SHOW-ME INSTITUTE

WHERE LIBERTY COMES FIRST

ESSAY

JUNE 2014

ARE EDUCATION AND ECONOMIC GROWTH RELATED? SOME EVIDENCE FROM THE STATES

By R.W. Hafer

"*Without education, you are not going anywhere in this world."*

--Malcolm X

"Our progress as a nation can be no swifter than our progress in education."

--John F. Kennedy

INTRODUCTION

The above quotes encapsulate the important role that education plays in determining economic success. At the individual level, it seems common sense that the more educated someone is, the greater the chances that they will have relatively higher incomes. And the data support this: On average, someone with a college degree probably will experience a higher lifetime stream of earnings than someone who only graduates from high school.[1] What we see at the individual level also holds true at the national level. Studies have found that countries with higher levels of education, measured various ways, tend to be countries that experience faster economic growth and achieve higher standards of living.

This common-sense view explains why there is so much angst accompanying the release of the perennial report showing that the United States is not among the elite when it comes to educational attainment. The 2013 results from standardized tests measuring 15-year-old students' ability in math, science, and reading pushed the United States outside of the

A task force comparing education policies in the United States and other countries warns that "The United States' failure to educate its students leaves them unprepared to compete and threatens the country's ability to thrive in a global economy."

top 20 countries.[2] The worry is that, if a country's future economic growth and its standard of living are positively related to the educational attainment of its children, continued erosion in the relative cognitive ability for U.S. students forewarns a diminished standard of living of U.S. residents. A task force comparing education policies in the United States and other countries warns that, "The United States' failure to educate its students leaves them unprepared to compete and threatens the country's ability to thrive in a global economy."[3]

Should we be concerned only about education and economic growth at the national level? What about educational attainment at the state level and its effect on state-level economic growth? In this essay we use state-level data to answer the question "Are states with better education outcomes also the states that tend to grow faster?"

Missouri Gov. Jay Nixon had it correct when he declared in his 2014 State of the State address that "We've got to believe in education so much that we commit to making it better." If there is a positive relationship between state-level education and economic growth, the policy debate about how and why we should improve educational outcomes in Missouri takes on an even greater importance.

WHAT *IS* ECONOMIC GROWTH?

This question may seem trivial but it is important because it establishes a common ground. The traditional definition that economists favor is that economic growth is *a sustained increase in real income per person over time*. This definition means that we are concerned with how the economy expands over time, not year to year. Just like individuals, economies experience transitory fluctuations in their income and output. For example, during recessions, overall real income and output per person declines. By measuring economic growth over time, we smooth out the temporary setbacks and advances in income and output and are able to focus on long-term trends.

What we are measuring over time is some measure of income or output, such as Gross Domestic Product (GDP), adjusted for changes in prices and population.[4] Accounting for price-level changes allows us to focus on goods and services being produced, not on how much they cost. Think of it this way: If your income doubled but the price of everything else also doubled, you are no better off. Real output (and real income) accounts for such price changes. And it is equally important to account for the size of the population when comparing output growth across states. Adjusting for population — GDP per capita — is a rough way to measure the average individual's share of the total economic pie.[5] These adjustments mean that a higher level of real GDP per capita in 2014 than in 2000 signals that the citizens are better off today than they were a decade ago.[6]

WHAT CAUSES ECONOMIC GROWTH?[7]

Producing something, whether it is a computer, a mown lawn, or a haircut, occurs when we combine human labor, machinery (capital), and knowledge. When you buy breakfast from the local fast-food restaurant, you experience the interplay between these factors at work: Someone takes your order, which is relayed via computer to the cooking station, where another person prepares your order using his or her knowledge of food preparation acquired through training in addition to the available capital of ovens, heating trays, etc. The simple task of getting breakfast actually is a well-choreographed dance between humans and machines, between labor and capital.

Our everyday experiences teach us that capital and labor are combined to produce goods and services. In the fast food restaurant, more and better machines — ovens with precise timers and more predictable temperature control, and computers that keep better sales records, etc. — make workers more productive. We also know from our experiences that adding more and more machinery tends to increase worker output. But there is a limit to this process. While adding more capital may increase output of the existing workers, it is subject to diminishing returns.

