The Economic Gains to Colorado of Amendment 66

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Colorado is considering raising personal income taxes to fund a $950 million initiative. Are the increased benefits from educational attainment worth the revenue costs? This study surveys in-depth the economic literature on the impact of increased educational expenditure on future income, entrepreneurship, health care, housing, crime and business location. It discusses the economic links between educational spending and educational outcomes, and estimates the pecuniary and non-pecuniary impact of the initiative on the state.

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Executive Summary:
The Economic Gains to Colorado of Amendment 66

Most studies that evaluate the impact of taxes on the economy are limited to analyzing the drag of the tax compared to the benefits of increased government expenditures. In the case of education taxes, this type analysis fails to incorporate the full picture of the economic gains of a quality education system such as the one Amendment 66 would help to produce. This study is thus meant to supplement the more limited economic studies by calculating the economic gains, both monetary and nonmonetary, of Amendment 66. To do this, this study measures the impacts that Amendment 66 will have on crime, healthcare, unemployment and welfare, future earnings and tax payments, property value, student achievement, dropout rates, business relocation, and entrepreneurship.

As reviewed in this study, there is extensive literature on the economics of education that documents the tremendous gains to a state economy as a result of targeted education investments such as those provided by Amendment 66[1]. The report that follows this summary carefully reviews the literature and impacts of $950 Million infusion of revenues into our schools as directed by SB 213. The report concludes that, if passed, Amendment 66 will result in as many as 11,850 more high school graduates than the current system, and will generate the following economic gains to the state:

- **Reduction in crime**. Over 300 fewer victims of violent crime. A decline of almost 3,000 incidents of property crime. Over 6,000 fewer drug related offenses. Amendment 66 has the potential to reduce criminal justice expenditures by $329 million.
- **Healthcare savings**. Education results in less smoking, drinking, and obesity, as well as improved lifestyle choices. Amendment 66 has the potential to result in a $500 million savings in healthcare costs.

[1] Amendment 66 includes $366 million for a Teacher and Leadership fund, $317 million focused on at-risk children, $102 million for expanding full-day kindergarten, $80 million for special education, $40 million for bolstering preschool programs, and other important programs. Colorado has an overall graduation rate of 74%, but graduation rates are only 53% for children with limited English and 62% for economically disadvantaged children. Amendment 66 targets programs that improve educational attainment and lower Colorado's high school dropout rates through focused spending on high-risk children. Amendment 66 further funds programs to increase teacher effectiveness, including programs for the monitoring and possible dismissal of ineffective teachers. Rewarding good teachers and dismissing poor teachers is critical for improving class performance.

- **Lower unemployment and welfare costs**. Amendment 66 has the potential to result in a 4% increase in graduation rates with a resulting savings of $37 million in welfare payments by the state.

- **Increased property values**. The report estimates that Amendment 66 will lead to an average housing price increase of $7,280, which could contribute an additional $675 million in spending on Colorado's goods and services. The housing price increase could further lead to $86.8 million in additional property tax revenue for the state**.**

- **Higher quality teachers and higher educational attainment**. Funding the implementation of teaching monitoring and the dismissal of 1.5% of poor teachers has the potential to cause gains of $180 million due to increases in educational attainment. Removing poor teachers and replacing them with better and/or average teachers leads to substantial gains in student performance, particularly in science and math.

- **Reduced dropout rate**. Educational gains from reducing the number of high school dropouts has the potential to increase Colorado's GDP by $2770 million, which in turn generates $184 million and $102 million in additional income and sales tax revenues.[2]

- **Increased entrepreneurship**. Amendment 66 will lead to a significant increase in entrepreneurship due to funding of teacher effectiveness programs, charter schools and gifted and talented programs (particularly in Science Technology Engineering and Math (STEM) fields).

- **Increased business retention and attraction**. This paper presents strong evidence that higher student achievement affects business decisions more than taxes, as firms primarily compete on the quality of their ideas (which is directly related to their human capital).

The total economic benefits should Amendment 66 pass will be over $3.3 billion. As stated above, this is achieved through increased production, a savings of $866 million from lower health care, crime and welfare expenditures, and an increase in sales, income and property revenue of $373 million. In total, the benefits are expected to exceed the $950 million cost by $3624 million, and imply a benefit/cost ratio equal to 4.8.

[2]These estimates of education investment are consistent with Psacharopoulos and Patrinos, (2004) who estimate that $950 million education spending will yield $3919 million in higher income to the state; Federal Reserve Economist Rolnick and Grunewald (2003, 2010) show a return exceeding $45 24 million. Bretton (2013) and Kruger (2003) estimate that a $950 million in educational investment in Colorado leads respectively to $4500 billion and $3200-$4100 million rise in Colorado's GDP. These works summarized in our report further indicate the educational benefits of Amendment 66 outweigh the costs by a factor of 4-5 times.

Using the alternative economic analysis methodology of Belfield, Levin, and Rosen (2012), with the revisions of Amendment 66, Colorado's income gains from increased educational attainment (as well as benefits from increased tax revenues and reductions in public costs such as crime, public health and welfare costs), are $258,240 per youth (lifetime in present value), while the cost to Colorado is $56,925 per student. This implies that under this model the total benefit to Colorado of passing Amendment 66 is $6718 million, which exceeds our estimate of $4578 million. Using the approach advocated by Barnet and Masse (2007), we estimate a $950 million education investment yields income gains to Colorado over $5 billion, relatively close to our $4.5 billion estimate. These alternative estimates suggest that our methodology as set forth above is conservative, and that Amendment 66 will yield at least $4 billion in economic gains to the state.

The Economic Gains to Colorado of Amendment 66

Since 2000, Colorado's employment growth has increased nearly three times faster than the national average, and since 2010, job creation in Colorado has recovered 30% more rapidly than the average state. Colorado's population is growing: the state has added 17% population during the period of 2000-2010, while the U.S. population grew less than 10%. At the same time, spending on schools has not kept up with the skyrocketing enrollment; education spending in Colorado has lagged the national average more than 30%, and over the past decade, Colorado's teacher salaries (adjusted for inflation) have declined 5.5%, nearly twice the U.S. average. Since the recession's end, salary increases in Colorado's teachers have been half that of most states. Consequently, the NEA (2012) reports that Colorado teachers are paid $6,000 less than the U.S. average, and staff pay is 10% less than other states. The Wall Street Journal (Sauter, 2013) finds Colorado's teachers and staff pay benefits rank third from the bottom of all states.

