Research

A Recipe for Prosperity: The Quality of Educational Standards and Economic Growth

CHAD MILLER, BEN GITIS, CURTIS ARNDT | APRIL 27, 2016

EXECUTIVE SUMMARY

Educational attainment and economic success are closely related for individuals. Is the same true for economies as a whole? This paper examines the links between state education standards and states' long-term economic growth. Specifically, we examine state education standards and educational achievement (as measured by a state's average National Assessment of Educational Progress (NAEP) test score). We find that had average NAEP math test scores been 10 percent higher in 2003, then by 2013 the United States would have benefited from:

- Greater educational attainment– 14.6 million more adults with a high school degree and 10.3 million more with a bachelor's degree,
- Greater economic performance – 12.4 million additional jobs and $1.27 trillion in additional economic growth, and
- Additional resources that help to offset any new budget costs – $94.7 billion in additional state tax revenue nationwide – 4.6 times the size of average operating expenditures in each state.

INTRODUCTION

Policymakers and pundits from both sides of the aisle have long agreed that the U.S. education system is in need of a serious tune up. Many believe that today's students will lack the skills to compete in the global economy as many labor intensive jobs move overseas or are replaced by advancing technology. A number of education advocates urge it is essential to improve state educational standards in order to increase the educational achievement of our students. But, what exactly would be the economic benefits of improving standards and student achievement? In this paper we seek to answer this question by analyzing the relationship between average student achievement in every state and long-term economic growth, job growth, educational attainment, and state tax revenue.

STATE EDUCATION STANDARDS AND MEASURING THEIR QUALITY

Perhaps the most effective way to improve the quality of our students' education is to utilize educational standards. Educational standards are written descriptions of what students are expected to know and be able to do at a specific stage of their education.

After the 2001 passage of the No Child Left Behind (NCLB) Act, states were required to use standardized assessments based off of their educational standards to evaluate academic achievement – a common measure of quality. The law allowed each state to adopt standards of their own design, and by 2003 the standards were as varied as the individual states when it came to rigor. Because of this, the differences in state education standards have been difficult to compare, as the law also afforded states the flexibility to adopt the assessment of their choosing and define the benchmark of proficiency. Moreover, the results from state assessments often mislead the public as the proficiency levels reported by the states conflicted with other national measurements. This inability to measure the quality of standards across states gave rise to the Common Core State Standards (CCSS) initiative and its rapid adoption in a majority of the states.

A state-led effort, the CCSS were drafted by experts and teachers from across the country and provided policymakers and researchers the commonality needed to compare quality across states. To date, forty-six states [i], the District of Columbia, four territories, and the Department of Defense Education Activity (DoDEA) have adopted CCSS. However, the widespread adoption hardly settles the debate. Since 2011, legislatures in 32 states have introduced bills to repeal the standards but only three states (Indiana, Oklahoma, and South Carolina) have voted to repeal. Of those states, only Oklahoma put in place standards that were dramatically different than the Common Core. Still, supporters of CCSS advocate fervently for the successful implementation of the standards that have been shown to be more rigorous and better prepares student.