To see this, suppose there are three line cooks working with three ovens at our fast-food restaurant. Add another oven and the number of meals produced will increase. For example, suppose adding a fourth oven increases output from the three cooks by 10 meals an hour. Adding a fifth, or sixth, or seventh oven may yield additional meals produced per hour, but the additional number of meals is lower for each extra oven. This is because, given the number of cooks, each oven gets used less and less efficiently. The fifth oven may increase meal output by seven, the sixth oven by five, and so on. The idea of diminishing returns to capital simply means that adding more and more machines to an existing labor force is not an explanation for *persistent* increases in the output of goods and services.

Labor also is subject to diminishing returns. Adding more and more workers to a given stock of capital — adding more line cooks to a given number of ovens — may increase output, but diminishing returns set in and the increase per additional worker gets smaller and smaller. So labor is not an explanation for long-term economic growth either.

If capital and labor cannot explain persistent increases in output, what does? After accounting for the roles that capital and labor play, economists have focused their attention on human capital. That is, the skills and knowledge that labor possesses. In this context, human capital — what we will here define as *knowledge* — may be the engine of economic growth.[8]

Why does knowledge deserve such a starring role in the story of economic growth? In the above set-up, we assumed that knowledge was given: That the workers at the fast-food restaurant making

Missouri Gov. Jay Nixon had it correct when he declared in his 2014 State of the State address that "We've got to believe in education so much that we commit to making it better."

If there is a positive relationship between state-level education and economic growth, the policy debate over how and why we should improve educational outcomes in Missouri takes on an even greater importance.

breakfast know how to produce the breakfast you ordered; that the most modern production processes were established and being used; that state-of-the-art technology was embedded in the stock of capital. But what if we increase "knowledge" in the workplace by giving the workers more innovative ways of producing that breakfast using the same inputs? This may be as simple as making sure all employees can read and write. Or, perhaps we simply rearrange the kitchen to allow for greater efficiency: no one runs into each other. We could accomplish this outcome by introducing a new production technology that better transmits information from those taking orders to those cooking the meals. Such changes lead to the existing work force making more productive use of existing capital. In other words, improved knowledge, whether through workers' improved skills or improvements in production processes, increases worker productivity.[9] And, as research shows, such advances in "knowledge" are directly associated with educational attainment.

Isn't educational attainment subject to diminishing returns just like capital and labor? The answer to that question appears to be no. Economics predicts that raising the knowledge of the workers (and individuals in general) in an economy leads to higher levels of output and economic growth, *given capital and labor*. The preponderance of evidence supports this prediction. Early work by Barro (1991) and Mankiw, Romer, and Weil (1992) found that, after controlling for the amount of capital and the number of workers in a country, increases in education, measured as an increase in the average years in school, were associated with significant increases in economic growth rates. In an exhaustive study that tested for the effects of 67 different possible variables that could impact economic growth, Sala-i-Martin, et al. (2004) reported that education (average years in school) was one of the top two factors. Still others (*see* Hanushek and Woessmann, 2008) used alternative measures of knowledge to assess the link between knowledge and economic growth. Instead of "years in school"-type measures, this line of inquiry focuses on what you learned (and retained) in school, not merely how many years you attended. The evidence indicates that differences in educational attainment based on standardized test scores is a significant factor explaining differences in standards of living across countries.[10]

While research continues into finding the best approach to measuring "knowledge," it has become overwhelmingly clear that education/knowledge is vital to explaining a country's economic growth. The question for our purpose is whether this relation holds at the state level.[11]

METHODOLOGY

We investigate whether differences in economic growth across states are due in part to differences in educational attainment. State

economic growth is measured using the percentage change of real GDP per capita between 1997 and 2012.[12] We use two measures of education. One is based on the degrees that the adult population attains across states. The other is state-specific results from standardized tests for math. To make the results directly comparable, we normalize all values (including economic growth) to the overall U.S. economy.

Before diving into the results, a brief word about our statistical approach is useful. Given values for each state's education and economic growth, we can plot these in a figure with economic growth on one axis and education on the other. The resulting plot, referred to as a scatter plot, provides a visual assessment of how well the two measures are related. If the scatter of points lie in a southwest-to-northeast pattern, this suggests a positive relationship. If they lie in a generally northwest-to-southeast pattern, the implied relation is negative. If they are scattered at random, there is no relationship.

We make use of a commonly used statistic to measure the "tightness" of the link between education and economic growth. Given the data for each state's educational attainment and its economic growth rate, we calculate the statistical association between the two series using the correlation coefficient. The correlation coefficient gives us a statistical "fit" in the observed pattern of the data in the scatter plot. If the estimated correlation coefficient is 1.0, the two series move together in perfect unison. A correlation coefficient of -1.0 signifies a perfect negative correlation: the two measures move in opposite directions. And a correlation of zero indicates no relation between the measures. Not only will we measure the correlation between education and economic growth, but we also determine whether the estimated value is statistically different from zero.

