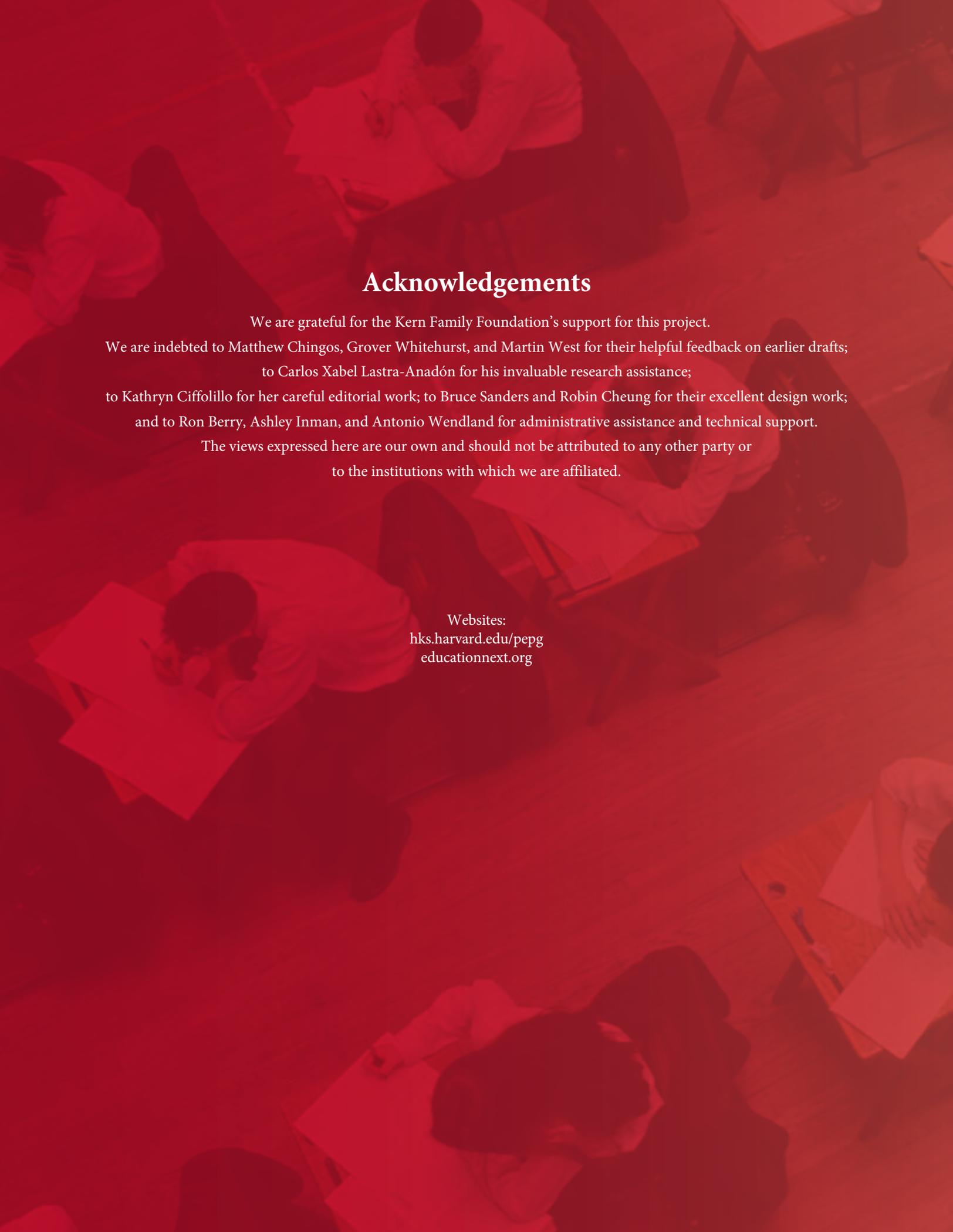
Eric A. Hanushek  
Paul E. Peterson  
Ludger Woessmann



Prepared under the auspices of:

Harvard's Program on Education Policy and Governance & Education Next  
Taubman Center for State and Local Government  
Harvard Kennedy School





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## U. S. Math Performance in Global Perspective

How well does each state do at producing high-achieving students?

**Eric A. Hanushek**

**Paul E. Peterson**

**Ludger Woessmann**

## Executive Summary

Maintaining our innovative edge in the world depends importantly on developing a highly qualified cadre of scientists and engineers. To realize that objective requires a system of schooling that produces students with advanced math and science skills. To see how well the U.S. as a whole, each state, and certain urban districts do at producing high-achieving math students, the percentage of U.S. public and private school students in the high-school graduating Class of 2009 who were highly accomplished in mathematics in each of the 50 states and in 10 urban districts is compared to the percentages of similarly high achievers in 56 other countries.

Unfortunately, the percentage of students in the U.S. Class of 2009 who were highly accomplished in math is well below that of most countries with which the U.S. generally compares itself. No less than 30 of the 56 other countries that participated in the Program for International Student Assessment (PISA) math test had a larger percentage of students who scored at the international equivalent of the advanced level on our National Assessment of Educational Progress (NAEP) tests. While 6 percent of U.S. public and private school students rated as advanced in 8th-grade mathematics, 28 percent of Taiwanese students did. (See Figure 1, p. 16, for these results as well as for the relative rank internationally of each individual U.S. state.)

It is not only Taiwan that did much, much better than the U.S. At least 20 percent of students in Hong Kong, Korea, and Finland were highly accomplished, and 12 other countries had at least twice the percentage of highly accomplished students as the U.S.: Switzerland, Belgium, the Netherlands, Liechtenstein, New Zealand, the Czech Republic, Japan, Canada, Macao, Australia, Germany, and Austria. The only members of the Organization for Economic Co-operation and Development (OECD) taking part in PISA 2006 that produced a smaller percentage of advanced math students than the U.S. were Spain, Italy, Israel, Portugal, Greece, Turkey, Chile and Mexico. The performance of the U.S. cannot be distinguished statistically from that of Russia.<sup>1</sup>

The percentage of students scoring at the advanced level varies considerably among the 50 states, but none does well in international comparison. Massachusetts, with more than 11 percent advanced, does the best, but the performance of the Massachusetts Class of 2009 still trails that of 14 countries. Minnesota, ranked second among the 50 states, comes in at the same level as France, Sweden, Denmark, Iceland, Slovenia and Estonia. California students are roughly comparable to those in Portugal, Italy, Israel and Turkey, and the lowest ranking states—West Virginia, New Mexico, and Mississippi—have a smaller percentage of high-performing students than do Serbia and Uruguay (although they do edge out Romania, Brazil, and Kyrgyzstan).

In short, the percentages of high-achieving math students in the U.S.—and most of its individual states—are shockingly below those of many of the world's leading industrialized nations. Results for many states are at the level of developing countries.

<sup>1</sup> Countries participating in PISA 2006 but not members of the OECD in 2010 that had lower results than the United States include Croatia, Uruguay, Romania, Brazil, Argentina, Azerbaijan, Montenegro, Qatar, Tunisia, Colombia, Indonesia, Jordan and Kyrgyzstan.

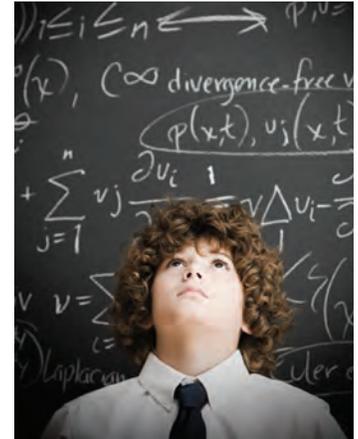
This is not simply the result of having a population that is heterogeneous and difficult to educate. Only 8 percent of white students in the U.S. Class of 2009 scored at the advanced level, a percentage that was less than the share of advanced students in 24 other countries regardless of their ethnic background. The percentage of white students in the state of New York rated as advanced (7.7) is roughly the same as the percentage of *all* students in Hungary and Norway; California's white students, 7.2 percent of whom score at the advanced level, are roughly even with *all* students in Poland and Ireland.

The portion of students in the Class of 2009 with at least one parent who graduated from college who are performing at the advanced level is 10.3 percent. In 16 countries, students of all backgrounds, regardless of their parents' education, do better than this advantaged segment of the U.S. population. The percentage of Illinois students with a college-educated parent who are highly accomplished is 9 percent, roughly the same percentage as for all students, regardless of background, in France and the U.K. Nearly 6 percent of Rhode Island's students from college-educated backgrounds score at the advanced level, the same percentage as all students in Italy, Spain, and Latvia, regardless of background. Uruguay and Bulgaria produce the same proportion of advanced students, no matter their background, as found among children of the college-educated in Mississippi, just 2.2 percent.

At the district level, while the percentages of highly accomplished public and private school students in Austin, Charlotte, and Boston exceed the U.S. as a whole, New York City trails these cities as well as Israel. San Diego, Houston, Washington, D. C., Chicago, Los Angeles, and Atlanta are all clustered below Uruguay and Bulgaria but above Chile, Thailand, Romania, Brazil, and Mexico, placing them at a level roughly equal to that of a Latin American country.

Some have attributed this comparatively poor performance to the focus of the 2002 federal accountability statute, No Child Left Behind (NCLB), on the educational needs of very low performing students. But, in fact, the percentage of students performing at a high level in math climbed steadily in the years following the law's passage. The incapacity of American schools to bring students up to the highest level of accomplishment in mathematics is much more deep-seated than anything induced by recent federal legislation.

In sum, the U.S. trails other industrialized countries in bringing its students up to the highest levels of accomplishment in mathematics. It is not a story of some states' high performance being offset by the low performance of other states. Nor is it a story of immigrant or disadvantaged or minority students hiding the good performance of better prepared students. Comparatively small percentages of white students in the states achieve at a high level. And only a small proportion of the children of our college-educated population is equipped to compete with students in a majority of OECD countries. ♦



**Only 8 percent  
of white students in  
the U.S. Class of 2009  
scored at the  
advanced level.**

## Introduction

*“Although many people assume that the U.S. will always be a world leader in science and technology, this may not continue to be the case inasmuch as great minds and ideas exist throughout the world.”*

— Committee on Prospering in the Global Economy of the 21st Century (2005)

The economic and technological demand for a talented, well-educated, highly skilled population has never been greater. With rapidly advancing technologies in an increasingly integrated world economy, no one doubts the extraordinary importance of highly accomplished professionals. Not only must everyday workers have a set of technical skills surpassing those needed in the past, but a cadre of highly talented professionals trained to the highest level of accomplishment is needed to foster innovation and growth. In the words of President Barack Obama, “Whether it’s improving our health or harnessing clean energy, protecting our security or succeeding in the global economy, our future depends on reaffirming America’s role as the world’s engine of scientific discovery and technological innovation. And that leadership tomorrow depends on how we educate our students today, especially in math, science, technology, and engineering.”<sup>1</sup> Unfortunately, the data show that our schools are not supporting levels of achievement that are competitive internationally.

The U.S. has long recognized the importance of a well-educated work force. During the early decades of the 20th century, the country made disproportionately large investments in secondary and higher education, which translated into unparalleled growth that made the U.S. the dominant economic power in the world.<sup>2</sup> But in recent years the performance of U.S. schools, once the envy of the world, has slipped, even as technological innovations have intensified the demand for human capital. The test-score performance of 17-year-old students on the National Assessment of Educational Progress (NAEP) has remained essentially unchanged for the past 40 years, and high school graduation rates have declined since the 1970s.<sup>3</sup> While the U.S. has stagnated, other countries have advanced rapidly to emulate investments in human capital begun by the U.S. In fact, many other countries now exceed the U.S. in the provision of secondary and tertiary schooling, and, more importantly, they do dramatically better than the U.S. in terms of achievement.<sup>4</sup> Those issues are the subject of this analysis.

1. Office of the Press Secretary, White House Office, “Remarks by the president on the “Educate to Innovate” Campaign and Science Teaching and Mentoring Awards,” January 6, 2010.

2. Goldin and Katz (2008).

3. Peterson (2010), Figures 1-5, pp. 268-272.

4. See Hanushek and Lindseth (2009), chapter 2.

How serious is the mismatch between the country's needs for a highly skilled work force and the product of American schools? Is it just a few states or particular regions that are not producing as large a percentage of high achievers as other industrialized countries? Is the problem primarily the performance of students from minority racial and ethnic backgrounds or from homes where the parents lack a college education? Or do too many students, even white students or those from well-educated backgrounds, fail to achieve at a high level? These are some of the key questions that we address in this study.