As we assess the value of increased funding on the public education system in Colorado, it is important to point out that education has complex pecuniary and nonpecuniary returns in the community that are difficult to capture using standard economic modeling or economic impact studies, for a variety of reasons. For example, economic models are designed to simplify reality and focus on the importance of only a few factors, and impact studies are designed to weigh the benefits of government spending compared to the costs of increased taxes to pay for these expenditures. Neither approach directly accounts for the fact that "schooling generates many experiences and affects multiple dimensions of skill that in turn affect central aspects of individuals lives in and outside the labor market" (Card, 1999). Moreover, in a comprehensive work, Lochner (2011) reports that "a growing body of work suggests that education offers a wide-range of benefits that extend beyond increases in labor market productivity. Improvements in education can lower crime, improve health, and increase voting and democratic participation."[3] Hence, by their nature, the positive externalities of education will be difficult to capture in standard economic modeling and

[3] Recent work by Oreopoulos and Salvenes (2011) entitled "Priceless: The Nonpecuniary Benefits of Schooling" also detail the relevance of education in improving the lives of its citizens including increased job satisfaction, improved health, parenting (Kalil, Ryan and Corey, 2010) and better marriage prospects (see also Becker, 1973; LaFortune 2013; Chiappori, Iyigun and Weiss, 2009).

impact studies; therefore, most models and studies will substantially underestimate the importance of education on Colorado's economy.

This report details six advantages of Amendment 66 that demonstrate the economic rationality of the personal income tax increase, looking at both monetary and nonmonetary benefits. The economic benefits of Amendment 66 include: increased productivity and pay, improved prospects for business relocation, augmented entrepreneurship, higher property values, lower crime, and increased health, and reduced poverty and inequality. This report additionally documents the impact of educational investment in early childhood education and the advantages of smaller class size. Overall, this report demonstrates that Amendment 66 will generate significant economic activity in Colorado.

In recent decades, a plethora of papers have emerged that demonstrate that education is key to economic growth, and that a well-educated labor force is key to a state's success (Berger and Fisher 2013). States, including Colorado, that fail to invest in their children's future will generate fewer jobs, will experience higher unemployment, and will have slower wage increases. According to Card, "hundreds of studies in many different countries and time periods have confirmed that better-educated individuals earn higher wages, experience less unemployment, and work in more prestigious occupations than their less-educated counterparts" (1999). A focus on luring employers from other states with lower taxes will not make the workforce more productive. Even worse, Berger and Fisher (2013) show that a short term focus on limiting taxes "drains resources from the most important, proven, path to increasing productivity: investments in education."

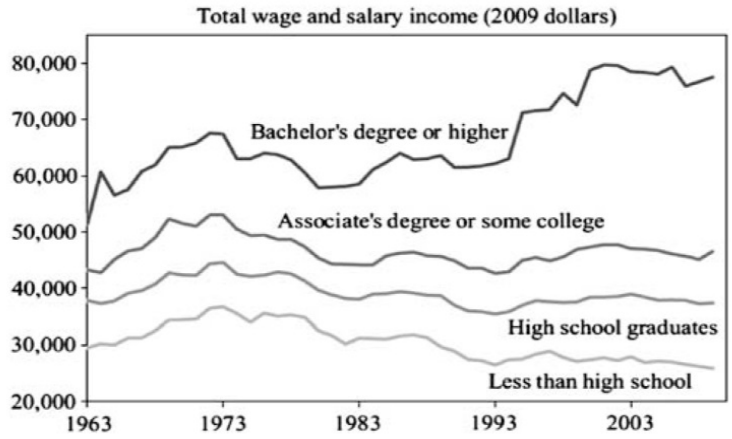
Education leads to higher pay and productivity

Federal Reserve economists Bauer, Schweitzer and Shane (2006) demonstrate that the overwhelming determinant of a state's long-run economic growth is an increase in education funding, and conclude that "knowledge variables play the main role in accounting for relative levels of per capita income across states." The impact of education in terms of magnitude and statistical significance dominate other explanatory variables… personal incomes across states tax rate is insignificant." High educational spending (MA, CT, NJ), not low taxes, contribute to a state's high productivity and wages (see Figures VI). These states also have education spending above the national average.

Michael Porter and Jan Rivlin (2012) show that America's competitiveness depends on its productivity, which in turn depends on its system of education. Additional work by Glaeser and Saiz (2004) confirms that educated cities have grown more quickly than comparable cities with less human capital over the past century, and are better able to handle adverse business cycle shocks; human capital predicts city growth because education enables people to adapt well to change (as in Shultz, 1964; Welch, 1970; Glaeser and Saiz (2004), Rangazas (2005), Benhabib and Speigel (1994). Further scholarly work by Barro (1997) emphasizes the central value of education in influencing technology innovation and adoption, and further shows that education is an increasingly important ingredient in agglomeration economies and makes making cities grow economically. Jacobs (1968) and Glaeser and Saiz (2004) present evidence that education leads to increased information flow, specialization, and comparative advantage in particular skills or ideas such as technology hubs. These authors highlight that technology and education are complementary, and that increases in education spending boosts technical progress. Overall, these works demonstrate that businesses succeed or perish due to their ideas; intrinsic to idea creation is a strong education background.