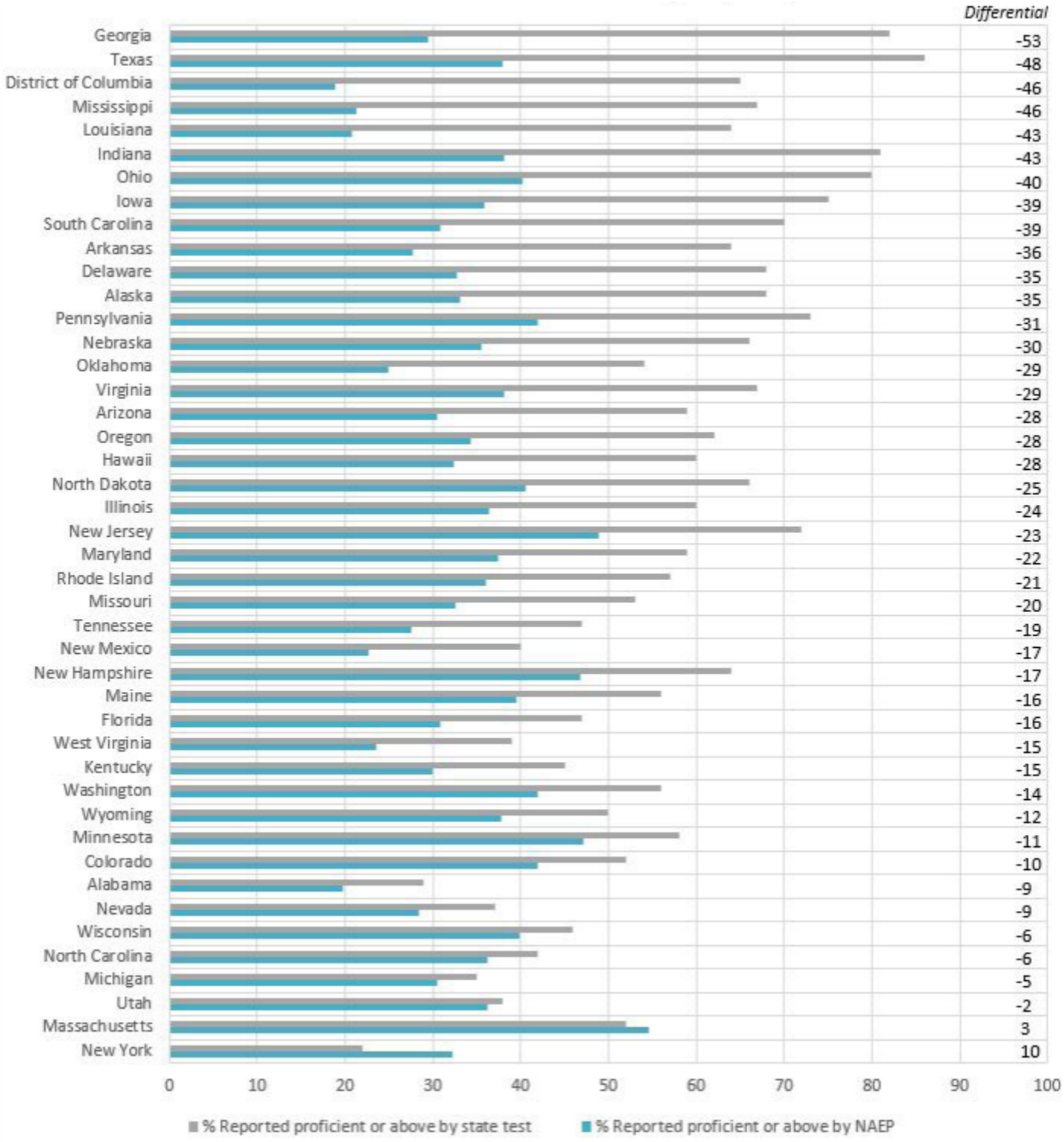
Unfortunately, prior to 2015, the use of common assessments by a majority of Common Core states had not been implemented. Thus, to analyze the long-term relationship between standards and economic outcomes, a proxy measurement for the quality of educational standards was needed. So to measure educational quality, American Action Forum (AAF), like most other researchers, turned to NAEP.

NAEP Reveals Educational Quality

Governed by the Institute of Education Sciences (IES), NAEP is considered the most reliable measure of state educational quality in the United States. It is the leading national measure that reports on the academic achievement of students in grades four, eight and twelve in subjects such as mathematics, reading, and writing. [ii]

Dating as far back as 2003, researchers have also used NAEP scores to gauge the rigor of state educational standards. In fact, using NAEP researchers have found evidence of what advocates today call “the honesty gap.” The honesty gap (or proficiency gap) illustrates the difference between proficiency levels reported by NAEP assessments and proficiency levels reported by individual state assessments. This suggests that individual state assessments may not be reliable measures of educational quality. For instance, Achieve, an education reform organization dedicated to working with states to raise education standards, found that a majority of states’ demonstrated significant discrepancies between state test results and NAEP results (see figure below). The large discrepancy between NAEP proficiency and state reported proficiency emphasizes the need for a common assessment on the national level to provide better comparison and accountability among the states.