## The Demand for High Achievers

The gap between the burgeoning business demand for a highly accomplished workforce and a lagging educational system has steadily widened. Even as the U.S. was struggling with a near 10 percent unemployment rate in the summer of 2010, businesses complained that they could not find workers with needed skills. “The people that are out of work just don’t match the types of jobs that are here, open and growing,” says the head of a nonprofit group trying to make Cleveland a center for medical innovation. *New York Times* writer Motoko Rich says the complaints are not just coming from Ohio: “The problem...is a mismatch between the kind of skilled workers needed and the ranks of the unemployed.”<sup>5</sup>

Skill shortages have severe consequences for a nation’s overall productivity. Two of the authors of this report have shown elsewhere that countries with students who perform at higher levels in math and science show larger rates of increase in economic productivity than do otherwise similar countries with lower-performing students.<sup>6</sup> As Bill Gates, chairman of the Microsoft Corporation, has put it, “Unless the schools of the U.S. find the tools to bring students up to the highest level of accomplishment, it places the nation at risk in the international economy of the 21st Century. In particular, I’m concerned that too few young people are acquiring the knowledge they need to use technology in creative and innovative ways.”<sup>7</sup>

The public seems to have grasped the fact that American students are faltering in math and science relative to their peers in other countries. When the public was asked for the ranking of student performance in math as compared with other countries in the world, those interviewed were, on average, correct in identifying U.S. performance as below the median of all participating countries.<sup>8</sup>

Public discourse, however, has tended to focus on the need to address basic levels of achievement, particularly among disadvantaged students. This focus has been evident since the passage of the federal Elementary and Secondary



*“Leadership tomorrow depends on how we educate our students today, especially in math, science, technology, and engineering.”*  
—Barack Obama

5. Rich (2010).

6. Hanushek and Woessmann (2008, 2009).

7. Gates (2007). Lowell, Salzman, and Bernstein (2009) are unpersuaded that there is a crisis in STEM education, suggesting that the larger problem might be on the demand side. They do calculate, however, that a significantly smaller percentage of the most able U.S. high school students entered STEM higher education and subsequent STEM careers over the past two decades than did in the prior two decades.

8. Howell, Peterson, and West (2009), p. 27.



*“Unless the schools of the U.S. find the tools to bring students up to the highest level of accomplishment, it places the nation at risk in the international economy of the 21st Century.”*

*—Bill Gates*

9. Stem Education Coalition website, STEM Ed Coalition Objectives, accessed July 1, 2010 at <http://www.stemedcoalition.org/content/objectives/>

10. Committee on Prospering in the Global Economy of the 21st Century (2005).

11. Hanushek and Woessmann (2009).

12. Bishop (1992); Murnane, Willett, and Levy (1995).

13. As quoted in Friedman (2007), p. 302.

14. As reported on Thinkport.org and quoted in Friedman (2007), p. 302.

Education Act (ESEA) in 1965, now known in its most recent re-authorization as No Child Left Behind (NCLB). Both federal funding and the accountability elements of NCLB have stressed the importance of bringing every student up to a minimum level of proficiency.

As great as this need may be, there is no less need to lift more students, no matter their socioeconomic background, to high levels of educational accomplishment. In 2006, the Science Technology Engineering and Math (STEM) Education Coalition was formed to “raise awareness in Congress, the Administration, and other organizations about the critical role that STEM education plays in enabling the U.S. to remain the economic and technological leader of the global marketplace for the 21st Century.”<sup>9</sup> In the words of a National Academy of Sciences report that jump-started the coalition’s formation, the nation needs to “increase” its “talent pool by improving K-12 science and mathematics education.”<sup>10</sup>

In short, the U.S. cannot afford to neglect high performers in our quest to bring up the bottom. Performance at the top end is no less important, and improvements at both ends reinforce each other, helping to accelerate the growth in productivity of the nation’s economy.<sup>11</sup>

## A Focus on Math

To see how well U.S. schools do at producing high-achieving math students, we compare the percentage of U.S. public and private school students in the graduating Class of 2009 who were highly accomplished in mathematics in each of the 50 states and in 10 urban districts to percentages of high achievers in 56 other countries.

We give special attention to math performance because math appears to be the subject in which accomplishment in secondary school is particularly significant for both an individual’s and a country’s economic well-being. Existing research, though not conclusive, indicates that math skills better predict future earnings and other economic outcomes than other skills learned in high school.<sup>12</sup> “Choose math,” a Norwegian scholar has advised students, “because you will meet it more and more in the future. Math becomes more and more important in all areas of work and scholarship. There will be more math at work, so you will need more math at school.”<sup>13</sup> The American Diploma Project agrees with this assessment, estimating that “in 62 percent of American jobs over the next 10 years, entry-level workers will need to be proficient in algebra, geometry, data interpretation, probability and statistics.”<sup>14</sup>

If individuals can profit by investments in math education, the same is true for countries as a whole. In a prior study, two of the authors of this report demonstrate that growth in the economic productivity of a nation is driven more clearly by the math proficiency of its high school students than by their proficiency in other subjects.<sup>15</sup>

There is also a technical reason for focusing our analysis on math. This subject is particularly well suited to rigorous comparisons across countries and cultures. There is a fairly clear international consensus on the math concepts and techniques that need to be mastered and on the order in which those concepts should be introduced into the curriculum. The knowledge to be learned remains the same regardless of the dominant language spoken in a culture. Comparing reading performances is more challenging because of structural differences in languages, and science comparisons can be faulted for a lack of consensus on the science concepts that need to be mastered. (See Appendix A for a further discussion of U.S. reading and science performance in international perspective along with tables that provide the performance data of countries, states, and urban districts that are the focus of this analysis.)

## Data and Methodology

Our analysis relies on test-score information from young adults collected by the National Assessment of Educational Progress (NAEP) and the Program for International Student Assessment (PISA).<sup>16</sup> NAEP, often called “the nation’s report card,” is a large, nationally representative assessment of student performance in mathematics, reading, and science that has been administered periodically since the early 1970s to U.S. students in 4th grade and 8th grade, and at the age of seventeen. Since 2001, it has provided achievement data for a representative sample of students in each of the 50 states and a select number of urban school districts. PISA is an internationally standardized assessment of student performance in mathematics, science, and reading established by the Organization for Economic Co-operation and Development (OECD). It was administered in 2000, 2003, and 2006 to representative samples of 15-year-olds in all OECD countries as well as in many others.<sup>17</sup>

We focus on the performance of the international equivalent of the U.S. high school graduation Class of 2009 at the time when this class was in the equivalent of U.S. grades 8 and 9. The NAEP used was administered to 8th graders in 2005 (NAEP 2005), while PISA 2006 was administered one year later to students at the age of 15, the year at which most Americans are in 9th grade.

**15.** Hanushek and Woessmann (2009), Table 2.

**16.** Data for NAEP come from the official website [accessed June 1, 2010], <http://nces.ed.gov/nationsreportcard/>. NAEP has also tested periodically a representative sample of students in several other subjects. Results from these other tests are not used here.

**17.** The OECD which administers PISA is an international economic organization encompassing most of the high income, developed countries of the world. In 2007, it had 30 members; three new members (Chile, Israel, and Slovenia) were added in 2010. Information about PISA can be found in Organisation for Economic Co-operation and Development (2004), table 6.2, and Organisation for Economic Co-operation and Development (2007). Data for PISA 2006 come from the PISA microdata (<http://www.pisa.oecd.org/>). The PISA assessments build upon earlier international testing, most importantly those of the International Association for the Evaluation of Educational Achievement (IEA) now known as Trends in Mathematics and Science Survey (TIMSS). IEA has conducted assessments since the mid-1960s and is responsible for the TIMSS testing that is discussed below. See <http://www.iea.nl/>. Historical PISA scores and those of the Trends in International Mathematics and Science (TIMSS), used below, are summarized in Provasnik, Gonzales, and Miller (2009), which also contains references to the original publications for TIMSS.



*Math appears to be the subject in which accomplishment in secondary school is particularly significant for both an individual's and a country's economic well-being.*

18. Loveless (2008).

19. Mullis, Martin, and Foy (2008), p. 71.

20. Some have suggested that PISA and NAEP do not test a common domain of knowledge. Former Commissioner of the National Center for Education Statistics Mark Schneider objects to using PISA to test a representative sample of students in each state on the grounds that "PISA is a self-proclaimed 'yield study' assessing the 'literacy' of 15-year-olds and is not tied to any specific curricula (Schneider (2009))." Brookings scholar Tom Loveless (2009) has critiqued the validity of the PISA science test. But average student performances across countries on different international tests are strongly correlated, suggesting that a common domain of knowledge is being tested (Hanushek and Woessmann (2009)). For example, the correlation between TIMSS 2007 and PISA 2007 was 0.93 (Phillips (2009), p. 36).

NAEP is governed by the National Assessment Governing Board (NAGB), which consists of 26 educators and other public figures appointed by the U.S. Secretary of Education. In 2005, NAEP tested representative samples of 8th-grade public and private school students in each of the 50 states, in 10 large public school districts, and in the U.S. as a whole in math, science, and reading. For each of these jurisdictions, NAEP 2005 calculates the percentage of students who perform at three levels: basic, proficient, and advanced. The focus of this report is the top performers, the percentage of students NAEP found to perform at the advanced level.

Only 6.04 percent of the students in the U.S. in 8th grade in 2005 scored at the advanced level in math. That the percentage is small is not by itself a definitive indication that only a few American 8th graders are highly accomplished in the subject. Since NAGB has the power to set the advanced bar at whatever level it deems appropriate, the specific level at which the standard is set is ultimately a matter of judgment by its board, which in turn is advised by experts in the field. Some critics feel that the standard set by the NAEP governing board is excessively stringent.<sup>18</sup> However, the 2007 Trends in International Math and Science Study (TIMSS 2007), another international test that has been administered to students throughout the world, appears to have set a standard very similar to NAEP 2005, as only 6 percent of U.S. 8th graders scored at the advanced level on that test as well.<sup>19</sup>

We do not take a position on this question but instead simply take the NAEP 2005 standard as given and compare U.S. performance at that advanced level to that of other countries. We use information from the PISA 2006 mathematics test to estimate the percentage of students in other countries who would have scored at this same advanced level or higher had they taken NAEP 2005. We are able to estimate that percentage because students in the U.S. and in 56 other countries took the PISA 2006 math examination. (See Appendix Table A.2, p. 30, for the list of countries who participated in the administration of the PISA 2006 math examination.) Because U.S. students took both the NAEP 2005 and the PISA 2006, it is possible to find the score on the PISA that is tantamount to scoring at the advanced level on the NAEP, i.e., the score that will yield the same percentage of U.S. students as scored at the advanced level on the NAEP.

A score on PISA 2006 of 617.1 points is equivalent to the lowest score obtained by anyone in the top 6.04 percent of U.S. students in the Class of 2009. (The PISA assessment has an average score of 500 among OECD students and a standard deviation of 100.) It is assumed that both NAEP and PISA tests randomly select questions from a common universe of mathematics knowledge.<sup>20</sup> Given that assumption, it may be further assumed that students

who scored similarly on the two exams will have similar math knowledge, i.e., students who scored 617.1 points or better on the PISA test would have been identified as advanced had they taken the NAEP math test. Inasmuch as a score of 617.1 points is more than one standard deviation above the average student score on the PISA, it is clear that a group of highly accomplished students has been isolated. (For more methodological details, see Appendix B.)

As stated above, NAEP examinations are given to 8th graders, while PISA examinations are given at the age of 15, the age of the average U.S. 9th grader, so tracking the Class of 2009 means relying on the 2005 NAEP test and the PISA test of 2006.<sup>21</sup> In comparing the performance of the Class of 2009 on the NAEP and PISA tests at these two different points in time, we assume that no event happened between 8th and 9th grade that significantly altered the performance of American students relative to that of students in other countries.<sup>22</sup>

Because representative samples of student performance on the NAEP 2005 are available for each state and for 10 urban school districts, it is possible to compare the percentages of students in the Class of 2009 who scored at the advanced level for each state and for 10 urban districts to the percentage of equally advanced students in countries from around the globe.

In short, linking the scores of the Class of 2009 on NAEP 2005 and PISA 2006 provides us with the opportunity to assess from an international vantage point how well the U.S. as a whole, individual states, and certain school districts are doing at lifting students to high levels of accomplishment.

## United States Advanced Math Performance in World Perspective

We first provide an overall assessment of the relative percentages of adolescents in the U.S. and other countries who have reached a very high level of mathematics achievement. Largely as a way of explaining away the disappointing relative performance of U.S. students, it is frequently noted that the U.S. has a very heterogeneous population with large numbers of immigrants. Such a diverse population, with students coming to school with varying preparation, may handicap U.S. performance relative to other, more homogeneous countries. For this reason, we provide two additional analyses. We examine two U.S. subgroups conventionally thought to have better preparation for school—white students and students from families where at least one parent is reported to have received a college degree—and compare the percentages of high-achieving students among them to the (total) populations abroad.



*No less than 30 of the 56 other countries that participated in the PISA math test had a larger percentage of students who scored at the international equivalent of the advanced level.*

**21.** It is fortunate that the NAEP math, science and reading tests were given in 2005 and the PISA math, science and reading tests were given in 2006, as those are the only years in the 21st century when that coincidence occurred.

**22.** A similar analysis could be made using the 2007 Trends in International Mathematics and Science Study (TIMSS 2007), which also administered a mathematics examination to a representative sample of 8th grade students in the United States and 49 other countries around the world (Mullis, Martin, and Foy (2008)). However, as is discussed further below, TIMSS 2007 was not administered to students in many industrialized (OECD) countries that out-scored the United States on the PISA.

## Overall Results

The percentage of public and private school students in the U.S. Class of 2009 who were highly accomplished is well below that of most countries with which the U.S. generally compares itself. No less than 30 of the 56 other countries that participated in the PISA math test had a larger percentage of students who scored at the international equivalent of the advanced level. While just 6 percent of U.S. students earned at least 617.1 points on the PISA 2006 exam, 28 percent of Taiwanese students did. (See Figure 1, p. 16, for these results as well as for the relative rank internationally of each individual U.S. state.)