EVIDENCE FROM THE STATES

Degree attainment

Does "years of schooling" help explain output growth across states? Similar measures have been used in the past, partly because the data are readily available, and because a basic educational foundation arguably is important for workers' productivity. A worker unable to read or write is at a distinct disadvantage in most workplaces. At the state level, the two commonly used measures are the percentage of adults 25 years and older with a high school degree or higher; the other is the percentage of adults 25 years and older with a bachelor's degree or higher. Both are available from the U.S. Census Bureau.

Because we want to see if economic growth is related to educational attainment, it is desirable to somehow "exogenize" the effects of education. We know that education is a normal good. This means that as incomes rise so does the demand for education. Thus, states that have grown and become relatively wealthier are more likely to have a better-educated population. Consequently, we should not be

The traditional definition that economists favor is that economic growth is a sustained increase in real income per person over time.

surprised to find that high-income states in, say, 2014, also are states with high levels of educational attainment in 2014. Because we want to see if more education leads to better *future* economic growth, it is best to observe our measure of education at some point prior to the period over which economic growth is calculated. We therefore use observations of the two education measures in 1993, prior to the period covered for economic growth (1997 through 2012).[13]

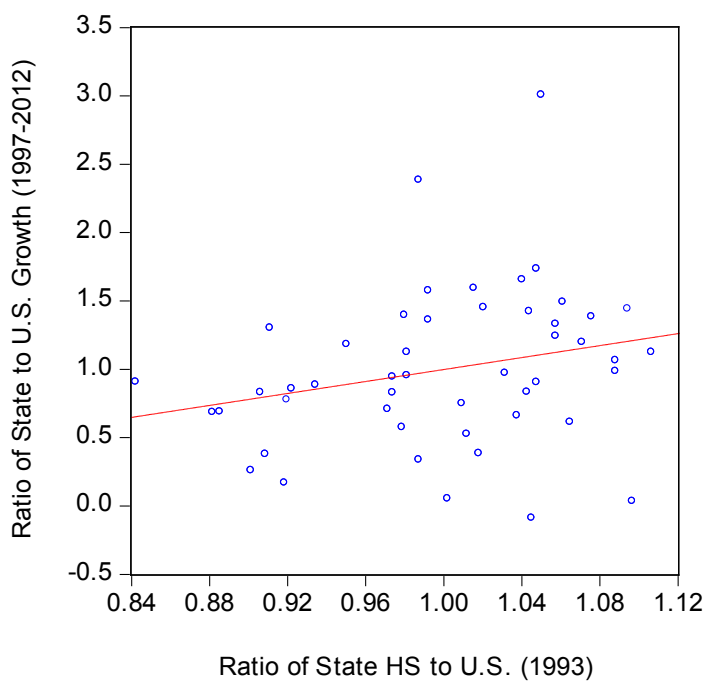
Figure 1 is the scatter plot of each state's high school attainment (hereafter, HS) in 1993 (relative to US) and its growth rate in real GDP per capita from 1997 through 2012. As mentioned, each dot in the figure represents an individual state.[14] The fact that the dots in Figure 1 tend to lie in the southwest-to-northeast direction shows that there is a positive relation between states with more high school degree holders and economic growth. States with a larger percentage of high school degree holders tend to be states that experienced higher rates of economic growth in subsequent years.

Even though the visual array of the states' education-growth relation fits with previous findings at the national level, is the average relationship

By measuring economic growth over time, we smooth out these temporary setbacks and advances in income and output and are able to focus on long-term trends.