Figure 1. Proficient vs. Prepared: Disparities Between State Tests and the 2013 NAEP[iii]



Source: Achieve

These findings are similar to those presented by the National Center for Education Statistics in their report, "Mapping State Proficiency Standards onto NAEP Scales."[iv] The data generally indicate that using NAEP as a common yardstick provides the best context for understanding the rigor of education standards.

PREVIOUS LITERATURE ON EDUCATIONAL ACHIEVEMENT AND ECONOMIC GROWTH

Eric Hanushek, a Stanford University economist and AAF Education Expert, has long researched the relationship educational achievement and economic growth. In Hanushek & Woessmann (2011), the authors analyzed how average test scores in the Programme for International Student Assessment (PISA) related to long-run economic growth among countries in the Organization for Economic Co-operation and Development (OECD). They found statistically significant evidence that a one standard deviation increase in the average PISA test score was associated with a 1.86 percentage point increase in the average annual economic growth rate over a 40-year time period.[v]

More recently, Hanushek, Ruhose, & Woessmann (2015) applied a similar methodology to assess the relationship between NAEP test scores among the 50 U.S. states and long-run economic growth. They found that from 1970 to 2010 a one standard deviation increase in NAEP scores was associated with a 1.4 percentage point increase in the average annual economic growth rate.[vi]

METHODOLOGY

In this paper, we base our analysis on the methods employed in Hanushek & Woessmann (2011) and Hanushek, Ruhose, & Woessmann (2015) to examine the relationship between educational achievement and long-run economic growth among the 50 U.S. states. Specifically, we estimate the relationship between state average 8th grade NAEP scores in 2003 and average economic growth rates, job growth rates, and educational attainment over the following 10 years. We also analyze how the change in economic growth impacts state tax revenue.

Data and Empirical Models

In the following, we perform four different analyses. In the first three, we examine the long-term impact of educational achievement (measured by average NAEP test scores) on economic growth, job growth, and educational attainment. In the fourth analysis, we examine how the changes in economic growth resulting from higher NAEP scores impacts state budget outlooks. To accomplish this, we analyze the relationship between state economic growth and state tax revenue.

To measure the impact of educational achievement on economic growth, job growth, and educational attainment, we use variations of the same regression model. Our observations consist of all 50 states and we use state average 8th grade math and reading NAEP test scores to measure average state educational achievement.[vii] We then run a series of regressions to estimate the relationship between a state's average 8th grade NAEP scores in 2003 and average economic growth, job growth, and educational attainment over the following decade, 2003 to 2013. We examine this time period in particular because it is the most recent decade in which all the economic data necessary for this analysis are available.[viii]

To analyze the impact of 2003 NAEP scores on economic growth, we estimate the relationship between 2003 average NAEP scores and compounded annual real Gross Domestic Product (GDP) growth rate from 2003 to 2013 in each state.[ix] Likewise, for jobs, we estimate the relationship between 2003 average NAEP scores and compounded annual job growth rate from 2003 to 2013 in each state.[x] Finally, for educational attainment, we estimate the relationship between 2003 test scores and the average percent of the state population 25 and older

with at least a high school degree and the average percent with at least a bachelor's degree.[xi], [xii]

In each of these long-run models, we control for several other state level variables that may influence economic growth, job growth, and how many people attain a high school or bachelor's degree. These control variables include the state population in 2003,[xiii] initial real GDP level in 2003,[xiv] local and state government spending as a percent of GDP in 2002,[xv], [xvi] the average Freddie Mac home price index over the ten-year time period, [xvii] and the percent of the population 25 and older in 2003 with at least a bachelor's degree.[xviii] We included the Freddie Mac home price index in order to account for the effect of the Great Recession, which took place from 2007 to 2009 and significantly lowered home prices during the time period we are analyzing. It should also be noted that in the educational attainment regression (the third regression model), we excluded our educational attainment control variable (percent of the population 25 and older in 2003 with a bachelor's degree).[xix]