It is not only Taiwan that did dramatically better than the U.S. At least 20 percent of students in Hong Kong, Korea, and Finland were also highly accomplished. Twelve other countries had more than twice the percentage of highly accomplished students as the U.S.: In order of math excellence, they are Switzerland, Belgium, the Netherlands, Liechtenstein, New Zealand, the Czech Republic, Japan, Canada, Macao, Australia, Germany, and Austria.

The remaining countries that educate to a high level of accomplishment a higher proportion of their students than the U.S. are Slovenia, Denmark, Iceland, France, Estonia, Sweden, the U.K., the Slovakia, Luxembourg, Hungary, Poland, Norway, Ireland and Lithuania.

This 30-country list includes virtually all the advanced industrialized countries of the world, most of whom are members of the OECD. The only countries currently members of the OECD countries that produce a smaller percentage of advanced math students than the U.S. are Spain, Italy, Israel, Portugal, Greece, Turkey, Chile and Mexico.<sup>23</sup> Additionally, 24 non-OECD countries participated in PISA 2006.

The percentage of students scoring at the advanced level varies among the 50 states. Massachusetts, with more than 11 percent advanced, does better than any other state, but the percentage of students in the Massachusetts Class of 2009 showing advanced skills trails those of 14 countries. Minnesota ranked second among the 50 states; its level of performance is roughly equal to that of France, Sweden, and Denmark. See Table 1 for a comparison of all states with performances abroad.

Even though California is known for its Silicon Valley, just 4.5 percent of the students in the Silicon Valley state are performing at a high level, a percentage roughly comparable to that of Portugal. The lowest ranking states—West Virginia, New Mexico, and Mississippi—have a smaller percentage of the highest-performing students than do Serbia and Uruguay, although they edge out Romania, Brazil, and Kyrgyzstan.

**23.** Other countries participating in PISA 2006 but not current members of the OECD who had lower results than the US include Russia (although not significantly so), Croatia, Uruguay, Romania, Brazil, Argentina, Azerbaijan, Montenegro, Qatar, Tunisia, Colombia, Indonesia, Jordan and Kyrgyzstan.

**Table 1**

Percentages of all students at the advanced level per state and countries with similar and higher percentages at the advanced level in overall student population

State	Percent advanced	Significantly outperformed by*	Countries with similar percentages of advanced students**
1. Massachusetts	11.4%	14	Austria • Germany • Denmark • France • Iceland • Slovenia
2. Minnesota	10.8	16	Denmark • Estonia • France • Iceland • Slovenia • Sweden
3. Vermont	8.8	22	U.K. • Hungary • Ireland • Luxembourg • Norway • Poland • Slovakia
4. New Jersey	8.7	18	Estonia • France • U.K. • Hungary • Ireland • Iceland • Lithuania • Luxembourg • Norway • Poland • Slovakia • Sweden
4. Washington	8.7	21	U.K. • Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia • Sweden
6. Virginia	7.9	22	U.K. • Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia
7. Connecticut	7.8	23	Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia
8. Oregon	7.3	25	Hungary • Ireland • Lithuania • Poland
9. North Carolina	7.1	27	Slovakia • Ireland • Lithuania • Poland
10. Maryland	6.8	29	Lithuania • Russia
11. South Carolina	6.7	29	Lithuania • Russia
11. Wisconsin	6.7	29	Lithuania • Russia
13. Ohio	6.6	29	Lithuania • Russia
14. New Hampshire	6.5	29	Lithuania • Russia
14. South Dakota	6.5	29	Lithuania • Russia
16. Colorado	6.3	29	Spain • Lithuania • Russia
16. New York	6.3	29	Lithuania • Russia
18. Texas	6.2	29	Lithuania • Russia
United States	6.0	30	Russia
19. Nebraska	6.0	29	Spain • Lithuania • Russia
20. Alaska	5.8	30	Spain • Latvia • Russia
21. Iowa	5.7	30	Spain • Latvia • Russia
21. Pennsylvania	5.7	30	Spain • Israel • Italy • Lithuania • Latvia • Russia
23. Montana	5.6	30	Spain • Latvia • Russia
24. Michigan	5.5	30	Spain • Israel • Italy • Latvia • Russia
25. Illinois	5.4	30	Spain • Israel • Italy • Latvia • Russia
26. Kansas	5.2	30	Spain • Israel • Italy • Latvia • Russia
27. Indiana	5.1	30	Spain • Israel • Italy • Latvia • Russia
28. Delaware	5.0	32	Israel • Italy • Latvia
28. Maine	5.0	32	Israel • Italy • Latvia
30. North Dakota	4.8	32	Israel • Italy • Latvia • Portugal • Turkey
31. Utah	4.7	32	Israel • Italy • Latvia • Portugal • Turkey
32. Arizona	4.6	33	Israel • Italy • Portugal • Turkey
32. Florida	4.6	32	Israel • Italy • Latvia • Portugal • Turkey
34. California	4.5	33	Israel • Italy • Portugal • Turkey
34. Idaho	4.5	33	Israel • Italy • Portugal • Turkey
36. Georgia	4.3	34	Greece • Israel • Portugal • Turkey
37. Missouri	4.1	35	Greece • Portugal • Turkey
38. Wyoming	3.5	37	Croatia • Turkey
39. Kentucky	3.4	37	Croatia • Turkey
40. Rhode Island	3.3	37	Croatia • Turkey
41. Nevada	3.1	38	Turkey
42. Arkansas	3.0	38	Bulgaria • Turkey
43. Tennessee	2.9	38	Bulgaria • Turkey
44. Hawaii	2.5	38	Bulgaria • Turkey • Uruguay
45. Oklahoma	2.4	38	Bulgaria • Serbia • Turkey • Uruguay
46. Alabama	2.3	38	Bulgaria • Serbia • Turkey • Uruguay
47. Louisiana	1.7	42	Bulgaria
48. West Virginia	1.4	42	Bulgaria
48. New Mexico	1.4	42	Bulgaria
50. Mississippi	1.3	42	Turkey

\*Number of countries whose percent advanced was statistically significantly higher

\*\*Countries where the percentage of students at the advanced level did not differ significantly from state. If no country had similar percentage, the country with the percentage just higher than that of the state is listed.

In short, the percentages of high-achieving students in the U.S.—and in most of its individual states—are shockingly below those of many of the world’s leading industrialized nations. Results for many states are at a level equal to those of developing countries.

### **White Students**

The overall news is sobering. Some might try to comfort themselves by saying the problem is limited to large numbers of students from immigrant families, or to African American students and others who have suffered from discrimination. For example, the statement by the STEM Coalition that we “encourage more of our best and brightest students, especially those from underrepresented or disadvantaged groups, to study in STEM fields” suggests that the challenges are concentrated in non-white segments of the U.S. population.

Without denying that the paucity of high-achieving students within minority populations is a serious issue, let us consider the other side of that coin and inquire about the performance of white students for whom the case of discrimination cannot easily be made. Figure 2, p. 16, compares the percentage of U.S. *white* students in the Class of 2009 who scored at the advanced level with the percentage of *all* students in other countries. Note that in this figure no adjustment is made in any other participating country for the size of its minority population. U.S. white students are being compared to all students, of whatever ethnic or racial background, in the other countries. If the issue of math education is strictly a minority group issue, then this chart can be expected to show the U.S. as one of the world leaders.

Figure 2 reveals that to be far from the case. In 24 countries, the percentage of highly accomplished students (from all ethnic backgrounds) surpasses that in the U.S. white student population in the Class of 2009, 8 percent of whom score at the advanced level. The percentage of white students at the advanced level in the state of New York was 7.7 percent, roughly the same as the percentage of all students in Hungary and Poland. In California, 7.2 percent of white students are performing at the advanced level, a percentage insignificantly different from the percentage of all students in Ireland and Lithuania. Table 2 provides a full comparison of white students in each state with the performances of all students abroad.

**Table 2**

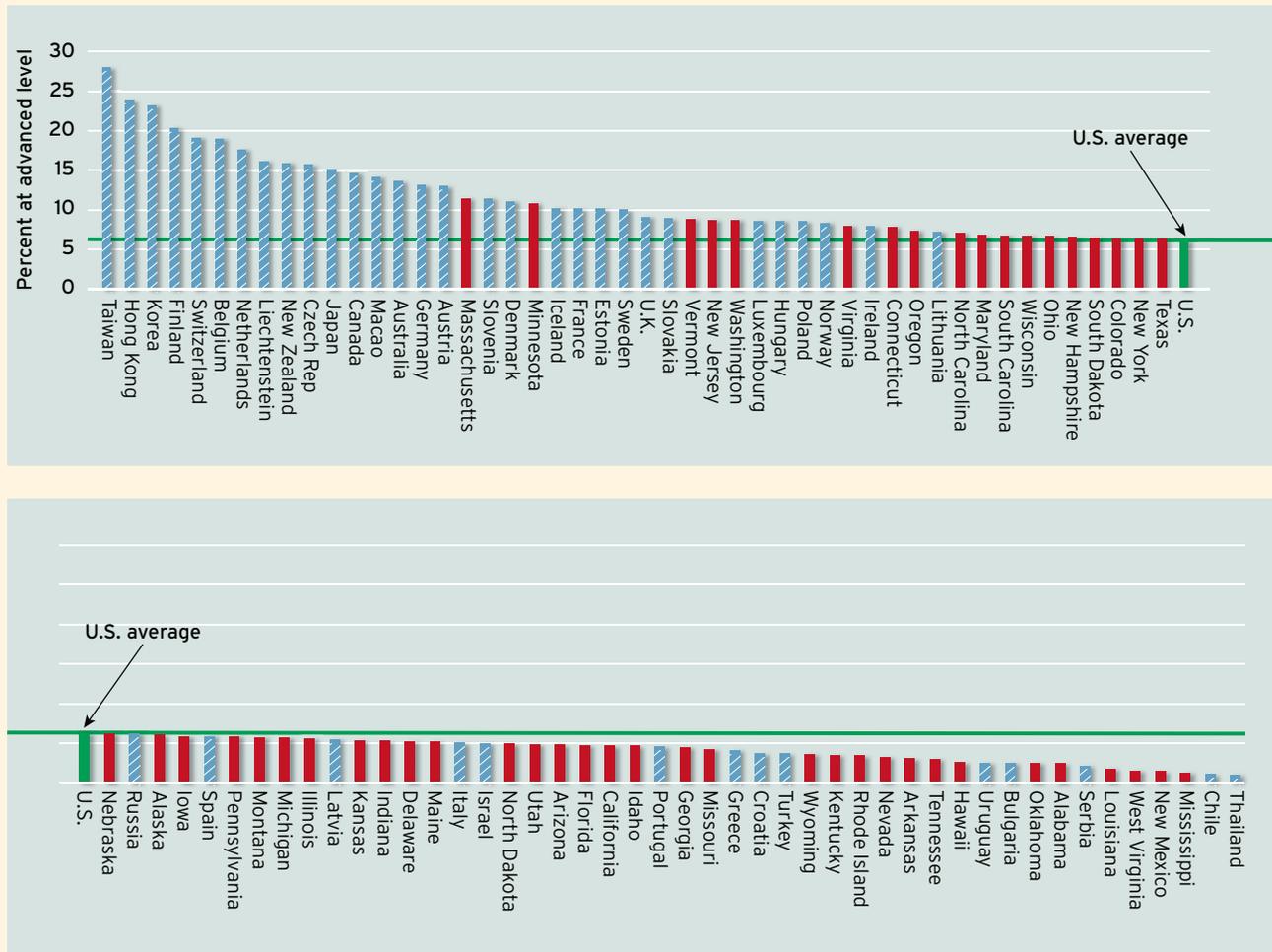
Percentages of white students at the advanced level per state and countries with similar and higher percentages at the advanced level in overall student population