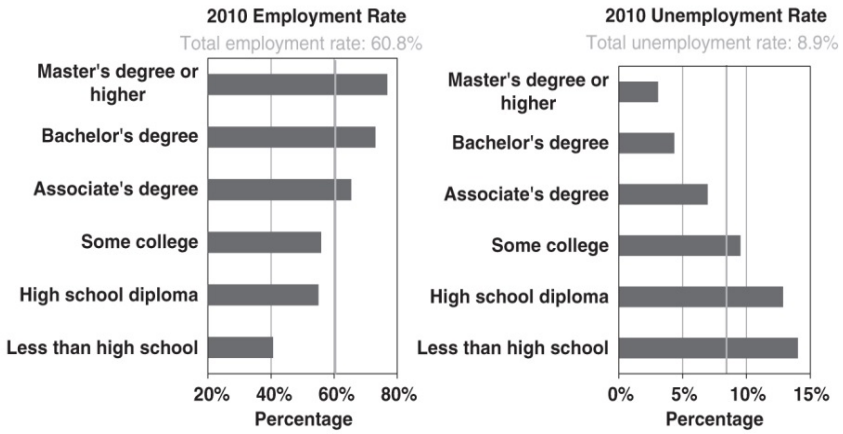
Figure I shows that the average college graduate earns twice as much as a high school graduate over his or her lifetime (White House, 2010; Wobbekind, 2009). Figure II illustrates that lack of schooling is strongly related to unemployment, and Wobbekind (2009) posits that in a globally competitive world that is rapidly changing, education is more critical than ever, and concludes that we should be doing whatever we can to improve the quality and quantity of education. Figure III highlights that the U.S. leadership in education has declined, and that the increase in remedial courses is also a strong warning sign that high schools are not preparing students adequately for the challenges ahead (Wobbekind, 2009).

Figure I: More Education leads to Higher Worker Pay



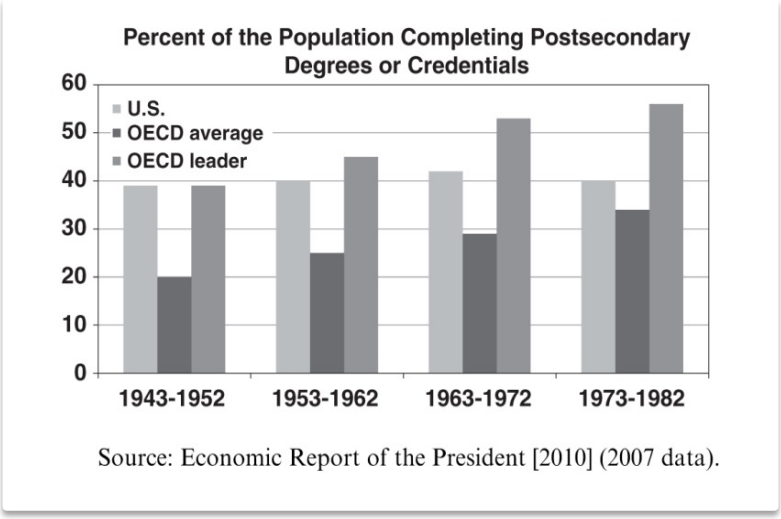
Source: Bureau of Labor Statistics, Current Population Survey (Calculations are for full-time workers over age 25).

Figure II: More Education Leads to Lower Unemployment



Source: National Center for Education Statistics, U.S. Department of Education, Institute of Education Sciences (adults aged 25–34).

Figure III: US Education Falling Behind



Source: Economic Report of the President [2010] (2007 data).

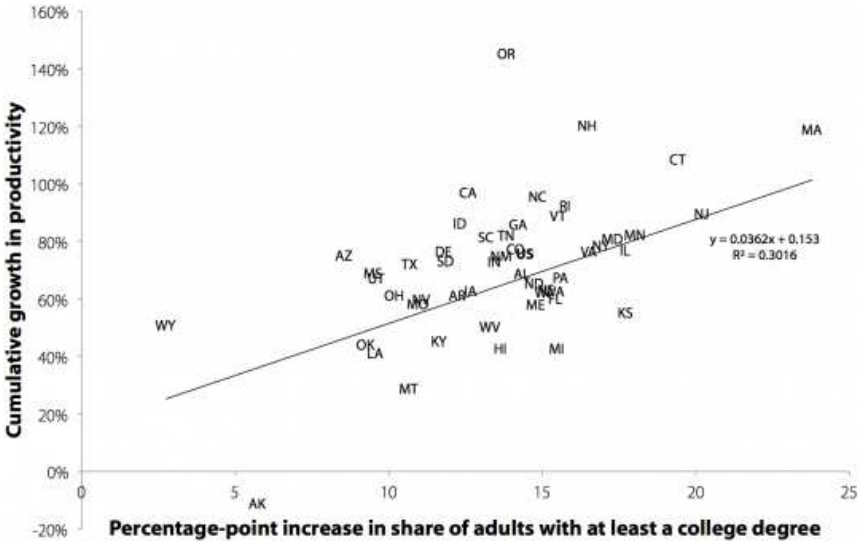
Berger and Fisher (2013) show the following:

- Overwhelmingly, high-wage states are states with a well-educated workforce. There is a clear and strong correlation between the educational attainment of a state's workforce and median wages in the state.
- States can build a strong foundation for economic success and shared prosperity by investing in education. Providing expanded access to high quality education will not only expand economic opportunity for residents, but also likely do more to strengthen the overall state economy than anything else a state government can do.
- States can increase the strength of their economies and their ability to grow and attract high-wage employers by investing in education and increasing the number of well-educated workers.
- Investing in education is also good for state budgets in the long run, since workers with higher incomes contribute more through taxes over the course of their lifetimes."

Berger and Fisher illustrate that increasing education increases productivity, which in turn raises wages; further, wages are higher in well-educated states. Hence, there is a strong statistical relationship between education, productivity and wages; e.g., low education states such as Oklahoma and Louisiana have low wages and productivity. If Colorado wishes to maintain its income and wage advantage over most states, it must invest in education to boost productivity and wages. Maintaining low taxes will lead only to mediocre educational performance and poor future student attainment (Berger and Fisher, 2013).