In our fourth analysis, to analyze the impact of higher NAEP scores on state budget outlooks, we estimate the association between real GDP and state tax revenue. We accomplish this by performing a simple fixed effects regression that measures the relationship between the log of real GDP and log of state tax revenue from 2003 to 2013. State tax revenue data came from the Census Bureau[xx] and real GDP was from the Bureau of Economic Analysis.[xxi] The regression contains both state and year effects. The use of state effects controls for characteristics that vary across states, but not over time, and the use of year effects controls for factors that vary over time, but not by state. The year effects help account for macroeconomic forces during this period, such as the loss in employment and state revenue due to the Great Recession. Finally, any fixed effects model can face the problem of autocorrelation, in which a variable is correlated with itself over time and biases the results. Our model addresses this issue by using heteroscedasticity- and autocorrelation-consistent standard errors.

RESULTS

We find consistent evidence that improved state education standards and higher NAEP scores are associated with substantially faster economic growth, more rapid job growth, and a population with much higher educational attainment. The faster economic growth also leads to higher state tax revenue.

Economic Growth

As shown in Table 1, we find that higher NAEP math scores were significantly associated with accelerated economic growth.

Table 1: Impact of NAEP Scores on Economic Growth†

Test	Real GDP Growth Rate
Math	0.8*
Reading	0.5

*Significant at the 10% level

†Impact of a 10 percent increase in state average test scores on real GDP growth rate

We find that a 10 percent increase in average 8th grade NAEP math scores in 2003 was statistically significantly associated with a 0.8 percentage point increase in the state's real GDP annual growth rate. To put this in perspective, from 2003 to 2013 the average state annual real GDP growth rate was only 1.5 percent. If average

state NAEP scores in 2003 increased 10 percent, however, the average state annual real GDP growth rate would have jumped to 2.3 percent.

Our regression model does not find statistically significant evidence that increases in 8th grade NAEP reading scores in 2003 were associated with higher economic growth. Nevertheless, it is important to note that the model does yield a positive relationship between reading scores and growth. In particular, a 10 percent increase in reading scores in 2003 was associated with a 0.5 percentage point increase in the long-term real GDP growth rate.

The results indicate that the increase in state real GDP growth rates from higher test scores in 2003 would have amounted to substantial economic gains during the following decade. Table 2 illustrates the results' implications for economic growth in each state.

Table 2: Additional Economic Growth from a 10 Percent Increase in NAEP Math Scores by State

State	Increase in Real GDP (2003-2013) ($ Billions)		
U.S. Total	**$1,266.6**	***Continued***	
Alabama	$14.9	Montana	$3.3
Alaska	$4.1	Nebraska	$7.6
Arizona	$21.8	Nevada	$9.6
Arkansas	$9.2	New Hampshire	$5.4
California	$170.8	New Jersey	$39.1
Colorado	$21.8	New Mexico	$7.2
Connecticut	$19.6	New York	$106.6
Delaware	$4.6	North Carolina	$35.9
Florida	$63.3	North Dakota	$3.6
Georgia	$33.6	Ohio	$41.5
Hawaii	$5.7	Oklahoma	$13.5
Idaho	$4.5	Oregon	$16.0
Illinois	$57.3	Pennsylvania	$50.9
Indiana	$24.6	Rhode Island	$4.3
Iowa	$11.6	South Carolina	$13.6
Kansas	$11.3	South Dakota	$3.2
Kentucky	$13.4	Tennessee	$23.3
Louisiana	$16.6	Texas	$113.3
Maine	$4.1	Utah	$10.6

Maryland	$25.6	Vermont	$2.3
Massachusetts	$34.3	Virginia	$35.7
Michigan	$32.5	Washington	$30.6
Minnesota	$24.7	West Virginia	$5.2
Mississippi	$8.0	Wisconsin	$22.0
Missouri	$21.5	Wyoming	$2.9

If every U.S. state in the country had increased its average NAEP math scores by 10 percent in 2003, the additional economic growth in all 50 states over the next decade would have totaled $1.27 trillion. To put this in perspective, U.S. real GDP shrank by $636.2 billion during the Great Recession. The additional $1.27 trillion from a 10 percent increase in NAEP scores would have been almost double the size of the economic decline we experienced during the worst recession since the Great Depression.