Figure 1

State Economic Growth and High School (HS) Attainment

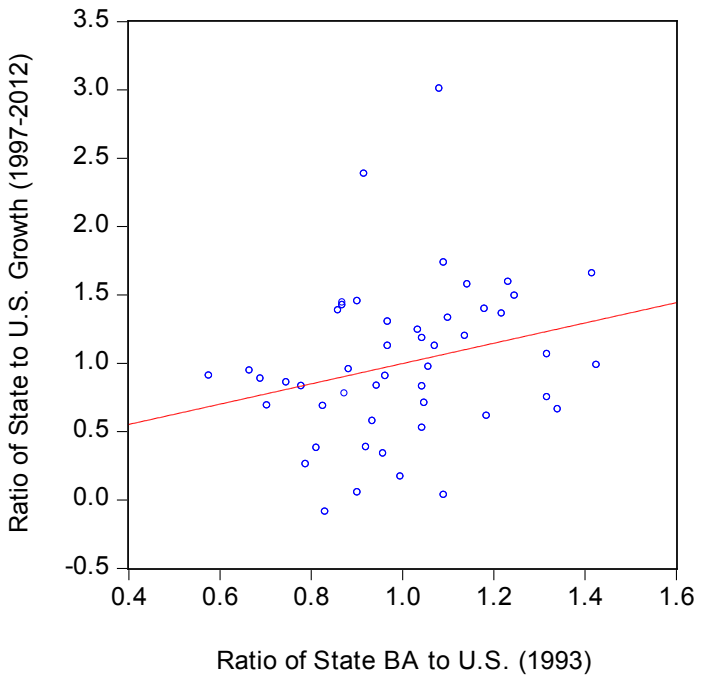


statistically significant? To assist our assessment of the link between education and economic growth, we superimpose a line that represents the "best fitting" relationship between the two variables. Its positive slope indicates that states with higher levels of high school attainment in 1993 are states that, in general, also experienced faster economic growth in the subsequent 1997-2012 period. The simple correlation between these data is 0.25, a value that is statistically different from zero at the 9 percent level of significance. The scatter plot and the estimated correlation coefficient both indicate that the positive relation between economic growth and the percentage of adults with at least a high school degree are not due merely to chance.

Figure 2 presents the scatter plot comparing the percent of bachelor degree holders (hereafter, BA) in the adult population in 1993 and economic growth. The scatter of points and the super-imposed line, as in Figure 1, indicate that states with a higher percentage of adults having obtained a BA or more are states that experienced faster economic growth in later years. Like the results using the HS degree, the correlation between BA attainment and the growth rate in real GDP per capita is 0.25, statistically different from zero

Figure 2

State Economic Growth and Bachelor's Degree (BA) Attainment



Producing something, whether it is a computer, a mown lawn or a haircut, occurs when we combine human labor, machinery, and knowledge.

The simple task of getting breakfast actually is a well-choreographed dance between humans and machines, between labor and capital.

at the 8 percent level of significance.

Based on the evidence in Figures 1 and 2, we cannot reject the notion that education, as measured by degree attained, and subsequent economic growth are positively related across states. One aspect of the results using these measures of educational attainment is that the estimated correlations are different from zero, but at relatively low levels of significance. That is, with the standard metric being a 5 percent level of significance, high school and bachelor's degree attainment achieve significance at the 9 and 8 percent levels, respectively. This suggests that the relationship, while significant, is somewhat loose.[15] Still, differences in educational attainment across states, here based on the degree earned, are important in explaining differences in economic growth across states.

Cognitive ability

One drawback with the previous measures of education is that they may not effectively capture educational *attainment*. Even if two high school (or college) graduates spend the same number of years in the same school and acquire a diploma, this feat may not accurately assess their relative cognitive abilities. And it is cognitive ability, not years in school, that really is the conceptual analogy to knowledge in our earlier discussion of economic growth. With this in mind, many researchers have turned to using results from standardized tests to measure educational attainment. One such battery of tests given in the United States is the National Assessment of Educational Progress (NAEP).[16]

The NAEP is administered by the U.S. Department of Education and serves as a national assessment of student achievement in select academic areas. The tests are standardized across all participants, and cover the subjects of math, reading, science, and writing. They are administered to students in the fourth, eighth, and 12th grades, grade levels chosen to match critical points in a student's primary and secondary educational experience. Test results for fourth- and eighth-grade students are available at the state level for 41 states.[17]

We use two NAEP assessment scores in this analysis: the NAEP math scores for grades four and eight. One reason is simply to keep the discussion manageable. The other reason is that previous research has shown that math skills are better predictors of future earnings success than other topics in high school.[18] Similar to the approach taken for the HS and BA measures, the NAEP scores are "exogenized" by using the states' scores for 1992. Each state's NAEP score is measured relative to the U.S. average.

We first compare each state's growth in output over the 1997-2012 period to its fourth-grade NAEP math score in 1992. The scatter plot in Figure 3 indicates an overall positive relation between education and future economic growth. States with higher fourth-grade math scores generally have higher rates of economic growth. The statistical relation in Figure 3 *(page 10)* is

stronger than that based on the HS and BA measures. The correlation between fourth-grade math scores and economic growth rates is 0.32, a value that is statistically different from zero at the 5 percent level of significance.