Figure IV: Relationship between state productivity growth and increase in college attainment from 1979-2012

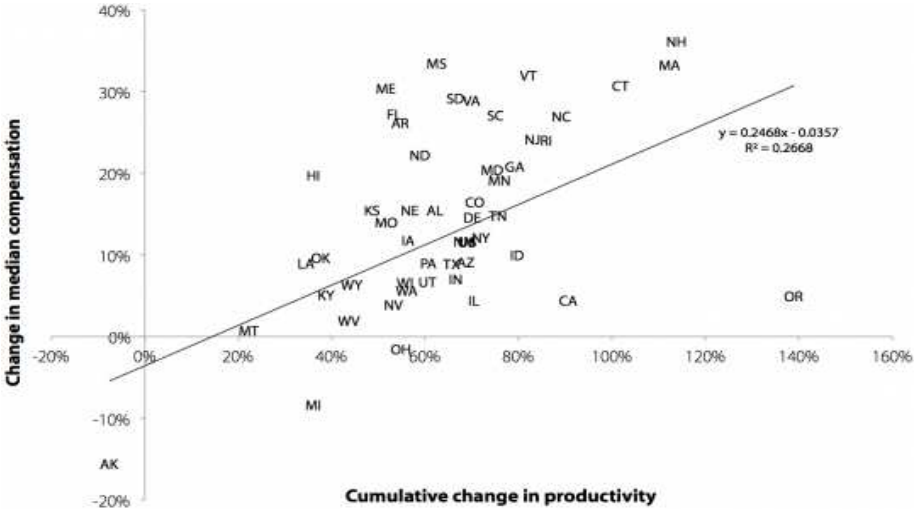
Productivity has grown faster in states with greater growth in education.



Source: EPI analysis of unpublished total economy productivity data from the BLS, Labor Productivity and Costs program and college attainment data from the CPS Census monthly microdata.

Figure V: Relationship between change in state median worker compensation and productivity from 1979 to 2012

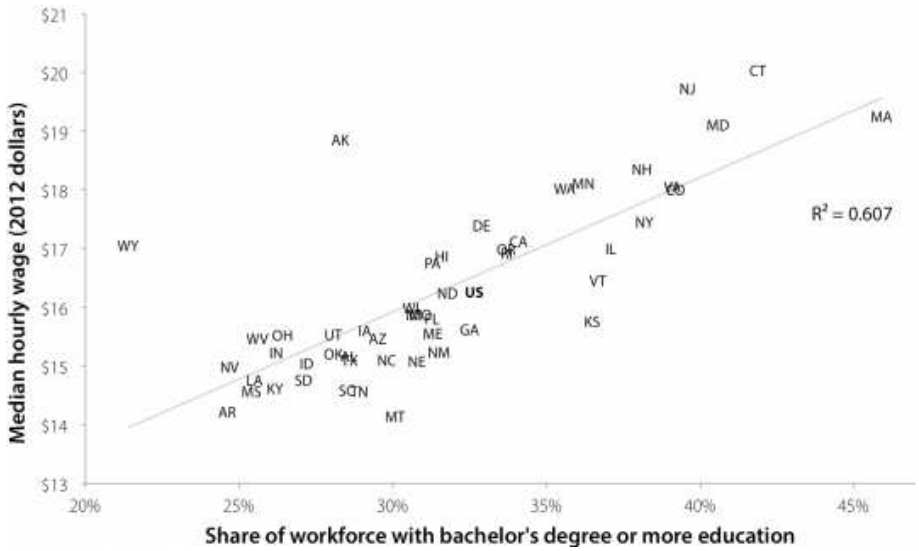
Worker compensation has increased more in states with greater increases in productivity



Source: EPI analysis of unpublished total economy productivity data from the Bureau of Labor Statistics (BLS) Labor Productivity and Costs program, state employment data from BLS Local Area Unemployment Statistics, state compensation data from the Bureau of Economic Analysis State/National Income and Product Accounts public data series, and wage data from BLS.

Figure VI: Relationship between state median hourly wage and share of state's workforce with a bachelor's degree or more education, 2012

Median wages are substantially higher in states with better-educated workers



Source: Authors' analysis of Current Population Survey (CPS) basic monthly and CPS Outgoing Rotation Gro

Figures IV-VI illustrate that education increases productivity, which in turn raises wages. Further, Sockice (1993) as well as Green and Ridell (2003) determine that education is strongly and positively related to critical thinking and social skills. Recent work by Bretton (2013) "shows education has positive direct and indirect effects of national output. Educated workers raise national income directly because schooling raises their marginal productivity." Investment in schooling has a considerable positive return of 8-10%, and greatly exceeds the both the standard discount rate of 2-3% and therefore the cost of a tax increase. Glaeser, La Porta, Lopes-de-Silanes and Shleifer (2004) present overwhelming statistics demonstrating that education is the fundamental cause of higher income. Additionally, Bretton (2013) confirms that education has large external effects on national income. Substantive work using twins data by Ashenfelter and Krueger (1994), Miller et al. (1995), Ashenfelter and Rouse (1998), Rouse (1999) and Berhrman and Rosenzweig, (1999) further examines the nature versus nuture debate and show that twins in better schools achieve higher test scores and later more employment success.

Bretton comments that in the aftermath of the financial crisis of 2008, governments are legitimately asking whether they can afford public investment in schooling. Empirical

evidence is clear. Investment in education, or human capital, is an important element in the economic growth process, and educated workers are more productive and earn higher salaries. Psacharopoulos and Patrinos, (2004), for instance, show that the return on education is 8%; this implies that $950 million expenditure will yield a benefit of 8 times this amount after 30 years. If one assumes a discount rate of 2.5%, this implies a yield of $5225 million in income. Assuming that 75% of the students stay in Colorado, the benefit to of higher salaries is $3919 million. Overall, Card (1999) posits "Hundreds of studies in many different countries and time periods have confirmed that better-educated individuals earn higher wages, experience less unemployment, and work in more prestigious occupations than their less-educated counterparts."