Each state's real GDP would have grown an additional $25.3 billion on average. The economic gains from higher educational achievement in math range from $2.3 billion in Vermont to $170.8 billion in California.

Job Growth

The results also indicate that an increase in NAEP scores in 2003 was positively associated with more rapid job growth from 2003 to 2013. This finding is shown in Table 3.

Table 3: Impact of NAEP Scores on Job Growth†

Test	Job Growth Rate
Math	0.9*
Reading	0.2

*Significant at the 10% level

†Impact of a 10 percent increase in state average test scores on job growth rate.

We find that a 10 percent increase in average 8th grade NAEP math scores in 2003 was statistically significantly associated with a 0.9 percentage point increase in the state's annual job growth rate. To put this in perspective, from 2003 to 2013 the average state annual job growth rate was only 0.5 percent. If average state NAEP math scores in 2003 increased 10 percent, however, the average state annual job growth rate would have jumped to 1.4 percent.

Just like for economic growth, the regression model does not find statistically significant evidence that increases in 8th grade NAEP reading scores in 2003 were associated with higher job growth rates. Nevertheless, it is important to note that the model does yield a positive relationship between reading scores and growth. In particular, a 10 percent increase in reading scores in 2003 was associated with a 0.2 percentage point increase in the long-term job growth rate.

The results also indicate that the increase in job growth rates from higher math test scores in 2003 would have amounted in a massive increase in employment during the decade. Table 4 illustrates the results' implications for job growth in each state.

Table 4: Additional Jobs from a 10 Percent Increase in NAEP Math Scores by State

State	Added Jobs (2003-2013) (Thousands)		
U.S. Total	**12,426.9**	***Continued***	
Alabama	172.7	Montana	40.5
Alaska	30.4	Nebraska	86.9
Arizona	231.0	Nevada	107.9
Arkansas	107.1	New Hampshire	57.9
California	1,435.9	New Jersey	357.8
Colorado	216.7	New Mexico	73.8
Connecticut	153.6	New York	809.5
Delaware	38.7	North Carolina	370.0
Florida	702.1	North Dakota	38.8
Georgia	365.9	Ohio	480.6
Hawaii	57.5	Oklahoma	144.8
Idaho	58.5	Oregon	156.2
Illinois	533.2	Pennsylvania	523.4
Indiana	266.8	Rhode Island	42.9
Iowa	139.3	South Carolina	172.3
Kansas	124.8	South Dakota	37.5
Kentucky	166.2	Tennessee	251.6
Louisiana	177.1	Texas	1,014.8
Maine	55.0	Utah	115.3
Maryland	236.3	Vermont	28.2
Massachusetts	307.4	Virginia	338.9
Michigan	379.5	Washington	274.3
Minnesota	251.2	West Virginia	65.7
Mississippi	102.5	Wisconsin	254.8
Missouri	247.0	Wyoming	25.8

If every U.S. state in the country had increased its average NAEP math scores by 10 percent in 2003, there

would have been an additional 12.4 million jobs in all 50 states by 2013. To put this in perspective, nonfarm employment declined by 8.7 million during the Great Recession. The additional 12.4 million jobs from a 10 percent increase in NAEP scores would have more than offset the job losses experienced during the economic decline.

Employment in each state would have increased by 248,500 on average. The job gains from higher educational achievement in math range from 25,800 in Wyoming to 1.4 million in California.

Educational Attainment

We also find that an increase in student achievement was associated with higher educational attainment. As shown in Table 5, both 8th grade math and reading scores in 2003 were significantly associated with higher levels of high school degree and bachelor's degree holders from 2003 to 2013.

Table 5: Impact of NAEP Scores on Educational Attainment†

Test	High School Degree	Bachelor's Degree
Math	7.1*	5.0*
Reading	8.5*	6.9*

*Significant at the 1% level

†Impact of a 10 percent increase in state average test scores on educational attainment

We find that a 10 percent increase in math scores was associated with a 7.1 percentage point increase in the percent of the population 25 and older with at least a high school degree and a 5.0 percentage point increase in the percent with at least a bachelor's degree. To put this in perspective, from 2003 to 2013 in the average state, 86.7 percent of the 25 and older population had at least a high school degree and 27.6 percent had at least a bachelor's degree. With a 10 percent increase in 8th grade math scores in 2003, the percent with at least a high school degree would have increased to 93.8 percent and the percent with a bachelor's degree would have increased to 32.6 percent. This translates to a substantial number of additional high school and college graduates. If every state increased its average NAEP math score by 10 percent in 2003, by 2013 there would have been 14.6 million more adults with a high school degree and 10.3 million more with a bachelor's degree.