Figure 4 *(page 11)* is the scatter plot from using the eighth-grade NAEP math scores. Like each of the previous scatter plots, there is a generally positive relation between educational attainment and economic growth. States with higher eighth-grade NAEP math scores tend to have higher subsequent rates of economic growth. The statistical relation between the eighth-grade NAEP math scores and economic growth across states is statistically the strongest thus far. The estimated correlation between the eighth-grade math scores and economic growth is 0.42, which is statistically different from zero at less than a 1 percent level of significance.

These results using the NAEP scores suggest that measures of cognitive ability may be a better indicator of future economic success than measures of degree attainment. As noted earlier, this makes sense: It is not the years spent in school that count but what you learn and retain that makes you a more productive individual. And if it is true for the individual, it is likely true when we aggregate to the state (or national) level.

Summary

The evidence we have presented shows that economic growth and educational attainment are positively related at the state level. And it seems that cognitive skill, not years in school, are the better measure.[19] One feature of our work, and most previous work, is that we do not account for migration. Hanushek, et al. (2014), explore this important gap by accounting for the fact that states' residents migrate. Even though an individual is educated in, say, Missouri, it does not mean that person will remain in Missouri throughout his or her productive years. It also is true that current Missouri residents include individuals who emigrated from another state (or country). Thus, the evidence to date suggests that it is important for future economic growth not only to educate and keep resident populations, but also to attract educated individuals from elsewhere.[20]

CONCLUSION

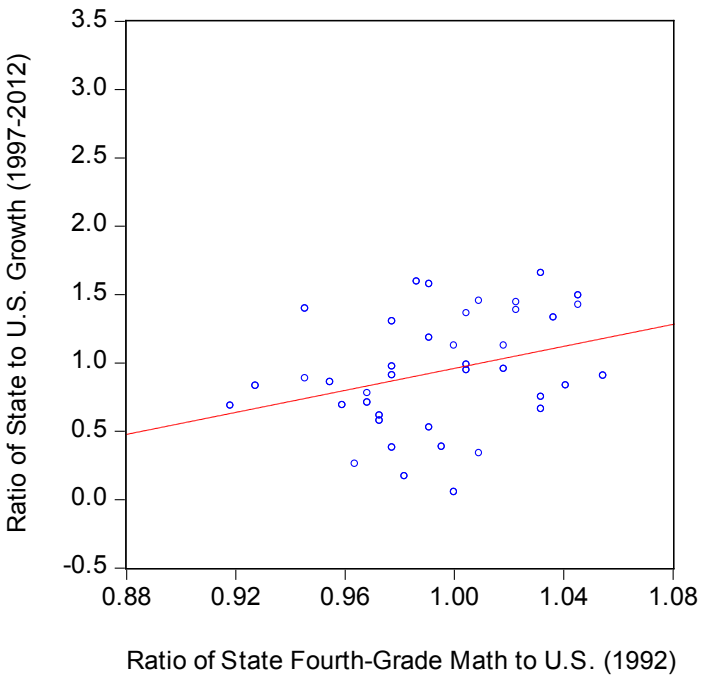
The results presented here, together with previous research, indicate that policies that improve educational attainment at the state level *today* affect a state's *future* economic growth and standards of living. At a minimum, this means education policies should aim at improving graduation rates at both the high school and college levels. Recognizing that graduation rates may not be the best indicator of educational attainment—cognitive ability—our finding that the correlation between standardized test results and higher economic growth suggests improving standardized test scores should be the focus of future economic policy for Missouri's students.

The idea of diminishing returns to capital simply means that adding more and more machines to an existing labor force is not an explanation for persistent increases in the output of goods and services.

Economics predicts that raising the knowledge of the workers (and individuals in general) in an economy leads to higher levels of output and economic growth, given capital and labor. The preponderance of evidence supports this prediction.

Figure 3

State Economic Growth and Fourth-Grade NAEP Math Scores



What do these results suggest for Missouri's economic future? Missouri ranks in the lower half of states when comparing the percent of the adult population holding high school and college degrees. Moreover, improvement in Missouri students' achievement on the NAEP tests is among the lowest in the country. Comparing improvement in overall NAEP test scores between 1992 and 2011, Hanushek, et al. (2012) found that Missouri ranked 27th out of the 41 states for which scores are available. This record coupled with the fact that Missouri's economic growth record over the past 15 years places it near the bottom of all states should intensify concerns about the success of our educational system.