Investments in education encourage businesses to locate in high skilled areas

Economists have investigated factors that influence organizational and individual decisions to (re)locate ever since the seminal work of Alfred Marshall (1890). Business location theory posits that a number of factors influence the decision of a business to locate in a particular region, state or locality. Berger and Fisher (2013) find that "While cutting costs to business has become the principal focus of economic development policy in many states, more and more states are cutting programs across the spectrum to lower state taxes. In many cases these ideas are promoted as a way to attract employers from other states—to steal jobs by offering incentives to business leaders. But the preponderance of evidence has shown that in the long run these strategies are inefficient and ineffective (see also, Fisher, 2013; Mazerov, 2013; Lynch 2004)." They show that "low taxes to capture private investment from other states is a race-to-the-bottom state economic development strategy that undermines the ability to invest in education."

Fox and Murray (1990) reveal that the positive effects of increased expenditure on schooling outweigh the negative effects of taxes on firms and businesses. Plaut and Pluta (1983) present evidence that "previous studies have consistently found that state and local taxation is not a significant variable in industry location." These works include Advisory Commission on Intergovernmental Relations (1967,1981), Dean and Carroll (1977) and Williams (1967). Further, and Plaut and Pluta (1983). These studies find that businesses consistently rank educational expenditures as a desirable governmental expenditure, and that while taxes are a component affecting firm location, they are not first, second or third on the list, and that low

tax burdens typically imply low levels of public services. The preponderance of evidence has shown that in the long run, low tax strategies are inefficient and ineffective (Fisher 2013; Mazerov 2013; and Lynch 2004).

More recent work in other countries by Araurzo and Viladecans (2009), Alanon et al. (2007), Autant-Bernard (2006), Cieslik (2005) and Holl (2004) all stress the benefits of education, including knowledge spillovers and skilled workforce as a critical factor in influencing a firm's decision to locate. In a comprehensive review of more than 4 dozen studies, Arauzo-Carod, Liviano-Solis, and Manjon-Antolin (2010) posit "most studies tend to conclude that geographical areas that have a higher-mean level of education in the working population are more attractive;" see also Couglin et al. (1991); Woodward, (1992), Simth and Florida (1994); and Coughlin and Segev (2000) for the critical importance of education as a significant factor in firm's location decision. Arauzo-Carod, Liviano-Solis, and Manjon-Antolin (2010) confirm that "according to earlier studies on industrial location, the effect of taxation is ambiguous see e.g., Lugar and Shetty (1985) and Buss (2001) for an overview."

Gabe and Bell (2004) present evidence that "there is a trade-off between taxes and the provision of public goods and services in that high-tax location remain attractive as long as they spend large sums of money on the provision of public goods and services." They show that low tax locations are not attractive to firms, due to the poor provision of public goods and services. Gebremariam, Gebremedhin and Shaeffer (2011) estimate the positive spillovers of public spending and their work reveals the positive effects of education on business location. Kampelmann and Rycx (2012) highlight the relevance of higher education's relationship to firm business productivity, and document that under- education (dropouts) is detrimental to firms. Chi (2008), Liu (2007) and Lopez-Bazo and Moreno (2008) all establish that increases in educational attainment lead to higher productivity, which is critical to a firm's success. Psacharopoulos and Patrinos (2004) estimate that education attainment increases have an average rate of return of 10%, far higher than the real return of capital of 2-3%.

In a large study of Colorado businesses that had relocated, expanded or newly launched, Love and Crompton (1999) show that quality of life factors in Colorado are statistically relevant for

firms choosing to locate in the region. Further, the quality of primary/secondary education ranked higher (in terms of important or very important) than personal income taxes.

The fact that increased spending on education per student has positive effects on the local or state economy in terms of jobs and/or income has also been established by Tannenwald and Kendrick (1995), Dalenberg and Partridge (1995), Garcia-Mila and McGuire (1992), Testa (1989), Helms (1985) and Waslenko and McGuire (1985). Krueger and Ludwig (2013) present evidence that economic growth would be higher if taxes are raised to pay for education, as the investment in education has not reached diminishing returns in the U.S.; thus, increases in Colorado's taxes to support education will benefit the state overall, and the reforms provided in Colorado's education bill funded by Amendment 66 will lead to more businesses moving to Colorado.

Why Education Spending Helps – The Importance of Preschool

How can we improve education quality? The academic literature below shows a clear link between increased spending on early education including pre-school, all day kindergarten programs, and more attention paid to children in early grades. Diefendorf and Goode (2005) find that an extensive body of research indicates that high quality early intervention for at-risk infants, toddlers and young children and their families is a sound economic investment: "Studies have found a number of long-term cost savings in terms of decreased grade repetition, reduced special education spending, enhanced productivity, lower welfare costs, increased tax revenues, and lower juvenile justice costs". Additionally, Barnett (2011) finds that a broad range of early educational interventions are found to produce meaningful, lasting effects on cognitive, social, and schooling outcomes. Federal Reserve economists Rolnick and Grunewald (2003, 2010) mention that early childhood programs should be at the top of state and local government's agendas due to very high public returns: they cite a cost/benefit of 8 to 1. They find that an educational investment of $12,356 yields gains of $108,000 (in 2003 dollars). Using these calculations, in 2013 the gains to Colorado of $650 million spending in these types of programs are more than $4 billion.

Belfield, Nores, Barnett, & Schweinhart (2006); Deming (2009) and Krueger & Whitmore (2001) present considerable statistical analysis that childhood educational interventions including preschool can produce long-term benefits. In a comprehensive review of 36 studies,

Barnett (1995) finds positive long-term effects of early childhood programs on cognitive and school outcomes. Results indicate that early childhood programs can produce large short-term benefits for children on intelligence quotient (IQ) and sizable long-term effects on school achievement. Moreover, Garces, Thomas and Currie (2002) indicate that participation in preschool programs for white children is associated with a significantly increased probability of completing high school and attending college, and evidence of elevated earnings in one's early twenties. African Americans who participated in Head Start are significantly less likely to have been charged or convicted of a crime. The evidence also suggests that there are positive spillovers from older children who attended Head Start to their younger siblings. They conclude: "Head Start participants gain social and economic benefits that persist into adulthood." Overall, though these gains are not typically modeled or accounted for in an impact/cost benefit analysis study, Nores and Barnett (2013) find that preschool by itself can close half the achievement gap, and recently summarize the benefits from preschool investments (these gains are not typically modeled or accounted for in an impact/cost benefit analysis study as follows:

- Higher Achievement test scores
- Increased High school graduation
- Less Special education and grade repetition
- More educational success and higher wages
- Lower Behavior problems, delinquency, and crime
- Decline in welfare dependency
- Lower Smoking, drug use, depression
- Lower Social services costs
- Lower Crime costs
- Lower Health care costs (teen pregnancy and smoking)

Additionally, studies show that early educational intervention partially offsets the negative impacts of poverty and inadequate learning environments on child development and school success (Barnett, 2011). Magnuson, Meyers, Ruhm and Waldfogel (2004) document that preschool programs reduce inequality and increase poor at-risk children's success later in school. Nobel Prize Winner James Heckman and Cunha (200) show "economic returns to initial investments at early ages are high," and that early investment in disadvantaged children must be followed by later investment." Heckman and Cunha find that specialized programs toward economically disadvantaged children must continue throughout all grades. Thus,

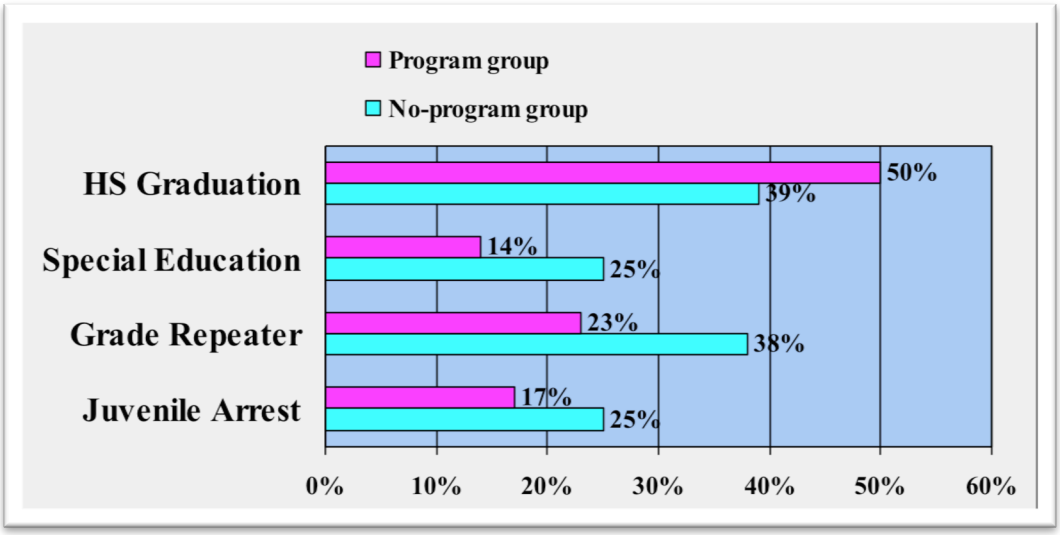
Ludwig and Phillips (2007), after reviewing new accumulating evidence on preschool programs, including Head Start's long-term effects on early cohorts, demonstrate that early pessimists were incorrect and that the benefits of investment in early education clearly outweigh its costs.

Table VI: Economic Returns to Pre-K for Disadvantaged Children
(In 2006 dollars, 3% discount rate)

	Cost	Benefits	B/C
Perry Pre-K	$17,599	$284,086	16
Abecedarian	$70,697	$176,284	2.5
Chicago	$8,224	$83,511	10

Source: Barnett, W. S., & Masse, L. N. (2007). Early childhood program design and economic returns: Comparative benefit-cost analysis of the Abecedarian program and policy implications, *Economics of Education Review, 26,* 113-125; Belfield, C., Nores, M., Barnett, W.S., & Schweinhart, L.J. (2006). The High/Scope Perry Preschool Program. *Journal of Human Resources*, *41*(1), 162-190; Temple, J. A., & Reynolds, A. J. (2007). Benefits and costs of investments in preschool education: Evidence from the Child-Parent Centers and related programs. *Economics of Education Review, 26(1), 126-144.*

Figure VII: Early Childhood Gains to lower class size



The evidence clearly illustrates below that early education benefits are considerable and exceed their costs by several times; students involved in an early education program experience increases in high school graduation, need fewer special education classes, repeat grades less

often and are arrested at a lower rate. Colorado needs to offer our students the same advantages.

Why Education Spending Helps – Smaller Classes

Approximately 85% of Amendment 66 will be targeted toward teachers and staff, including the hiring of 10-15,000 teachers and staff. Altonji and Dunn (1996) show that higher spending per pupil, along with higher teacher salaries, raises school quality and educational outcomes. Boozer and Rouse (2001) offer strong evidence that larger classes have a significant and negative effect on test scores. Word et al. (1994), Mosteller (1995), Krueger (1999), Krueger and Whitmore (2001) and Eide and Showalter (2010) all demonstrate that the STAR initiative (a program that reduced class size in Tennessee) had significant positive effects on tests scores and on the likelihood of taking a college-entrance exam.

Mitchell & Mitchell (1999), Molnar, Smith, & Zahorik, (1999) and Ehrenberg, Brewer, Gamoran, & Willms (2001) prove that smaller class sizes in lower grades boosts student reading and math scores. Fidler, (2001) and Nye, Hedges, & Konstantopoulos (2001) present statistical results demonstrating that the achievement of students in small classes outpaces that of students in larger classes by a widening margin for each additional year spent in small classes. Nye, Hedges, & Konstantopoulos (2004) further find that the benefits of smaller class size in primary school last more than five years. Rice (1999) determines that teachers with small classes give more individual attention to students. High school math teachers with small classes were found to engage with individual students and small groups more frequently than teachers with larger classes, possibly because they spend less time on classroom management than teachers in larger classes. Krueger (2003) estimates that hiring more teachers and reducing class size by 31% has a (discounted present) value of $38,000. If Colorado hired 11,000-15,000 teachers and reduces class size by 15-20%, the increase in income to the state is $3200-$4,100 million (assuming that 75% of the children stay for most of their working lives). Work by Levin, Belfield, Muenning and Rouse (2007) demonstrates that 4 years of smaller classes in early grades would lead to an additional 11 students graduating for every 100 students. Given that Colorado has more than 320,000 in early grades, a decrease in class size of 22% would lead to an extra 24,200 high school graduates, or 6050 per year.