State	Percent advanced	Significantly outperformed by*	Countries with similar percentages of advanced students**
1. Massachusetts	12.6%	11	Australia • Austria • Germany • Denmark • Liechtenstein • Macao • Slovenia
2. Minnesota	12.3	12	Australia • Austria • Germany • Denmark • Liechtenstein • Slovenia
3. New Jersey	11.5	12	Australia • Austria • Germany • Denmark • Estonia • France • Iceland • Liechtenstein • Slovakia • Slovenia • Sweden
4. South Carolina	10.8	15	Austria • Denmark • Estonia • France • Iceland • Slovakia • Slovenia • Sweden
5. Connecticut	10.6	16	Denmark • Estonia • France • Iceland • Slovakia • Slovenia • Sweden
5. Texas	10.6	16	Denmark • Estonia • France • Iceland • Slovenia • Sweden
7. Virginia	10.3	15	Austria • Denmark • Estonia • France • U.K. • Hungary • Iceland • Luxembourg • Poland • Slovakia • Slovenia • Sweden
8. North Carolina	9.9	16	Denmark • Estonia • France • U.K. • Hungary • Iceland • Luxembourg • Norway • Poland • Slovakia • Slovenia • Sweden
9. Maryland	9.8	16	Denmark • Estonia • France • U.K. • Hungary • Iceland • Luxembourg • Norway • Poland • Slovakia • Slovenia • Sweden
10. Washington	9.5	17	Denmark • Estonia • France • U.K. • Hungary • Iceland • Luxembourg • Norway • Poland • Slovakia • Sweden
11. Vermont	9.0	19	Estonia • France • U.K. • Hungary • Luxembourg • Norway • Poland • Slovakia • Sweden
12. Alaska	8.5	21	U.K. • Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia • Sweden
13. Colorado	8.4	19	Estonia • France • U.K. • Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia • Sweden
United States	8.0	24	Poland • Slovakia • Norway • Lithuania • Ireland • Hungary
14. Oregon	7.9	22	U.K. • Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia
15. New York	7.7	23	Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia
16. Ohio	7.6	24	Hungary • Ireland • Lithuania • Norway • Poland • Slovakia
16. Wisconsin	7.6	23	Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia
16. Arizona	7.6	23	Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia
16. Illinois	7.6	23	Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia
20. South Dakota	7.3	25	Hungary • Ireland • Lithuania • Poland
21. California	7.2	27	Slovakia • Ireland • Lithuania • Poland
22. Florida	7.1	24	Hungary • Ireland • Lithuania • Norway • Poland • Russia • Slovakia
22. Delaware	7.1	26	Hungary • Ireland • Lithuania • Poland • Russia
24. Nebraska	6.8	29	Lithuania • Russia
24. Michigan	6.8	24	Spain • Hungary • Ireland • Lithuania • Latvia • Norway • Poland • Russia • Slovakia
26. New Hampshire	6.5	29	Lithuania • Russia
27. Pennsylvania	6.4	29	Spain • Lithuania • Russia
28. Georgia	6.3	29	Spain • Lithuania • Latvia • Russia
28. Kansas	6.3	29	Spain • Lithuania • Russia
30. Iowa	6.2	29	Spain • Lithuania • Russia
31. Montana	6.0	29	Spain • Lithuania • Latvia • Russia
32. Indiana	5.9	29	Spain • Lithuania • Latvia • Russia
33. Utah	5.4	30	Spain • Israel • Italy • Latvia • Russia
34. North Dakota	5.3	30	Spain • Israel • Italy • Latvia • Russia
35. Maine	5.1	32	Israel • Italy • Latvia
36. Idaho	5.0	32	Israel • Italy • Latvia • Turkey
36. Missouri	5.0	31	Spain • Israel • Italy • Latvia • Portugal • Turkey
38. Nevada	4.6	32	Greece • Israel • Italy • Latvia • Portugal • Turkey
39. Rhode Island	4.2	35	Greece • Portugal • Turkey
40. Wyoming	3.8	36	Greece • Croatia • Turkey
40. Arkansas	3.8	36	U.K. • Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia • Sweden
42. Tennessee	3.7	36	Greece • Croatia • Turkey
43. Kentucky	3.6	36	Greece • Croatia • Turkey
43. Alabama	3.6	34	Bulgaria • Greece • Croatia • Israel • Portugal • Turkey • Uruguay
45. Hawaii	3.4	32	Bulgaria • Greece • Croatia • Israel • Italy • Latvia • Portugal • Serbia • Turkey • Uruguay
46. New Mexico	3.2	36	Bulgaria • Greece • Croatia • Turkey
47. Oklahoma	3.0	38	Bulgaria • Turkey
48. Louisiana	2.6	38	Bulgaria • Serbia • Turkey • Uruguay
49. Mississippi	2.4	38	Bulgaria • Serbia • Turkey • Uruguay
50. West Virginia	1.3	42	Turkey

\* Number of countries whose percent advanced was statistically significantly higher

\*\* Countries where the percentage of overall students advanced did not differ significantly from the percentage of advanced white students in the state. If no country had similar percentage, the country with the percentage just higher than that of the state is listed.

**Class of 2009: Percentage of students at advanced level in math in U.S. states and countries participating in PISA 2006. (Figure 1)**



Note: Excludes participating countries below 1 percent: Romania, Brazil, Argentina, Azerbaijan, Mexico, Montenegro, Qatar, Tunisia, Columbia, Indonesia, Jordan, and Kyrgyzstan.

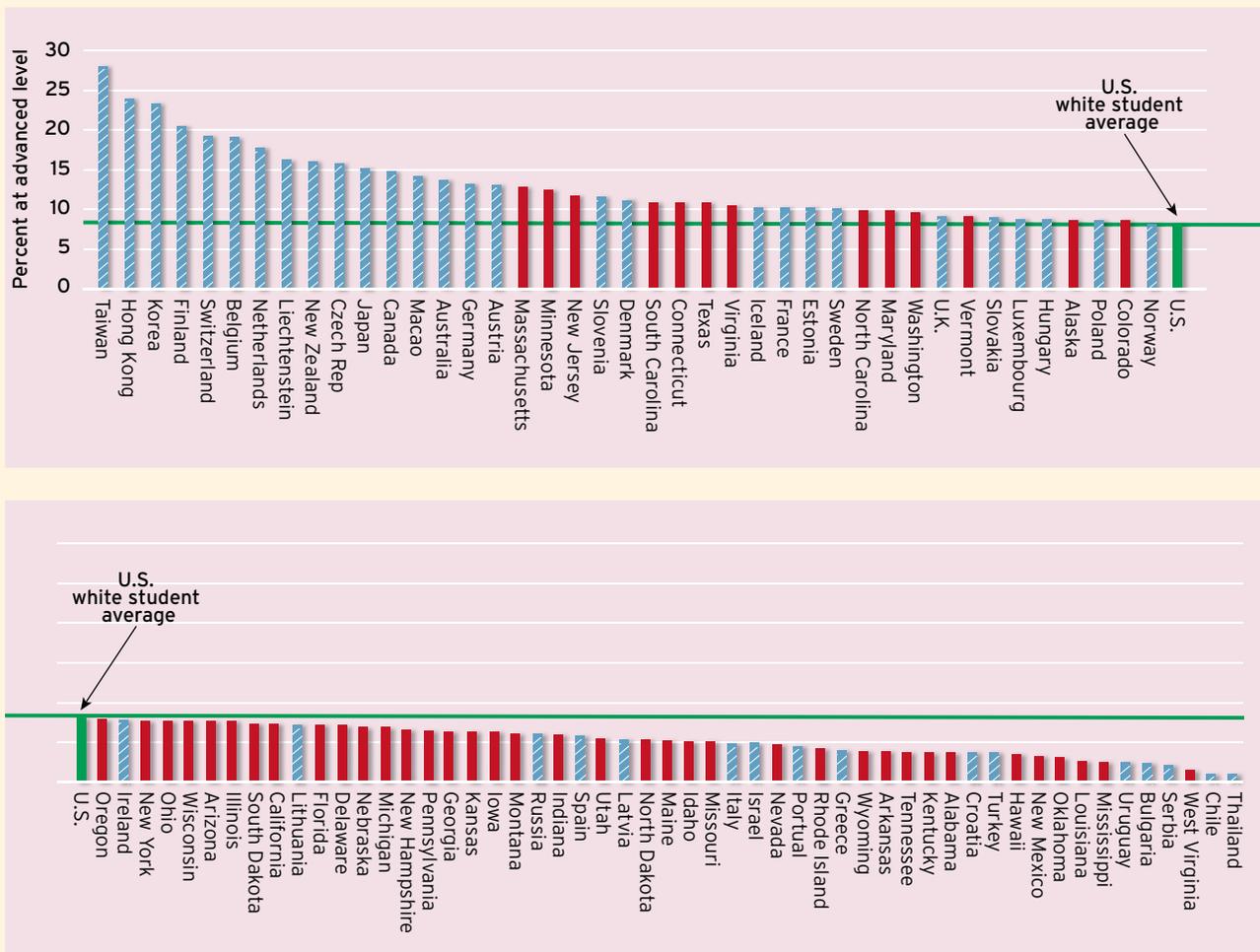
### Children of Parents with a College Degree

Another possibility is that schools help students reach levels of high accomplishment if parents are providing the necessary support. To explore this possibility, we assumed that students who reported that at least one parent had graduated from college were most likely to be given the kind of support that is needed to reach high levels of achievement. Approximately 45 percent of all U.S. students reported that at least one parent had a college degree.<sup>24</sup>

When we compared these U.S. students from highly educated families to all students in other countries, without regard to their parents' education, we expected to find that the U.S. would place among the world leaders. But as can be seen in

24. This is only an estimate of parental education, as students tend to over-report parental attainment. In a study of high school sophomores, where parents reported their own education, 38 percent reported that at least one parent had a college diploma (Education Longitudinal Study of 2002).

**Class of 2009: Percentage of *white* students in U.S. states at advanced level in math and percentage of *all* students at that level in countries participating in PISA 2006. (Figure 2)**

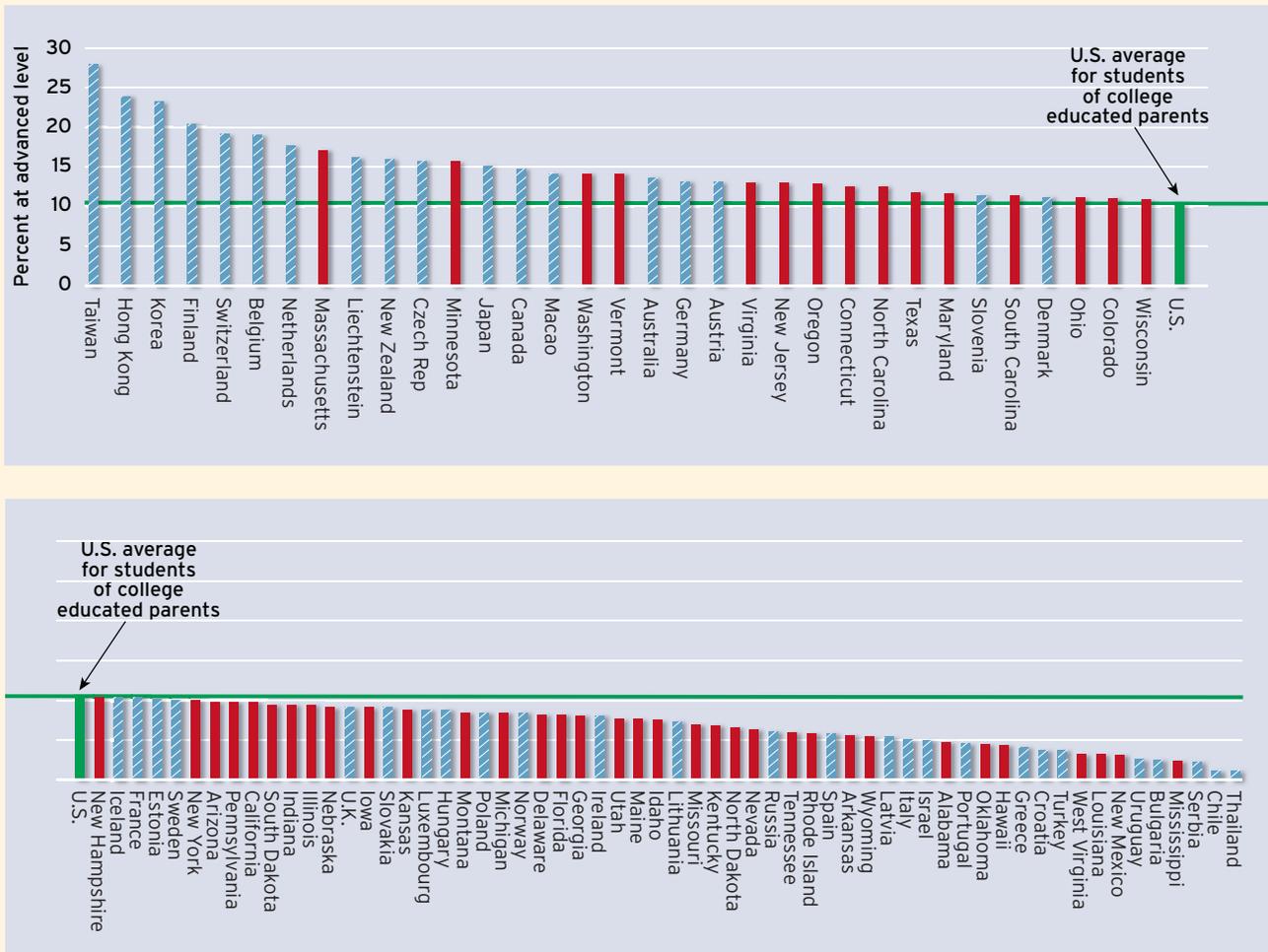


Note: See note to Figure 1.

Figure 3, p. 16, the percentage of students in the Class of 2009 whose parent had graduated from college and who are performing at the advanced level is just 10.3 percent of the total. Students in 16 countries, no matter their parents' educational attainment, out-rank this more-advantaged segment of the U.S. population.