The blunt message from this study is that until the educational system in Missouri builds a stronger foundation of educational attainment and improving cognitive skills, do not expect long-term progress anytime soon in the state's economic standard of living.

REFERENCES

Barro, R. J. 1991. "Economic growth in a cross-section of nations," *Quarterly Journal of Economics* 106(2): 407-43.

Chappell, Bill. 2013. "U.S. Students slide in global ranking on math, reading and science." National Public Radio, December 3.

Glaeser, Edward L. 2012. *The Triumph of the City. How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier.* New York: Penguin Books.

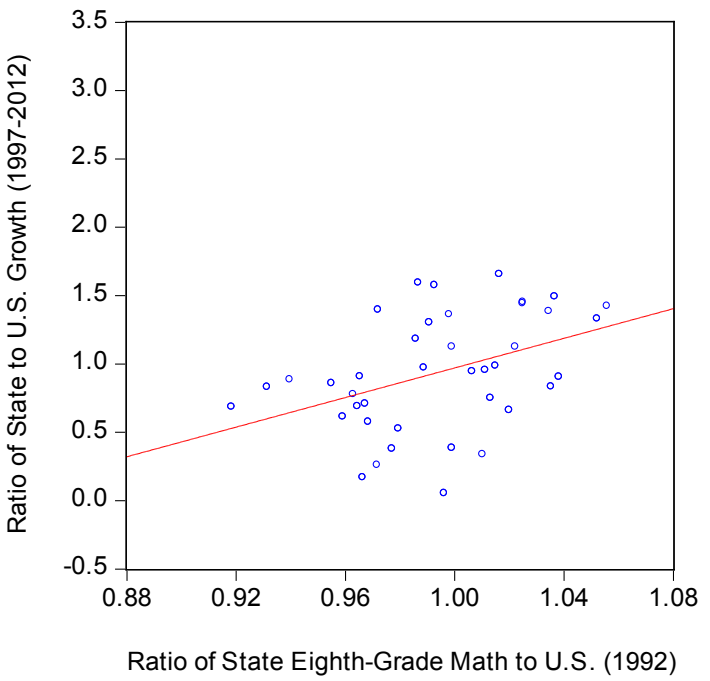
Glaeser, Edward L., Jose A Scheinkman, and Andrei Shleifer. 1995. "Economic growth in a cross-section of cities." *Journal of Monetary Economics* (36): 117-143.

Hanushek, Eric A., and Ludger Woessmann. 2008. "The role of cognitive skills in economic development." *Journal of Economic Literature* 46(3): 607-688.

Hanushek, Eric A., Paul E. Peterson, and Ludger Woessmann. 2010. "U.S. math performance in global perspective: How well does each state do at producing high-achieving students?" Report prepared for the Program on Education Policy and Governance, Harvard.

Figure 4

State Economic Growth and Eighth-Grade NAEP Math Scores



While research continues into finding the best approach to measuring "knowledge" it has become overwhelmingly clear that education/ knowledge is vital to explaining a country's economic growth. The question for our purpose is whether this relation holds at the state level.

States with a larger percentage of high school degree holders also tend to be states that experienced higher rates of economic growth in subsequent years.

Hanushek, Eric A., Paul E. Peterson, and Ludger Woessmann. 2011. "Teaching math to the talented." *Education Next* (Winter): 11-18.

Hanushek, Eric A., Paul E. Peterson, and Ludger Woessmann. 2012. "Is the U.S. catching up? International and state trends in student achievement." *Education Next* (Fall): 25-33.

Hanushek, Eric A., Jens Ruhose, and Ludger Woessmann, 2014. "The importance of state human capital." Unpublished paper presented at the American Economic Association Meetings, Philadelphia, PA., January.

Jones, G. and Schneider, W.J. 2006. "Intelligence, human capital, and economic growth: A Bayesian averaging of classical estimates (BACE) approach." *Journal of Economic Growth*. 11(1): 71-93.

Lynn, R., and G. Meisenberg, 2010. "National IQs calculated and validated for 108 nations." *Intelligence*. 38: 353-360

Mankiw, N. Gregory, David Romer, and David N. Weil. 1992. "A contribution to the empirics of economic growth." *Quarterly Journal of Economics*. 107(2): 407-437.

Sala-i-Martin, Xavier, Gernot Dopplehofer, and Ronald I. Miller. 2004. "Determinants of long-term growth: A Bayesian averaging of classical estimates (BACE) approach." *American Economic Review* 94(4): 813-835.