Why Education Spending Helps – Teacher Effectiveness

A critical piece to education reform is increasing teacher effectiveness. In 2010, Colorado passed a Senate Bill, 191, Teacher and Principal Accountability Act, that would allow poor teachers to be fired, but there was not money to implement the plan. A large chunk of the funding provided by Amendment 66, $366 million, goes to Teacher and Leadership Investment – giving incentives for good teachers to stay, and implementing monitoring programs that would make it possible to fire poor teachers. Work by Belfield and Heywood (2008) shows that performance-related pay substantially increases job satisfaction, and this leads to significantly higher high school graduation rates (Levin, Belfield, Muennig and Rouse, 2007). Woessmann (2011) further presents significant evidence that performance-related pay will boost student performance by one-quarter standard deviation. Leigh (2012) demonstrates the importance of teacher pay in boosting teacher aptitude and attracting better teachers. Chetty, Friedman and Rockoff (2011) further provide substantial statistical evidence of the importance of replacing "teachers in bottom 5% with one of average quality would generate cumulative earnings gains of $52,000 per student or more than $1.4 million for the average classroom"; discounting at a 5% interest rate to age 12 yields a present value gain of more than $250,000 per classroom." If Colorado were to replace 1.5% of its poor teachers, there would be gains of $180,000 million dollars. Performance pay increases of 6% by Levin, Belfield, Muennig and Rouse (2007) show this would lead in Colorado to increases of 5200 high school graduates.[4]

Lastly, Belfield, Levin, and Rosen (2012) estimated the cost of lost economic opportunities (as well as fiscal costs from foregone tax revenues), and additional public costs (such as crime and higher public health and welfare costs) of so-called "opportunity youth" at $258,240 per youth, over a lifetime in present value, and the cost to society at $755,900. Assuming that 75% of the 11850 graduates stay in Colorado work in for most of their adult lives, the gain to Colorado is $6 billion.

[4]Hanushek (2011) documents that raising teacher effectiveness by one standard deviation leads to "marginal gains of over $400,000 in present value of student future earnings with a class size of 20 and proportionally higher with larger class sizes." He notes that replacing the bottom 5-8% of poor teachers with average teachers could move the U.S. near the top of international math and size 'with a present value of 100 trillion." Using Hanushek's numbers, even replacing .1% of teachers would justify Amendment 66.

Education promotes higher housing prices

Public school quality is one of the most important determinants of housing prices (Haurin and Brasington, 1996; and Goodman and Thibodeau, 1998; Black, (1999) and Brasington, 1999). Chiodo, Hernandex-Murillo and Owyang (2010) offer significant evidence that differences in school quality generate substantial housing price differences; a one standard deviation increase is associated with a 11- 15% increase in home prices. Using Krueger's (2003) estimate that $800 leads to .15 standard deviation increase, the roughly $1,100 spending per student will lead to 2.3-3.1% increase in housing prices.

Higher housing prices, according to Carroll, Otsuka and Slacalek (2011), in turn cause increased spending in the area, which generates jobs and income for Colorado residents. These authors estimate a 9% increase in spending for every dollar housing prices increase; e.g., assuming a more conservative 7%, this implies an extra $500 spent by Colorado residents of which $375 is on local Colorado goods and services. Given the 1.5 million homes in Colorado, this implies $559 million in additional spending. Campbell and Cocco (2006), Muellbauer (2007) and Slacalek (2009) additionally document the strong positive relationship between housing prices and local and national economic spending. Thus, better schools will lead to increased demand for housing in Colorado, which in turn generates positive economic activity. The simple explanation is that parents with school-age children are willing to pay a premium for housing that gives their children access to superior schools (Black, 1999). Thus, increases in educational spending will make Colorado a more desirable place and boost home prices substantially. Using Carroll, Otsuka and Slacalek's (2011) conservative estimates, spending increases by more than $550 million on local Colorado products, thereby boosting jobs and income.

Education discourages crime

Harlow (2003) reports that 2/3 of all prison inmates in the U.S. are high school dropouts and results are robust after controlling for family background (Lochner, 2004). Lochner and Morretti (2004) shows that "Schooling significantly reduces the probability of incarceration and arrest" due to changes in criminal behavior and imply that the social return exceeds the private return, and further, due to large social costs of crime, "even small reductions in crime associated with education maybe economically important." A 2% increase in high school

completion rates then saves Colorado more than $55 million in reduced costs incurred by victims and society as a whole. Such positive externalities from increased education amount to $1400-2500 per additional high graduate. Lochner and Morretti (2004) find that "It is difficult to imagine a better reason to develop policies that prevent high school drop out."

In a comprehensive work, Currie (2001) documents that preschool programs reduce crime, while Merlo and Wolpin (2009) also establish that sizeable improvements in education "substantially reduce crime in late adolescence and early adulthood"; e.g., the probability of committing a crime falls by 13% by age 19; total crime and arrest rates fell by 42% and 23%, respectively. Cullen, Jacob and Levit (2006) and Deming (2011) offer compelling statistical evidence that by winning a high school lottery in Chicago raises peer graduation by 6%, and these students experienced 60% fewer arrests. Buonanno and Leonida (2006) and Machin, Marie and Vujic (2012) find that increases in education in Italy and UK additionally lead to considerable reductions in crime.

Lochner (2004, 2011) as well as Fella and Galllipoli (2009) developed a model that clearly shows that increases in education raise wages, increases future legitimate work opportunities, and then also discourages participation in crime. Becker and Mulligan (1997) also document that education teaches individuals to be more patient, which discourages crime, since forward-looking individuals place greater weight on possible punishments associated with criminal activities. The impact of education on crime is shown by Table I.