The percentage of Illinois students from college-educated families who are highly accomplished, 9 percent, is similar to the percentage of *all* students in France and Great Britain. Rhode Island's students from college-educated backgrounds, 6 percent of whom are advanced, are doing no better than all the students in Italy and Spain. Uruguay and Bulgaria produce a similar proportion of advanced students—about 2 percent—as is

**Class of 2009: Percentage of students with at least a college-educated parent in U.S. states at advanced level in math and percentage of all students at that level in countries participating in PISA 2006. (Figure 3)**



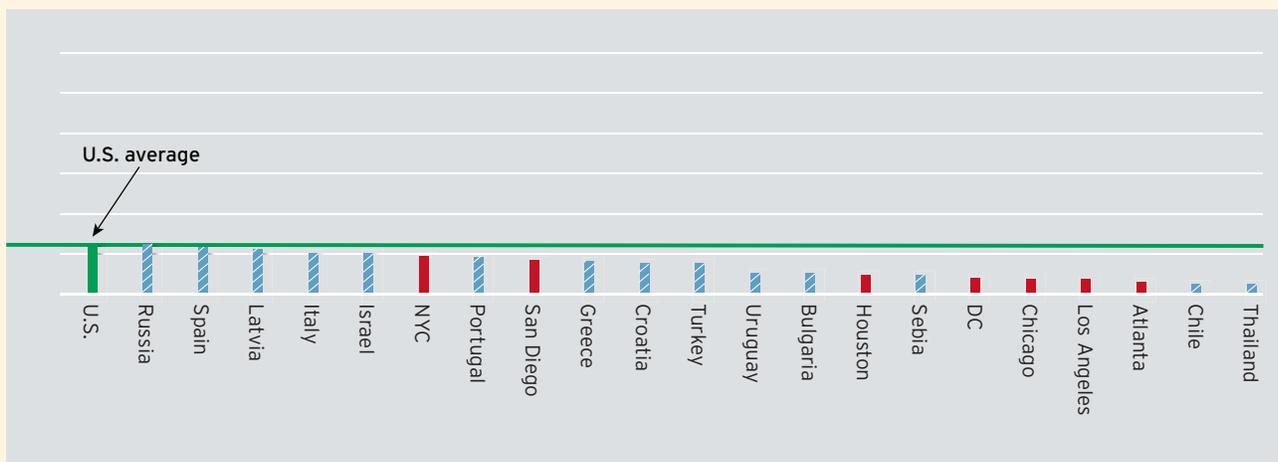
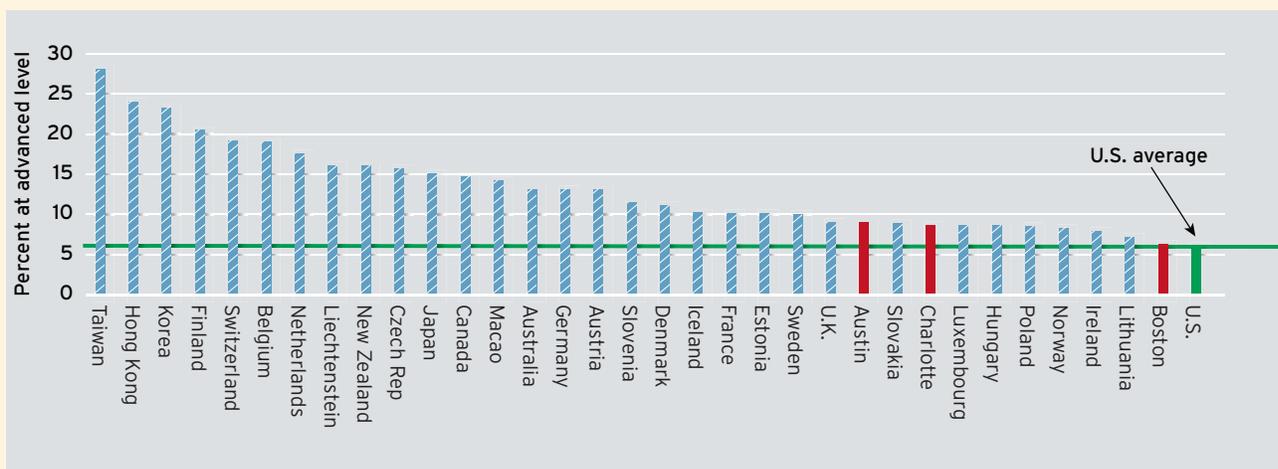
Note: See note to Figure 1.

found among children of the college-educated in Mississippi. Table 3, p.20, provides the percentage of students from college-educated backgrounds who perform at the advanced level in each state in comparison with all students in countries abroad.

### Urban School Districts

Given the comparatively low performance of students from families where a parent has a college degree, it is not surprising to learn that the percentage of high-achieving students attending schools in urban school districts generally trails that in other countries by an especially wide margin. In Figure 4, that information is displayed in the

### Class of 2009: Percentage of at advanced level in math in U.S. *urban districts* and countries participating in PISA 2006. (Figure 4)



Note: See note to Figure 1.

same way as the information for states was displayed in the three preceding figures.

The percentages of highly accomplished students in the three university cities of Austin (Texas), Charlotte (North Carolina), and Boston (Massachusetts) are higher than found in the U.S. as a whole. New York City trails Israel but slightly outperforms Portugal. San Diego, Houston, Washington, D. C., Chicago, Los Angeles, and Atlanta are all clustered below Uruguay and Bulgaria but above Chile, Thailand, Romania, Brazil, and Mexico. In other words, the ability of the schools in these districts to lift student performance to the highest level is roughly equal to that of schools in a Latin American country.

**Table 3**

Percentages of advanced students with a college educated parent per state and countries with similar and higher percentages advanced in overall student population

State	Percent advanced	Significantly outperformed by*	Countries with similar percentages of advanced students
1. Massachusetts	17.1%	4	Belgium • Canada • Switzerland • Czech Rep • Japan • Liechtenstein • Netherlands • New Zealand
2. Minnesota	15.7	5	Australia • Austria • Canada • Switzerland • Czech Rep • Germany • Japan • Liechtenstein • Macao • Netherlands • New Zealand
3. Washington	14.1	7	Australia • Austria • Canada • Czech Rep • Germany • Japan • Liechtenstein • Macao • New Zealand • Slovenia
4. Vermont	14.0	7	Australia • Austria • Canada • Czech Rep • Germany • Japan • Liechtenstein • Macao • New Zealand
5. Virginia	13.0	7	Australia • Austria • Canada • Czech Rep • Germany • Denmark • Japan • Liechtenstein • Macao • New Zealand • Slovenia
6. New Jersey	12.9	7	Australia • Austria • Canada • Czech Rep • Germany • Denmark • Japan • Liechtenstein • Macao • New Zealand • Slovenia
7. Oregon	12.7	8	Australia • Austria • Canada • Czech Rep • Germany • Denmark • Japan • Liechtenstein • Macao • Slovenia
8. Connecticut	12.5	11	Australia • Austria • Germany • Denmark • Liechtenstein • Macao • Slovenia
8. North Carolina	12.5	7	Australia • Austria • Canada • Czech Rep • Germany • Denmark • Estonia • France • Iceland • Japan • Liechtenstein • Macao • New Zealand • Slovakia • Slovenia • Sweden
10. Texas	11.7	14	Austria • Germany • Denmark • Slovenia
11. Maryland	11.6	12	Australia • Austria • Germany • Denmark • Estonia • France • Iceland • Liechtenstein • Slovenia • Sweden
12. South Carolina	11.3	14	Austria • Germany • Denmark • Estonia • France • Iceland • Slovakia • Slovenia • Sweden
13. Ohio	11.0	14	Austria • Germany • Denmark • Estonia • France • Iceland • Slovakia • Slovenia • Sweden
13. Colorado	11.0	12	Australia • Austria • Germany • Denmark • Estonia • France • U.K. • Hungary • Iceland • Liechtenstein • Poland • Slovakia • Slovenia • Sweden
15. Wisconsin	10.8	14	Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia
United States	10.3	17	Denmark • Estonia • France • Iceland • Sweden
16. New Hampshire	10.2	16	Denmark • Estonia • France • U.K. • Hungary • Iceland • Luxembourg • Poland • Slovakia • Slovenia • Sweden
17. New York	10.0	17	Denmark • Estonia • France • U.K. • Hungary • Iceland • Poland • Slovakia • Sweden
18. Arizona	9.6	17	Denmark • Estonia • France • U.K. • Hungary • Iceland • Luxembourg • Norway • Poland • Slovakia • Sweden
18. Pennsylvania	9.6	16	Denmark • Estonia • France • U.K. • Hungary • Ireland • Iceland • Luxembourg • Norway • Poland • Slovakia • Slovenia • Sweden
20. California	9.5	17	Denmark • Estonia • France • U.K. • Hungary • Iceland • Luxembourg • Poland • Slovakia • Sweden
21. South Dakota	9.3	17	Denmark • Estonia • France • U.K. • Hungary • Iceland • Luxembourg • Norway • Poland • Slovakia • Sweden
22. Indiana	9.1	17	Denmark • Estonia • France • U.K. • Hungary • Ireland • Iceland • Lithuania • Luxembourg • Norway • Poland • Slovakia • Sweden
22. Illinois	9.1	17	Denmark • Estonia • France • U.K. • Hungary • Ireland • Iceland • Lithuania • Luxembourg • Norway • Poland • Slovakia • Sweden
24. Nebraska	9.0	18	Estonia • France • U.K. • Hungary • Iceland • Luxembourg • Norway • Poland • Slovakia • Sweden
24. Iowa	9.0	18	Estonia • France • U.K. • Hungary • Ireland • Iceland • Lithuania • Luxembourg • Norway • Poland • Slovakia • Sweden
26. Kansas	8.8	18	Estonia • France • U.K. • Hungary • Ireland • Iceland • Lithuania • Luxembourg • Norway • Poland • Slovakia • Sweden
27. Montana	8.5	22	U.K. • Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia
27. Michigan	8.5	17	Denmark • Estonia • France • U.K. • Hungary • Ireland • Iceland • Lithuania • Luxembourg • Norway • Poland • Russia • Slovakia • Sweden
29. Delaware	8.1	22	U.K. • Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia
30. Florida	8.0	22	U.K. • Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia
31. Georgia	7.9	22	U.K. • Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Slovakia
32. Utah	7.5	24	Hungary • Ireland • Lithuania • Norway • Poland • Slovakia
33. Maine	7.4	24	Hungary • Ireland • Lithuania • Norway • Poland • Slovakia
34. Idaho	7.3	23	Hungary • Ireland • Lithuania • Luxembourg • Norway • Poland • Russia • Slovakia
35. Missouri	6.9	17	Denmark • Estonia • France • U.K. • Hungary • Ireland • Iceland • Lithuania • Luxembourg • Norway • Poland • Russia • Slovakia • Sweden
36. Kentucky	6.6	25	Spain • Hungary • Ireland • Lithuania • Latvia • Poland • Russia • Slovakia
37. North Dakota	6.4	29	Spain • Lithuania • Latvia • Russia
38. Nevada	6.2	27	Spain • Ireland • Israel • Italy • Lithuania • Latvia • Poland • Portugal • Russia • Turkey
39. Tennessee	5.8	29	Spain • Israel • Italy • Lithuania • Latvia • Russia
39. Rhode Island	5.8	29	Spain • Israel • Italy • Lithuania • Latvia • Russia
41. Arkansas	5.4	30	Spain • Israel • Italy • Latvia
42. Wyoming	5.3	30	Russia • Spain • Israel • Italy • Latvia • Portugal • Russia • Turkey
43. Alabama	4.6	29	Bulgaria • Spain • Greece • Croatia • Israel • Italy • Lithuania • Latvia • Portugal • Russia • Turkey
44. Oklahoma	4.3	33	Greece • Israel • Italy • Portugal
45. Hawaii	4.2	33	Turkey • Greece • Croatia • Israel • Italy • Portugal • Turkey
46. West Virginia	3.0	37	Bulgaria • Croatia • Turkey
46. Louisiana	3.0	35	Bulgaria • Greece • Croatia • Portugal • Serbia • Turkey • Uruguay
48. New Mexico	2.9	37	Bulgaria • Croatia • Turkey • Uruguay
49. Mississippi	2.2	38	Bulgaria • Serbia • Turkey • Uruguay

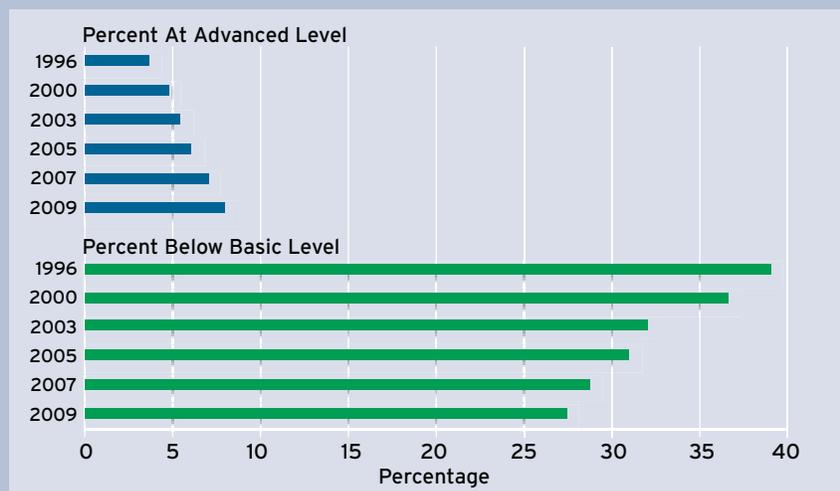
\* Number of countries whose percent advanced was statistically significantly higher

## Did *No Child Left Behind* Shift the Focus Away from the Best and the Brightest?

Some attribute the comparatively small percentages of students performing at the advanced level to the focus of the 2002 federal accountability statute, No Child Left Behind (NCLB), on the educational needs of very low performing students.<sup>25</sup> That law mandates that every student be brought up to the level a state deems proficient, a standard that most states set well below the NAEP standard of full proficiency, to say nothing of the advanced level that is the focus of this report.