APPENDIX

We can illustrate the connection between capital, labor, knowledge, and output using a visual device known as the *productivity curve*. The curved line in Figure A1 shows that changes in the amount of output per worker, measured along the vertical axis, are directly related to changes in the ratio of capital-to-labor, measured along the horizontal axis. For instance, suppose there is an increase in the capital-to-labor ratio from 100 to 200, caused by doubling the amount of machinery available to a given number of workers. The result is an increase from 50 to 90 units of output per worker. Figure 1 shows this by the movement from point A to point B along the curve. This suggests that an increase in the amount of machinery available to a given labor force leads to a higher level of output. If the population has not changed, it also means that real GDP per person increased.

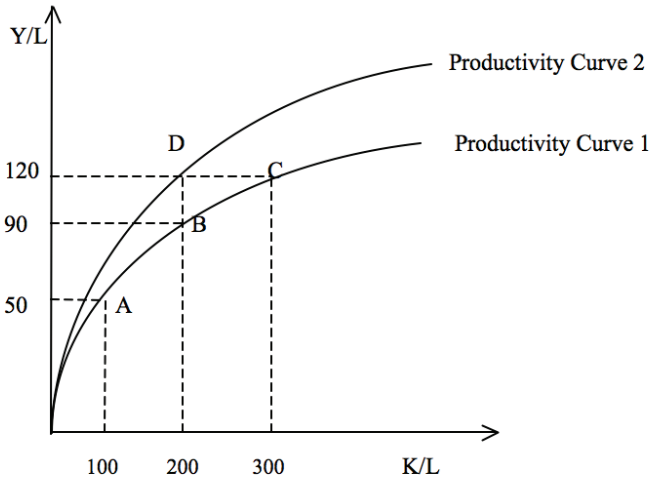
The productivity curve can be used to illustrate the idea that additional increases in capital per worker suffer from diminishing returns. When more machinery is added to the existing labor force, shown by the increase in the capital-labor ratio to 300, the increase in output per worker is positive, but the additional amount of output is smaller than the previous increase for the same change in the capital-labor ratio. Even though the economy moves from point B to point C with the addition of more machinery, the additional capital generates only 30 additional units of output per worker. As more machinery is added to the given number of workers,

the increase in output per worker is smaller and smaller. The fact that capital is subject to diminishing returns means that increases in capital alone are not *the* explanation of economic growth.

What happens if we increase knowledge? Figure A1 shows how this affects output. When there is an increase in knowledge, holding capital and labor constant, the entire productivity curve shifts upward. This is shown by the shift in the curve from Productivity Curve 1 to Productivity Curve 2. Why this is important is because not, at the capital-labor ratio equal to 200, the economy can produce 120 units of output. The economy moves from point B to point D. While this level of output was attainable only with an increase in the capital-labor ratio from 200 to 300, it is now the level of output obtained with (K/L) = 200. In general, then an increase in knowledge raises the level of output the economy can produce at each and every level of the capital-labor ratio. Because knowledge is not subject to diminishing returns like capital and labor, it is often times thought to be the engine of economic growth.

Differences in educational attainment across states, here based on degree earned, are important in explaining differences in economic growth across states.

Figure A1



Notes: Y/L, the ratio of output to labor, is a measure of worker productivity. K/L is the ratio of capital to labor. The shift from Productivity Curve 1 to Productivity Curve 2 occurs because of an increase in knowledge.

States with higher fourth-grade math scores generally are associated with higher rates of economic growth.

NOTES:

[1] The Bureau of Labor Statistics reports that the median weekly earnings in 2013 for the average person age 25 and over with a high school diploma is $651, or $33,852 annually. For the average individual with a bachelor's degree, their average weekly earnings is $1,108, or $57,616 per year. For more information, visit the Bureau's website at www.bls.gov.

[2] The U.S. score was equivalent to students in the Slovak Republic and Lithuania. See Chappell (2013).

[3] The Council of Foreign Relations sponsored the analysis. This citation from the report is from Hanushek, et al. (2012).

[4] We will use the terms "real income" and output interchangeably. This is not meant to confuse, but recognizes the fact that real GDP measures the output of goods and services in an economy—the apples, shoes, and trucks produced, the surgeries performed, the computer repairs made—and also accounts for the income that such production generates. If what is produced and purchased generates income, then real GDP is a reasonably good gauge of the output *and* the real income produced in the economy.