Likewise, we find that a 10 percent increase in reading scores was associated with an 8.5 percentage point increase in the percent of the population 25 and older with at least a high school degree and a 6.9 percentage point increase in the percent with at least a bachelor's degree. This means that a 10 percent increase in reading scores for the average state would have increased the percent of the population 25 and older with at least a high school degree from 86.7 percent to 95.2 percent and the percent with at least a bachelor's degree from 27.6 percent to 34.5 percent. Again, this translates to a large number of additional high school and college graduates. If every state increased its average NAEP math score by 10 percent in 2003, by 2013 there would have been 17.5 million more adults with a high school degree and 14.2 million more with a bachelor's degree.

Economic Growth and State Tax Revenue

We find that economic growth is positively associated with higher state tax revenue. This is illustrated in Table 6.

Table 6: Impact of Real GDP Growth on State Tax Revenue	
Growth	**State Tax Revenue**
Real GDP	1.5%*
*Significant at the 1% Level	

A 1 percent increase in the real GDP is associated with a 1.5 percent increase in state tax revenue. Moreover, our earlier results indicated that a 10 percent increase in NAEP math scores was associated with a 0.8 percentage point increase in real GDP growth rate. When combining these two results, we find that a 10 percent increase in NAEP math test scores is associated with a 1.2 percent increase in state tax revenue.

Table 7 illustrates the additional tax revenue that would result in each state if their 8th grade NAEP math scores rose by 10 percent in 2003.

Table 7: Additional Tax Revenue from 10 Percent Increase in NAEP Scores by State			
State	Additional State Tax Revenue (2003-2013) ($ Millions)		
U.S. Total	**$94,714.40**	***Continued***	
Alabama	$1,095.30	Montana	$286.00
Alaska	$556.70	Nebraska	$530.40
Arizona	$1,568.80	Nevada	$775.80
Arkansas	$947.90	New Hampshire	$283.90
California	$14,178.60	New Jersey	$3,457.70
Colorado	$1,162.40	New Mexico	$626.80
Connecticut	$1,685.20	New York	$7,996.80
Delaware	$371.90	North Carolina	$2,737.10
Florida	$4,433.40	North Dakota	$334.00
Georgia	$2,385.80	Ohio	$3,240.90
Hawaii	$635.80	Oklahoma	$1,010.20
Idaho	$414.80	Oregon	$980.20
Illinois	$3,854.30	Pennsylvania	$3,924.60
Indiana	$1,868.50	Rhode Island	$350.60
Iowa	$871.80	South Carolina	$1,015.70
Kansas	$854.70	South Dakota	$168.60
Kentucky	$1,274.80	Tennessee	$1,420.50

Louisiana	$1,218.30	Texas	$5,273.70
Maine	$459.10	Utah	$705.20
Maryland	$1,963.20	Vermont	$316.80
Massachusetts	$2,652.70	Virginia	$2,220.10
Michigan	$3,104.40	Washington	$2,158.10
Minnesota	$2,313.30	West Virginia	$613.70
Mississippi	$820.60	Wisconsin	$1,891.40
Missouri	$1,332.50	Wyoming	$370.80

If every state were able to increase the average NAEP math scores by 10 percent in 2003, state revenue from 2003 to 2013 would have increased by $94.7 billion nationwide. States would average an additional $1.9 billion in tax revenue and the extra revenue would have ranged from $168.6 million in South Dakota to $14.2 billion in California.