In order to comply with the federal law, some assert, schools are concentrating all available resources on the educationally deprived, leaving advanced students to fend for themselves. If so, then we should see a decline in the percentage of students performing at NAEP's advanced level subsequent to the passage of the 2002 federal law. In mathematics, however, the opposite has happened. As can be seen in Figure 5, the percentage performing at the advanced level was only 3.7 percent in 1996 and 4.7 percent in the year 2000. But the percentage performing at that level subsequently climbed to 7.9 percent by 2009. If one assumes that NCLB did not have an impact on schools until after 2003, the increment in the percentage advanced is from 5.4 percent in that year to 7.9 percent in 2009.<sup>26</sup>

**Percentage of 8th grade students at the advanced level and below basic level in mathematics on National Assessment of Educational Progress, 1996 to 2009. (Figure 5)**



*The incapacity of American schools to bring students up to the highest level of accomplishment in mathematics is much more deep-seated than anything induced by recent federal legislation*

<sup>25</sup>. Loveless (2008).

<sup>26</sup>. Education historian Diane Ravitch, among others, has objected to identifying NCLB effects as early as one year after the law was passed; see Ravitch (2010), p. 109.

It is true that the percentage performing below the basic level decreased, by 6.8 percentage points between 2000 and 2009, from 34.2 percent to 27.4 percent (see Figure 5, p.21), but that is only a 20 percent change, as compared to the 69 percent change in the percentage advanced over the same period. One should not put any particular weight on percent changes in percentage points, however, as such calculations can be misleading. The most sensible interpretation is that the percentages of students deemed proficient at both the basic and advanced levels increased noticeably during the first decade of the 21st century.

Perhaps NCLB's passage in 2002 dampened the prior rate of growth in the achievement of high-performing students. To ascertain whether that was the case we compared the rate of change in the NAEP math scores of the top 10 percent of all 8th graders between 1990 and 2003 (before NCLB had begun to be implemented) with the rate of change after NCLB had become effective law. Between 1990 and 2003, the scores of the student at the 90th percentile rose from 307 to 321, an increment of 14 points, or a growth rate of 1.0 points a year. Between 2003 and 2009, the shift upwards for the 90th percentile was another 8 points, or a change of 1.3 points a year.<sup>27</sup>

These findings are consistent with work by Thomas Dee and Brian Jacob (2009), who have undertaken a more complex analysis of the impact of NCLB on NAEP scores. In addition to estimating impacts on average performance across states, they estimate impacts on both very high and very low achieving students. Their study indicates that NCLB had positive impacts on the math performance of high-achieving students, even though larger impacts were observed for those at the bottom of the distribution.<sup>28</sup>

In short, the incapacity of American schools to bring students up to the highest level of accomplishment in mathematics is much more deep-seated than anything induced by recent federal legislation.

**27.** Data available from authors upon request. Tom Loveless has reached quite different conclusions from an examination of this same information (Loveless, 2008). His findings depend upon his assumption that NCLB was influencing school policy by 2000, two years before the law was enacted. Apart from the problems with this assumption, any conclusions that are sensitive to the choice of one or another year near the cusp are hardly robust; also his analysis extends only to 2007 and high achievers showed a growth spurt between then and 2009.

**28.** Dee and Jacob (2009) find no impact of NCLB on NAEP reading performance.

**29.** Phillips (2007, 2009). For other studies that compare test-score performances across countries, see Hanushek and Woessmann (2010).

## The Optimistic View from Prior Studies

Our findings differ from two reports issued by Gary Phillips of the American Institutes of Research that compared the average performance in math of 8th-grade students in each of the 50 states with the average scores of 8th-grade students in other countries.<sup>29</sup> In his reports, Phillips relied on information from NAEP 2007 and from math assessments in TIMSS: in his first report, achievement on TIMSS 2003, and in his second report, achievement on TIMSS 2007. Phillips' analysis compares average student achievement across countries, not the percentage of students performing at the advanced level, the focus of this report. His findings are distinctly more favorable to the U.S. than those shown by our analyses. While our study indicates that U.S. advanced student performance in math is tied for 31st place among countries surveyed, Phillips, in both his 2007 and his 2009 reports, finds U.S. students, on average, to be performing better than all but 8 countries.

The opening sentences to the executive summary of his 2007 report draws quite buoyant conclusions:

This report provides international benchmarks to help states see how students are doing in math within an international context.

**Good News**—Most states are performing as well or better than most foreign countries.

**Bad News**—The highest achieving states within the U.S. are still significantly below the highest achieving countries.<sup>30</sup>

Why do two studies that seem to be employing generally similar methodologies produce such strikingly different results?

The answer to that puzzle is actually quite simple and has little to do with the fact that Phillips compares average student performance while our study focuses on the percentage of advanced students. The key difference is that the set of countries to which we compare the U.S. is noticeably different from the set of countries included in the Phillips comparisons. Many OECD countries, including those that had a high percentage of high-achieving students, participated in PISA 2006 (upon which our analysis is based) but did not participate in either TIMSS 2003 or TIMSS 2007 (the two surveys included in the Phillips studies). In fact, 16 countries that outscored the U.S. on the PISA 2006 test did not participate in TIMSS 2003 (see Appendix Tables C.1 and C.2, p. 34-35). As a report by the U.S. National Center for Education Statistics has explained, “Differences in the set of counties that participate in an assessment can affect how well the U.S. appears to do internationally when results are released.”<sup>31</sup>



*The set of countries to which we compare the U.S. is noticeably different from the set of countries included in the Phillips comparisons.*

**30.** Phillips (2007) p. 1. These findings received extensive media attention. As part of its favorable coverage, the *New York Times* quotes Thomas Toch, a former co-director of Education Sector as saying: “It shows we’re not doing as badly as some say.... We’re in the top half of the table, and a number of states are outperforming the majority of the nations in the study” (Dillon (2007)).

**31.** Provasnik, Gonzales, and Miller (2009), p. 3. The report goes on to say: “One reason for this is that the average student performance in developed countries tends to be higher than in developing countries. As a result, the extent to which developing countries participate in an assessment can affect the international average of participating countries as well as the relative position of one country compared with the others.”

Put starkly, if one drops from a survey countries such as Canada, Denmark, Finland, France, Germany, and New Zealand, and includes instead such countries as Bulgaria, Botswana, Ghana, Iran, and Lebanon, the average international performance will drop, and the U.S. will look better relative to the countries with which it is being compared. (See Appendix C for a further discussion of the Phillips studies.)

## Discussion and Conclusions

Math performance of young people in their adolescent years is shaped by a multiplicity of factors both within schools and outside of them. For that reason we do not identify in this report any single cause of the relatively small percentage of students in the U.S. who are performing at a high level of accomplishment. Sources of the problem may lie in the lack of initiative among students themselves, anti-educational pressures within the adolescent peer group culture, a lack of parental concern and support, anti-intellectual influences within the entertainment and mass media industries, a substantial minority population, high rates of in-migration, or even broader and deeper societal influences. But even though we suspect that one or more of these factors is at work, some of our findings point specifically to problematic elements within the nation's schools. That even relatively advantaged groups in American society—white students and those with a parent who has a college education—do not generate a high percentage of students who achieve at the advanced level in math suggests, we submit, that schools are failing to teach students effectively.

Raising the numbers of students performing at the highest level is not likely to be accomplished simply by allocating more dollars to our public schools. The U.S. is already among the world leaders in expenditures per pupil in K–12 education, and the correlation between expenditures and achievement across OECD countries is virtually nil.<sup>32</sup> Spending more money on schools at a time of economic distress seems not only infeasible but also unlikely to produce the kind of changes that are needed if the U.S. is to remain among the highly productive countries of the world.

This is not the place to identify the policy changes that might foster excellence. But we do note that policy initiatives have in recent years focused on the educational needs of low-performing students, a commendable target of policy. We see no sign that NCLB has been harmful to the highest-performing students. But we do fear that this policy environment leaves the impression that

**32.** Hanushek and Woessmann (2008, 2010).

there is no similar need to enhance the education of those students the STEM coalition has called “the best and brightest.”

In its 2010 report, the “Rising above the Gathering Storm,” Committee of the National Academy of Sciences issued a second call for reform and innovation in math and science education.<sup>33</sup> “Our overall public school system...has shown little sign of improvement, particularly in mathematics and science,” it declared. Meanwhile, “many other nations have been markedly progressing, thereby affecting America’s relative ability to compete effectively for new factories, research laboratories, administrative centers—and jobs. While this progress by other nations is to be both encouraged and welcomed, so too is the notion that Americans wish to continue to be among those peoples who do prosper.” As its frontispiece, the report quotes Nobel Laureate Sir Ernest Rutherford: “Gentlemen, we have run out of money. It is time to start thinking.” We heartily agree. That is the idea that motivates this study.

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**33.** Members of the 2005 “Rising Above the Gathering Storm” Committee (2010)

## APPENDIX A

### U.S. Science and Reading Performance in Comparative Perspective

This report emphasizes math performance because that is the subject most closely correlated with increments in economic productivity and the subject for which common tests can be most readily designed for students coming from different language and cultural backgrounds. Two technical considerations have also dissuaded us from placing much emphasis on differences among nations in the percentage of students performing at the advanced level in science and reading. According to NAEP, only 3 percent of all U.S. students are said to have reached an advanced level of proficiency in these subjects. That should not be interpreted as showing that U.S. students are even more poorly taught in science and reading than in math. Rather, NAGB set the advanced proficiency standard in these two subjects at levels that were so high that only 3 percent of U.S. students could attain them. Any standard set that high isolates such a small percentage of the population that it introduces the possibility of considerable error in measuring cross-country differences. Simply put, the tests may be subject to considerable error when viewed at a cutoff so far from the average performance.

A second consideration arises with respect to the reading estimates. Because PISA was mal-administered within the U.S. in 2006, no PISA results are reported for that year. Thus, we cannot look directly at the Class of 2009 for reading, as we can in the case of math and science. Rather, we have to estimate results for that year by performing a similar analysis for the Class of 2006, with proper adjustments for the Class of 2009. That requires more assumptions than in the math and science analyses (see Appendix B for further methodological details). For those who nonetheless wish to make comparisons in these subject areas, Figures A.1 and A.2 as well as Tables A.1, A.2 and A.3 present results for the science and reading performances of the Class of 2009. The reader is urged to peruse these results cautiously. The only conclusion we are willing to draw is that the U.S. trails many other countries in science and reading as well, although the lag is not as pronounced as in mathematics.

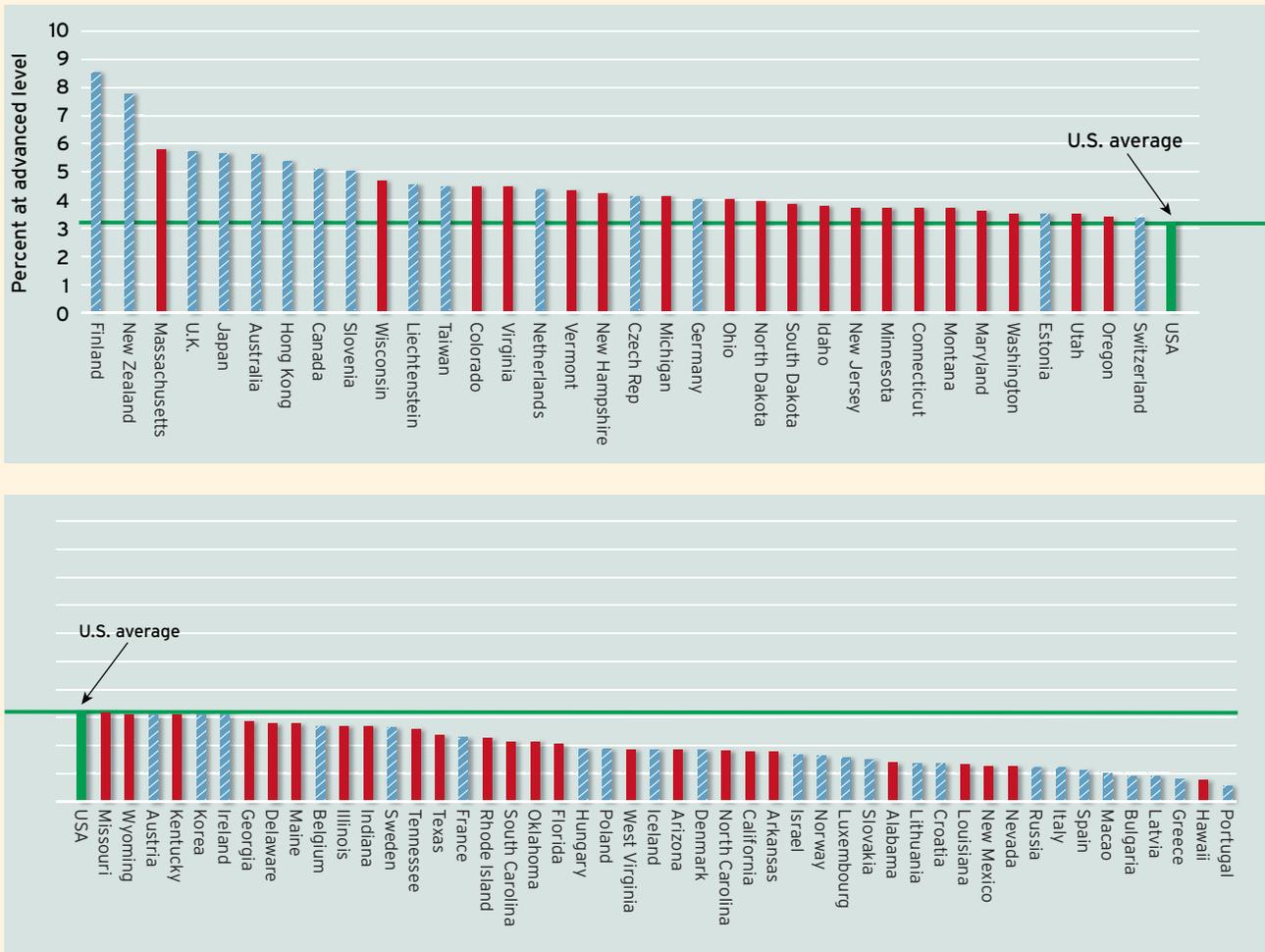
**Table A.1**

Percentage of students in selected urban districts in the United States who are at the advanced level on NAEP 2005

City	Percent advanced in...					
	Math		Science		Reading	
Atlanta	1.3%	(0.4)	0.7%	(0.3)	1.0%	(0.5)
Austin	8.9	(1.2)	3.9	(0.6)	3.1	(0.8)
Boston	6.3	(1.1)	0.6	(0.4)	1.9	(0.7)
Charlotte	8.6	(0.9)	N/A	N/A	3.2	(0.5)
Chicago	1.7	(0.6)	0.7	(0.3)	1.1	(0.3)
Houston	2.2	(0.5)	1.2	(0.3)	1.0	(0.3)
Los Angeles	1.7	(0.4)	0.5	(0.3)	0.8	(0.3)
NYC	4.5	(1.1)	1.6	(0.4)	1.4	(0.4)
San Diego	4.0	(0.7)	1.4	(0.4)	2.0	(0.7)

All numbers are in percentage points. Standard errors in parentheses.