[5] As an example, suppose we compare the size of the Chinese economy to that of Germany. In comparable dollar terms, in 2009 the size of the Chinese economy was about $9 trillion and the German economy was nearly $3 trillion. While the Chinese economy is obviously larger in absolute terms, this conclusion changes dramatically when comparing real GDP *per person*. On this basis, real GDP per person in China was $6,755, much less than the $36,192 for the German economy. Measuring real output on a per-person basis provides a more informative yardstick of relative standards of living for the "average" person.

[6] Like any broad measure of economic activity, real GDP per capita it is not perfect. Knowing that an economy's real GDP per person is higher today than it was 10 years ago does not tell us how it is distributed. Our GDP statistic also does not say anything about the "undesirable" externalities that may arise from production, such as pollution. Even with these caveats, real GDP per person is a very serviceable measure of whether an economy is expanding fast enough to increase the economic well-being of the average citizen.

[7] See the Appendix for a more detailed explanation of the relationship between capital, labor, knowledge and output.

[8] Some argue that *technological* improvements explain economic growth. Let's not get bogged down in semantics. Technology is the embodiment of "knowledge." Think of it this way: once you learned how to use your first computer or iPhone, adapting to the next generation of technology was much easier. Knowing *how* to use technology is what makes a worker more productive, not the technology itself. And education in a broad sense is how knowledge is transmitted, increased, and broadened.

[9] Innovations often involve the combination of knowledge and technology: Getting a computer and then discovering innovative ways to use it. Or, think of how entrepreneurs innovate by discovering new ways of combining labor and capital: the assembly line mode of production.

[10] Though more controversial, there also is research showing that a country's IQ is a significant factor that explains economic growth. See, among others, Jones and Schneider (2006). In this context, IQ is really a proxy for educational attainment. For more on the IQ-education nexus, see Lynn and Meisenberg (2010).

[11] In a related study, Glaeser, et al. (1995) tried to explain urban growth between 1960 and 1990. Using a large sample of urban areas, years of schooling in 1960 was found to be a significant factor, even after holding constant a variety of other influences.

[12] While a longer time span would be preferable, state real GDP per capita is available in a consistent measure only since 1997. Some may wonder whether our results are impacted by the fact that the data cover the period of the Great Recession (2007-09). We have conducted the analysis using data for the truncated sample 1997-2007 and the results are qualitatively identical.

[13] Selecting 1993 may seem odd. Why not 1990? While it makes little difference in the outcome, using 1993 locates this variable closer to our other measure of education. This will be apparent in the following discussion.

[14] We omit North Dakota from this analysis. North Dakota's growth rate over the 1997-2012 period far exceeds any other state's (or the U.S.) experience due to the dramatic increase in the oil extraction industry. Consequently, when its economic growth is measured relative to the United States, the resulting ratio is several times larger than the next highest state, obscuring the relation between education and growth.

[15] We should note that when the correlations use the level of real GDP per capita in 2012 instead of growth between 1997 and 2012, they increase notably. The correlation between high-school attainment in 1993 and real

States with higher eighth-grade NAEP math scores tend to have higher subsequent rates of economic growth.

The evidence we have presented shows that economic growth and educational attainment are positively related at the state level. And it seems that cognitive skill, not years in school, are the better measure.

GDP per capita in 2012 is 0.59. When bachelor's degree attainment is used, the correlation is 0.56. Both of these correlations are significant at less than a one-percent level of significance.

[16] The international counterparts to the NAEP are the PISA and TIMMS tests. Details about the NAEP are available from http://nces.ed.gov.

[17] The states for which data are not available include Alaska, Illinois, Kansas, Montana, Nevada, Oregon, South Dakota, Vermont, and Washington.

[18] See Hanushek, et al. (2010, 2011) and the references cited therein.

[19] In this vein, Hanushek, et al. (2014) note that "differences in human capital [cognitive skills] account for 20-30 percent of today's variation in GDP per capita across states."

[20] This is the gist of Glaeser's (2012) argument of why metropolitan areas tend to grow faster than rural areas. Basically, urban areas tend to attract larger groups of more highly educated and inventive individuals. The best example in the past few decades is the Silicon Valley area in California.

The results presented here, together with previous research, indicate that policies that improve educational attainment at the state level today affect state's future economic growth and standards of living.

4512 West Pine Blvd. I Saint Louis, MO 63108 I 314-454-0647 I www.showmeinstitute.org

View State Government Spending:	Read Our Blog:	Use Our Interactive Database:	Find Us on Facebook:	Follow Us on Twitter:
showmeliving.org	showmedaily.org	showmedata.org	facebook.com/showmeinstitute	twitter.com/showme