For perspective, operating expenditures in each state averaged $20.4 billion in 2013. This means that the $94.7 billion in additional revenue would have been 4.6 times larger than average state operating expenditures. Moreover, the $94.7 billion in additional revenue would have covered the combined operating expenditures in the 17 states with the smallest operating budgets in 2013: Alaska, Delaware, Hawaii, Idaho, Kansas, Maine, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Rhode Island, South Dakota, Vermont, West Virginia, and Wyoming.

CONCLUSION

To advocate for more rigorous educational standards, education reformers argue that stronger standards are needed for students to compete in the global economy.

In this paper, we find evidence that demonstrates the direct effects of quality educational standards on a state's economy. Using NAEP results as a proxy for the quality of educational standards, our findings indicate that improving standards results in increased GDP growth, job growth, educational attainment, and state tax revenue. These results indicate that improving the quality of our educational systems could be among the most effective ways to increase worker skills and grow the economy.

[i] 45 states adopted both ELA and math standards. The 46th state, Minnesota, only adopted ELA.

Source for repeal bills: http://www.ccrslegislation.info/CCR-State-Policy-Resources/common-core-status-map

[ii] National Assessment Governing Board https://www.nagb.org/naep/what-naep.html

[iii] Achieve,. 'Proficient Vs. Prepared: Disparities Between State Tests And The 2013 National Assessment Of Educational Progress (NAEP)'. N.p., 2015. Web. 12 Oct. 2015.

[iv] Bandeira de Mello, V., Bohrnstedt, G., Blankenship, C., and Sherman, D. (2015). Mapping State Proficiency Standards Onto NAEP Scales: Results From the 2013 NAEP Reading and Mathematics Assessments (NCES 2015-046). U.S. Department of Education, Washington, DC: National Center for Education Statistics. Retrieved [date] from http://nces.ed.gov/pubsearch.

[v] Eric A. Hanushek & Ludger Woessmann, "How much do educational outcomes matter in OECD countries?" Economic Policy, July 2011, pp. 427-491, http://hanushek.stanford.edu/publications/how-much-do-educational-outcomes-matter-oecd-countries

[vi] Eric A. Hanushek, Jens Ruhose, & Ludger Woessmann, "Economic Gains for U.S. States from Educational Reform," Working Paper, National Bureau of Economic Research, December 2015, http://www.nber.org/papers/w21770?utm_campaign=ntw&utm_medium=email&utm_source=ntw

[vii] Data generated from NAEP Data Explorer, National Center for Education Statistics, https://nces.ed.gov/nationsreportcard/naepdata/dataset.aspx

[viii] Specifically, state tax revenue data are only available through 2013 and educational attainment data are only available through 2014.

[ix] Bureau of Economic Analysis, Interactive Tables, http://bea.gov/itable/index.cfm

[x] Employment data come from Bureau of Labor Statistics, Quarterly Census of Employment and Wages, http://www.bls.gov/data/

[xi] For years 2003 and 2004, we used statewide education estimates from the Current Population Survey, which are made available at the Census Bureau, http://www.census.gov/hhes/socdemo/education/data/cps/index.html

[xii] For 2005 to 2013, we used estimates from the Census Bureau's American Community Survey, obtained from the Census Bureau's American Fact Finder, http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_05_EST_S1501&prodType=tabl

[xiii] Census Bureau, http://www.census.gov/

[xiv] Bureau of Economic Analysis, Interactive Tables, http://bea.gov/itable/index.cfm

[xv] State & Local Government Finances, Census Bureau, https://www.census.gov/govs/local/

[xvi] 2003 local and state government finance data unavailable for 2003.

[xvii] House Price Index Archive, Freddie Mac, http://www.freddiemac.com/finance/fmhpi/archive.html

[xviii] 2003 statewide education estimates are from the Current Population Survey, which are made available at the Census Bureau, http://www.census.gov/hhes/socdemo/education/data/cps/index.html

[xix] All independent variables (NAEP scores, population, initial real GDP, Freddie Mac home price index, and local and state government spending as percent of GDP) are in logs except for the average percent of the

population with at least a high school degree and the average percent with at least a bachelor's degree.

[xx] State Government Finances, Census Bureau, http://www.census.gov/govs/state/

[xxi] Bureau of Economic Analysis, Interactive Tables, http://bea.gov/itable/