**Class of 2009: Percentage of students at advanced level in science in U.S. states and countries participating in PISA 2006. (Figure A.1)**



Note: Excludes participating countries below 0.5%.

**Class of 2009: Percentage of students at advanced level in reading in U.S. states and countries participating in PISA 2006. (Figure A.2)**



Note: Excludes participating countries below 1%.



*The U.S. trails many other countries in science and reading as well, although the lag is not as pronounced as in mathematics.*

**Table A.2**

Percentage of students who are at the advanced level in all countries participating in PISA 2006

Country	Percent advanced in...		
	Math	Science	Reading
Argentina	0.8% (0.3)	0.1% (0.1)	0.2% (0.1)
Australia	13.6 (0.9)	5.6 (0.5)	3.1 (0.4)
Austria	13.0 (1.1)	3.0 (0.4)	2.7 (0.4)
Azerbaijan	0.6 (0.2)	0.0 (0.0)	0.0 (0.0)
Belgium	19.0 (1.0)	2.7 (0.3)	3.1 (0.3)
Brazil	0.8 (0.3)	0.1 (0.1)	0.3 (0.1)
Bulgaria	2.4 (0.7)	0.9 (0.3)	0.6 (0.2)
Canada	14.7 (1.0)	5.1 (0.4)	5.0 (0.5)
Chile	1.0 (0.3)	0.4 (0.1)	1.0 (0.3)
Colombia	0.3 (0.1)	0.0 (0.0)	0.1 (0.1)
Croatia	3.6 (0.4)	1.3 (0.3)	0.7 (0.1)
Czech Republic	15.7 (1.3)	4.1 (0.5)	3.0 (0.5)
Denmark	11.0 (0.9)	1.8 (0.4)	1.6 (0.4)
Estonia	10.1 (0.8)	3.5 (0.4)	1.0 (0.3)
Finland	20.4 (1.2)	8.5 (0.6)	5.3 (0.6)
France	10.1 (0.8)	2.3 (0.3)	1.6 (0.3)
Germany	13.1 (1.0)	4.0 (0.4)	3.2 (0.4)
Greece	3.9 (0.5)	0.8 (0.2)	0.7 (0.2)
Hong Kong	23.9 (1.2)	5.3 (0.7)	3.0 (0.4)
Hungary	8.6 (0.9)	1.9 (0.5)	0.9 (0.2)
Iceland	10.1 (0.8)	1.8 (0.3)	1.4 (0.2)
Indonesia	0.2 (0.2)	0.0 (0.0)	0.0 (0.0)
Ireland	7.9 (0.7)	2.9 (0.4)	3.7 (0.5)
Israel	4.8 (0.6)	1.6 (0.2)	1.5 (0.2)
Italy	4.9 (0.5)	1.2 (0.2)	1.3 (0.2)
Japan	15.1 (1.2)	5.7 (0.6)	3.1 (0.4)
Jordan	0.2 (0.1)	0.1 (0.1)	0.0 (0.0)
Korea	23.2 (1.7)	3.0 (0.6)	7.6 (1.1)
Kyrgyzstan	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)
Latvia	5.3 (0.6)	0.9 (0.2)	1.1 (0.2)
Liechtenstein	16.1 (1.8)	4.5 (1.2)	3.5 (1.3)
Lithuania	7.2 (1.0)	1.3 (0.3)	0.9 (0.3)
Luxembourg	8.6 (0.6)	1.6 (0.2)	1.2 (0.2)
Macao	14.1 (0.7)	1.0 (0.2)	0.5 (0.1)
Mexico	0.6 (0.2)	0.0 (0.0)	0.1 (0.0)
Montenegro	0.6 (0.2)	0.0 (0.0)	0.1 (0.1)
Netherlands	17.6 (1.1)	4.4 (0.5)	2.2 (0.5)
New Zealand	15.9 (1.0)	7.8 (0.6)	6.2 (0.7)
Norway	8.3 (0.6)	1.6 (0.3)	2.3 (0.3)
Poland	8.5 (0.9)	1.8 (0.4)	3.9 (0.5)
Portugal	4.4 (0.5)	0.5 (0.1)	1.0 (0.2)
Qatar	0.5 (0.1)	0.1 (0.0)	0.2 (0.1)
Romania	0.9 (0.3)	0.0 (0.0)	0.1 (0.1)
Russia	6.0 (0.7)	1.2 (0.2)	0.3 (0.1)
Serbia	2.1 (0.4)	0.1 (0.1)	0.0 (0.0)
Slovakia	8.9 (1.0)	1.5 (0.3)	1.4 (0.3)
Slovenia	11.4 (0.8)	5.0 (0.6)	0.8 (0.2)
Spain	5.7 (0.5)	1.1 (0.2)	0.3 (0.1)
Sweden	10.0 (0.8)	2.6 (0.4)	3.4 (0.4)
Switzerland	19.1 (1.3)	3.3 (0.5)	1.9 (0.3)
Taiwan	28.0 (1.5)	4.4 (0.5)	0.9 (0.2)
Thailand	1.0 (0.2)	0.0 (0.0)	0.0 (0.0)
Tunisia	0.4 (0.2)	0.0 (0.0)	0.0 (0.0)
Turkey	3.6 (1.1)	0.1 (0.1)	0.3 (0.2)
U.K.	9.0 (0.6)	5.7 (0.4)	2.9 (0.3)
U.S.	6.0 (0.7)	3.2 (0.4)	3.0 (0.3)
Uruguay	2.4 (0.4)	0.3 (0.1)	0.9 (0.2)

All numbers are in percentage points. Standard errors in parentheses. U.S. results for Reading are from PISA 2003 as no 2006 results are available (See Appendix B)

Table A.3

Percentage of students in U.S. states who are at the advanced level on NAEP 2005

State	Percent advanced in...								
	Math			Science		Reading			
	All students	White students	Students of a parent with College Education	All students	All students	All students			
Alabama	2.3% (0.6)	3.6% (1.0)	4.6% (1.4)	1.4% (0.4)		1.8% (0.6)			
Alaska	5.8 (0.6)	8.5 (0.9)	N/A N/A	N/A N/A		N/A N/A			
Arizona	4.6 (0.4)	7.6 (0.9)	9.6 (1.0)	1.8 (0.4)		1.6 (0.3)			
Arkansas	3.0 (0.4)	3.8 (0.5)	5.4 (0.8)	1.7 (0.3)		1.7 (0.4)			
California	4.5 (0.4)	7.2 (0.7)	9.5 (0.9)	1.8 (0.2)		1.6 (0.2)			
Colorado	6.3 (0.8)	8.4 (1.0)	11.0 (1.4)	4.4 (0.6)		3.5 (0.5)			
Connecticut	7.8 (0.7)	10.6 (1.0)	12.5 (1.1)	3.7 (0.6)		3.5 (0.8)			
DC (DCPS)	1.8 (0.5)	37.0 (0.9)	4.3 (0.8)	N/A N/A		1.1 (0.3)			
Delaware	5.0 (0.3)	7.1 (5.6)	8.1 (0.7)	2.8 (0.4)		1.7 (0.4)			
Florida	4.6 (0.7)	7.1 (1.0)	8.0 (1.1)	2.0 (0.3)		2.0 (0.3)			
Georgia	4.3 (0.5)	6.3 (0.9)	7.9 (1.1)	2.8 (0.4)		2.5 (0.5)			
Hawaii	2.5 (0.4)	3.4 (1.2)	4.2 (0.8)	0.7 (0.3)		1.2 (0.2)			
Idaho	4.5 (0.6)	5.0 (0.6)	7.3 (1.1)	3.8 (0.5)		2.4 (0.5)			
Illinois	5.4 (0.6)	7.6 (0.9)	9.1 (1.1)	2.6 (0.4)		2.7 (0.6)			
Indiana	5.1 (0.6)	5.9 (0.7)	9.1 (1.1)	2.6 (0.4)		2.2 (0.4)			
Iowa	5.7 (0.6)	6.2 (0.7)	9.0 (1.1)	N/A N/A		2.6 (0.4)			
Kansas	5.2 (0.6)	6.3 (0.7)	8.8 (1.0)	0.0 (0.5)		3.4 (0.4)			
Kentucky	3.4 (0.5)	3.6 (0.6)	6.6 (1.1)	3.0 (0.3)		3.0 (0.5)			
Louisiana	1.7 (0.4)	2.6 (0.7)	3.0 (1.1)	1.3 (0.6)		1.2 (0.4)			
Maine	5.0 (0.5)	5.1 (0.5)	7.4 (0.9)	2.8 (0.6)		3.5 (0.5)			
Maryland	6.8 (0.7)	9.8 (1.1)	11.6 (1.2)	3.6 (0.6)		3.6 (0.5)			
Massachusetts	11.4 (0.8)	12.6 (1.0)	17.1 (1.3)	5.8 (0.6)		5.2 (0.7)			
Michigan	5.5 (0.8)	6.8 (1.2)	8.5 (1.5)	4.1 (0.6)		2.0 (0.5)			
Minnesota	10.8 (0.9)	12.3 (1.1)	15.7 (1.4)	3.7 (0.2)		3.0 (0.5)			
Mississippi	1.3 (0.3)	2.4 (0.7)	2.2 (0.7)	0.7 (0.5)		0.8 (0.3)			
Missouri	4.1 (0.5)	5.0 (0.7)	6.9 (1.0)	3.1 (0.5)		2.6 (0.4)			
Montana	5.6 (0.6)	6.0 (0.7)	8.5 (0.9)	3.7 (0.5)		2.6 (0.6)			
Nebraska	6.0 (0.6)	6.8 (0.7)	9.0 (0.8)	N/A N/A		2.6 (0.4)			
Nevada	3.1 (0.5)	4.6 (0.8)	6.2 (1.2)	1.2 (0.2)		1.4 (0.5)			
New Hampshire	6.5 (0.7)	6.5 (0.7)	10.2 (1.2)	4.2 (0.9)		3.9 (0.5)			
New Jersey	8.7 (1.0)	11.5 (1.4)	12.9 (1.5)	3.7 (0.5)		4.3 (0.6)			
New Mexico	1.4 (0.3)	3.2 (0.7)	2.9 (0.8)	1.2 (0.3)		1.0 (0.2)			
New York	6.3 (0.5)	7.7 (0.8)	10.2 (0.8)	N/A N/A		3.3 (0.5)			
North Carolina	7.1 (0.8)	9.9 (1.1)	12.5 (1.7)	1.8 (0.5)		2.2 (0.4)			
North Dakota	4.8 (0.5)	5.3 (0.6)	6.4 (0.9)	3.9 (0.5)		2.9 (0.6)			
Ohio	6.6 (0.6)	7.6 (0.7)	11.0 (1.1)	4.0 (0.6)		3.7 (0.7)			
Oklahoma	2.4 (0.4)	3.0 (0.5)	4.3 (0.7)	2.1 (0.5)		1.1 (0.4)			
Oregon	7.3 (0.8)	7.9 (0.9)	12.7 (1.3)	3.4 (0.5)		2.6 (0.5)			
Pennsylvania	5.7 (0.8)	6.4 (0.8)	9.6 (1.2)	N/A N/A		3.4 (0.5)			
Rhode Island	3.3 (0.5)	4.2 (0.5)	5.8 (1.0)	2.2 (0.4)		3.1 (0.4)			
South Carolina	6.7 (0.7)	10.8 (1.2)	11.3 (1.2)	2.1 (0.4)		1.9 (0.4)			
South Dakota	6.5 (0.7)	7.3 (0.8)	9.3 (1.0)	3.8 (0.5)		1.9 (0.3)			
Tennessee	2.9 (0.4)	3.7 (0.5)	5.8 (0.9)	2.5 (0.5)		1.4 (0.4)			
Texas	6.2 (0.4)	10.6 (0.7)	11.7 (0.9)	2.3 (0.3)		2.2 (0.3)			
Utah	4.7 (0.6)	5.4 (0.6)	7.5 (0.8)	3.5 (0.5)		2.3 (0.4)			
Vermont	8.8 (0.7)	9.0 (0.7)	14.0 (1.1)	4.3 (0.5)		4.1 (0.4)			
Virginia	7.9 (0.9)	10.3 (1.3)	13.0 (1.5)	4.4 (0.6)		3.3 (0.5)			
Washington	8.7 (0.8)	9.5 (1.1)	14.1 (1.4)	3.5 (0.4)		3.4 (0.4)			
West Virginia	1.4 (0.3)	1.3 (0.3)	3.0 (0.6)	1.8 (0.4)		1.4 (0.3)			
Wisconsin	6.7 (0.7)	7.6 (0.8)	10.8 (1.2)	4.7 (0.5)		3.4 (0.5)			
Wyoming	3.5 (0.4)	3.8 (0.5)	5.3 (0.8)	3.1 (0.4)		2.2 (0.4)			

All numbers are in percentage points. Standard errors in parentheses.

## APPENDIX B

### Methodology for Comparing U.S. States to International Performance

The purpose of our analysis is to estimate the share of students in different countries that reach a competency level equivalent to the percentage of students in the U.S. who performed at the advanced level on NAEP 2005.

For math, we start with the national share of 8th-grade U.S. students who reach the advanced level on NAEP 2005: 6.04 percent. One year later, this will roughly be the cohort of 15-year-olds who participated in PISA 2006. Both tests survey representative samples of the respective national student population. Thus, using the PISA 2006 microdata, we can calculate the PISA math test score at which the 93.96th percentile (100.00-6.04) of the U.S. student population performs. (All PISA calculations use the PISA sampling weights to yield nationally representative estimates.) We do this separately for each of the five plausible values of test performance provided by PISA 2006. Across the five plausible values, the PISA score at which the 93.96th percentile of U.S. students performs is on average 617.1 PISA points.

Next, for each country participating in the PISA 2006 test, we calculate the share of students reaching this cut-off point from the PISA microdata. We do this separately for each plausible value and then take the average of the five estimates. This provides an estimate of the share of students in each PISA country who reach the level equivalent to the advanced level in 8th-grade math on NAEP 2005. The equivalent shares of students who reach the advanced level in 8th-grade math in each U.S. state are taken from NAEP 2005. The same applies for those cities that test representative samples of 8th graders on NAEP 2005.

Issues with the U.S. PISA 2006 test in reading require a slightly expanded procedure. In the 2006 wave of the PISA test, no reading results are available for the U.S. because of an error in printing the test booklets. Some of the reading items had incorrect instructions, and as a consequence the mean performance in reading could not be accurately estimated. However, PISA 2003 reading results for the U.S. are available, and equivalent NAEP proficiency estimates are available for U.S. 8th-graders in the reading component of NAEP 2002. We are thus able to apply the proficiency shares from the NAEP 2002 reading test to the U.S. performance on PISA 2003 in order to calculate the equivalent PISA cut-off scores in reading. Since both tests use the same scales in the two respective waves of the reading test—PISA 2003 and 2006 and NAEP 2002 and 2005—this allows us to again calculate the shares of other countries’

students that reach these cut-off scores in PISA 2006 and compare them to the shares observed in the NAEP 2005 reading test.

Some of the calculated differences in performance may simply reflect sampling uncertainty or measurement error. We therefore calculate whether the observed differences among states and countries are statistically significant (at the 5 percent level). The requisite standard errors are computed using the methodology described in Organization for Economic Co-operation and Development (2009), Chapters 7-9. These standard errors account for both sampling uncertainty (including the two-stage sampling design employed by PISA) and test unreliability (as captured by the five plausible values that represent the underlying probability distribution). NAEP 2007 standard errors are provided from the NAEP website (<http://nces.ed.gov/nationsreportcard/>, accessed August 28, 2010). Tests of significance were not calculated for urban districts or for reading and science test performances.

## APPENDIX C

### Further Reflections on the Phillips Studies

Findings reported two years later by Phillips in his 2009 report do not differ materially from those he presented in 2007, as discussed in the main text of this report. However, in 2009 he introduced a grading system that gave the U.S. and most other countries mediocre grades on the familiar “A” to “F” scale. Although the grading aspect of the report received the most attention,<sup>1</sup> it is arbitrary. More important is the fact that Phillips still found U.S. 8th graders to be performing at a level “not significantly different from the OECD average” and above the level of a “broad cross-section of countries around the world.” The second report was less ebullient than the first, however, because the U.S.—and most other countries—received a grade of “C” or worse.<sup>2</sup>

Phillips also found that individual states do much better vis-à-vis other countries than we report. As can be seen in Figure 1, p.16, we find 44 of the 50 states within the U.S. to be performing below 23 other countries. Meanwhile, Phillips reported that 21 U.S. states were scoring above the average for all OECD countries included in his survey. Moreover, every single state, including Mississippi, the lowest-performing, was scoring above the international average.<sup>3</sup>

U.S. is noticeably different from the set of countries included in the Phillips comparisons. Many OECD countries, including those that had a high percentage of high-achieving students, participated in PISA 2006 (upon which our analysis

1. Cavanagh (2009) Finn (2009).

2. Phillips (2009), p. 2. The tone of the 2009 report differs from the 2007 report, because Phillips gives the United States a mediocre grade of “C,” a grade he gives to the average of all OECD countries. But no particular attention should be given to the specific grades Phillips gives, as all grading schemes are arbitrary. Those familiar with the rampant grade inflation in American higher education know how easily a “C+” grade can inflate to an “A-.” Phillips does the opposite by creating a highly deflationary grading scheme that gives a country an “A” only if the average score of its students is at or above the “advanced” level, which was set at the 94th percentile for all students taking the TIMSS test. This is clearly an extremely high standard, attained by no country in the world. Even Hong Kong, where the average student was more than one standard deviation above the assessment average, only received a B+. In our view, what counts is a country’s level of achievement, not its grade on some arbitrary scale.

3. Phillips (2009), Table 4, pp. 24-25.

4. Provasnik, Gonzales, and Miller (2009), p. 3. The report goes on to say: “One reason for this is that the average student performance in developed countries tends to be higher than in developing countries. As a result, the extent to which developing countries participate in an assessment can affect the international average of participating countries as well as the relative position of one country compared with the others.”

5. Both PISA and TIMSS use a scale that has a midpoint of 500 and a standard deviation of 100, which produces a range of nearly 1000. The midpoint and standard deviation on the PISA refer to student performance for those in OECD countries. On TIMSS they refer to student performance for those in the 45 countries who participated in TIMSS in 1995, each country weighted equally. To link results across time, TIMSS links all tests taken since 1995 to results obtained in that year. In 1995 the average for 7th- and 8th-grade students on the TIMSS was 500 points, with a standard deviation 100 points. That TIMSS norm was based upon results from all countries who participated in TIMSS 1995, including 27 members of the OECD (where Scotland and England are considered separately), and 18 countries that were not members of the OECD, many of them from the developing world. The non-OECD countries that participated in the 1995 TIMSS were Argentina, Bulgaria, Colombia, Cyprus, Hong Kong, Indonesia, Iran, Israel, Kuwait, Latvia, Lithuania, Philippines, Romania, Russia, Singapore, Slovenia, South Africa, and Thailand. Because of this different norming of the tests, equally performing students will have higher scores on TIMSS tests than PISA tests, and so it is not surprising that the United States average on the TIMSS 2007 was 508 points, while its average on PISA 2006 was 474. Many OECD countries decided not to participate in the TIMSS 2003 and TIMSS 2007, while other countries have joined, so the international average fell from 500 points in 1995 to 466 points. Obviously, that should not be taken as evidence that students worldwide are performing at a lower level, but rather that the composition of countries participating in the TIMSS has changed over the years.

is based) but did not participate in either TIMSS 2003 or TIMSS 2007 (the two surveys included in the Phillips studies). In fact, 16 countries that outscored the U.S. on the PISA 2006 test did not participate in TIMSS 2003 (see Table C.1 and C.2). As a report by the U.S. National Center for Education Statistics has explained, “Differences in the set of countries that participate in an assessment can affect how well the U.S. appears to do internationally when results are released.”<sup>4</sup>

Other differences between our study and Phillips’s are less significant. Our attention is focused on the percentage of students who are high achievers, while the focus of the Phillips study is on average student performance. But even if we shift our focus to differences in average performance, the two studies yield dramatically different findings. For example, the average U.S. score of 474 points on PISA 2006 falls well short of the OECD average of 500 points on this test.<sup>5</sup> But on the TIMSS 2007, the U.S. average is 508 points, a score almost equivalent to the OECD average of 511 points. The OECD averages on the TIMSS are misleading, however, as they are based on results from just the 11 OECD countries that participated in TIMSS

**Table C.1**

Countries scoring higher than the United States on PISA 2006 and participation in TIMSS

Countries participating in PISA 2006 whose students had a higher average score than did the United States	PISA Score	Did not participate in TIMSS 2003	Did not participate in TIMSS 2007
Taiwan	549		
Finland	548	●	●
Korea	547		
Hong Kong	547		
Netherlands	531		●
Switzerland	530	●	●
Canada	527	●	●
Macao	525	●	●
Liechtenstein	525	●	●
Japan	523		
New Zealand	522		●
Australia	520		
Belgium	520		●
Estonia	515		●
Denmark	513	●	●
Czech Republic	510	●	
Iceland	506	●	●
Austria	505	●	●
Germany	504	●	●
Slovenia	504		
Sweden	502		
Ireland	501	●	●
France	496	●	●
Poland	495	●	●
U.K.*	495		
Slovakia	492		●
Hungary	491		
Luxembourg	490	●	●
Norway	490		
Latvia	486		●
Lithuania	486		
Spain	480	●	●
Russia	476		
Azerbaijan	476	●	●
U.S.	474		

\*Scotland and England participated separately in TIMSS 2003 and 2007. Wales and Northern Ireland did not participate.

2007. As stated above, the other 19 OECD countries, many of them the high-scoring countries, did not participate in this assessment. Phillips also compares states to an international average that includes the scores from all 48 countries that participated in TIMSS 2007. That average of 461 is well below the U.S. score, but, of course, it

includes many developing countries.<sup>6</sup> In contrast, the official international average for PISA is based strictly on the average for all countries that are members of the OECD.

In his 2009 study, Phillips indicates a preference for the TIMSS 2007 over PISA 2006, because TIMSS 2007 was administered to 8th graders in the same year as NAEP 2007, while PISA 2006 was administered to 15-year-olds one year after NAEP 2005 was administered to 8th graders. Theoretically, the administration of the two tests to the same grade levels in the same year is an advantage when making international comparisons. But, practically speaking, that advantage is relatively minor. Phillips himself gets much the same results regardless of whether he compares NAEP 2007 results to TIMSS 2003 (as he did in his 2007 report) or to TIMSS 2007 (as he did in his 2009 report).

Finally, Phillips suggests that PISA 2006 tests math “literacy” while TIMSS 2007 assesses math “proficiency” with a test that is more closely aligned to the curriculum offered by the U.S. But just as the words literacy and proficiency are virtually inter-changeable, the two tests are more alike than they are different. As Phillips himself demonstrates, the correlation between average student performances across countries on the PISA 2006 and TIMSS 2007 is 0.93.<sup>7</sup> When two indicators of student performance yield such similar results, one generally assumes them to be different measures of the same thing. Random differences in sampling and item construction can easily account for any observed differences in results.

In sum, the major difference between this study and the Phillips reports is the countries with which the U.S. is being compared. We include in our comparison all countries of the OECD, many of them among the highest-achieving countries, while Phillips has included in his comparisons only 11 of those countries.

**Table C.2**

Countries participating in TIMSS but not PISA 2006

TIMSS 2003 Participants with a higher score than the U.S.	TIMSS 2003 Score
<i>Singapore</i>	605
<i>Korea</i>	589
<i>Hong Kong</i>	586
<i>Taiwan</i>	585
<i>Japan</i>	570
<i>Belgium-Flemish</i>	537
<i>Netherlands</i>	536
<i>Estonia</i>	531
<i>Hungary</i>	529
<i>Malaysia</i>	508
<i>Latvia</i>	508
<i>Russia</i>	508
<i>Slovakia</i>	508
<i>Australia</i>	505
<i>U.S.</i>	504

TIMSS 2007 Participants with a higher score than the U.S.	TIMSS 2007 Score
<i>Taiwan</i>	598
<i>Korea</i>	597
<i>Singapore</i>	593
<i>Hong Kong</i>	572
<i>Japan</i>	570
<i>Hungary</i>	517
<i>England</i>	513
<i>Russia</i>	512
<i>U.S.</i>	508

Note: Countries in italic did not participate in PISA 2006.

6. Phillips (2009), p. 18.

7. Phillips (2009), p. 36.

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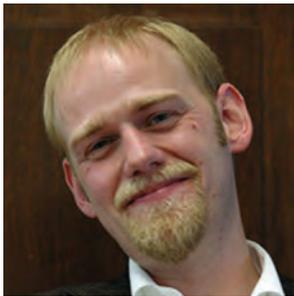
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