Table I: Social Benefits of Increasing High School Completion by 1%

	Total Cost per crime	Est. Change in Arrests	Est. Change in Crimes	Social Benefit
Violent Crimes				
Murder	4,506,253	-373	-373	$1,683,083,243
Rape	132,938	347	1,559	-$207,270,899
Robbery	13,984	134	918	-$12,839,495
Assault	14,776	-7,798	-37,135	$548,690,721
Property Crimes				
Burglary	1,471	-653	-9,467	$13,920,409
Larceny/Theft	295	-1,983	-35,105	$10,347,853
Motor Vehicle Theft	1,855	-1,355	-14,238	$26,414,558
Arson	58,171	-69	-469	$27,302,131
Total		-11,750	-94,310	$2,089,648,519

Notes: These costs reflect incarceration and victim costs. Victim costs are taken from Miller, et al. (1996). Incarceration costs per crime equal the incarceration cost per inmate multiplied by the incarceration rate for that crime (approximately $25,000). Incarceration rates by offense type are calculated as the total number of individuals in jail or prison (from U.S. Department of Justice, 1994) divided by the total number of offenses that year (where the number of offenses are adjusted for non-reporting to the police). Incarceration costs per inmate are taken from U.S. Department of Justice (1999). All dollar figures are translated into 2008 dollars using the CPI-U. Source: Lochner and Moretti (2004).

Overall, Lochner's (2011) comprehensive work demonstrates that:

- education raises wage rates which raises the opportunity costs of crime
- education may directly affect the financial or 'psychic' reward from crime
- education may alter preferences for risk-taking or patience
- schooling may affect the social networks or peers of individuals.

Table II: Annual Criminal Activity by Dropouts Aged 20

	Per 1,000 high school dropouts		*Impact from expected high school graduation*
	Arrests	*Crimes*	
Murder	0.48	0.82	–19.6%
Rape	0.69	2.43	–19.6%
Violent crime	14.02	32.24	–19.6%
Property crime	42.95	279.17	–10.4%
Drugs offenses	60.04	600.43	–11.5%

Sources: UCR (2004) adjusted for undersurvey; Wolf and Harlow (2003); Lochner and Moretti (2004).
Notes: Violent crime includes robbery and aggravated assault. Property crime includes burglary, larceny-theft, arson, and motor vehicle theft. The share of total arrests by high school dropouts is based on incarceration rates.

Thus, Colorado can save millions of dollars of taxpayer money, save lives, and prevent "wasted lives" (Belfield, Nores, Levin, and Rosen, 2012) by increasing spending on education. Also, these benefits further are generally not captured in impact analysis, and hence most economic modeling underestimates the social benefit of increases in education.

Education promotes health and reduces poverty

Increases in education attainment are also important in improving children's health, cognitive abilities, and academic achievement (see, Wolfe and Zuvekas (1995); Haveman and Wolfe, (1995); and Smith, Brooks-Gunn, and Klebanov (1997)). Grossman and Kaestner (1997) as well as Grossman (2000, 2006) prove that education is even more strongly related to health than income or occupation; for example, white males with at least some college education could expect to live 6.2 years more than less educated counterparts (Meara et al. 2008).

Johnson (2010) reveals that accessibility to quality schools and educational resources are key engines for upward mobility and can break the cycle of poverty. Johnson (2009) establishes strong correlations between health and education, which tend to perpetuate inequality. The accessibility of quality schools and educational resources for children are key engines of upward mobility in the United States, holding the potential to break the cycle of poverty from one generation to the next. Inequalities in economic status tend to be correlated across generations in part because of intergenerational correlations in health and education (Johnson 2009). Wagstff (1993) and Grossman (2005) present significant evidence that increased schooling improves health and reduces the number of doctor visits. Johnson (2010) as well as Cutler and Lleras-Muney (2010) demonstrate that increased education improves health; e.g., a 10% increase in student spending during adolescence is associated with a 3 point increase in the adult health utility index which is roughly 8 years longer. Head start participation also significantly increased health outcomes (lower diabetes, smoking and obesity).

Lleras-Muney (2005) determines that each additional year of education reduces ten-year mortality by 6%, and Lleras-Muney and Jensen (2013) shows that additional schooling causes results in lower rates of smoking and teenage drinking. Cutler and Lleras-Muney (2010) find that a high school dropout of the same age could expect to live 8 fewer years fewer than a college graduate, and "this is enormous difference in life expectancy by education is true for every demographic group, is persistent – if not increasing – over time (Kitagawa and Hauser,

1973; Elo and Preston, 1996; Meara, Richards, and Cutler, 2008), and is present in other countries (Marmot, Shipley, and Rose, 1984 (the U.K.); Mustard, et al. 1997 (Canada); Kunst and Mackenbach, 1994 (northern European countries)."

Glied and Lleras-Muney (2008) further find that increases in compulsory schooling led to significant declines in death rates caused by disease. Oreopoulos (2006) shows that an additional year of school reduces disability limiting personal care or mobility by about 30%. Currie and Moretti (2003) estimate that every year of college reduces the likelihood of a low birth weight baby by 20% and a pre-term birth by 15%. Additionally, education also reduces smoking during pregnancy by 33%. Milligan, Moretti and Oreopoulos (2004) further present considerable statistical results that increased education leads to large social returns including lower rates of smoking and drunk driving. Therefore, increasing expenditures on education in Colorado will lead to considerable health gains for its residents; these benefits, which are largely nonpecuniary, are not taken into account by standard economic modeling and impact analysis.

Table III: U.S. Studies of the Effects of Schooling on Health

Study	Data	Sample	Instrument	Schooling Measure	Health Outcome	Estimated Effect: No Instruments	Estimated Effect: IV Methods
						OLS/Probit (Marg. Eff.)	IV/2SCML (Marg. Eff.)
Mazumder (2008)	Survey of Income and Program Participation (1984, 1986-88, 1990-93, 1996)	Native Whites Born 1901-25	State-Level Compulsory Schooling Laws	Years of Education	Self-Reported Heath Fair or Poor	**-0.036** (0.001)	**-0.082** (0.034)
					Number of Nights in Hospital Last Year	**-0.073** (0.0186)	-1.083 (0.767)
					Trouble with Stairs	**-0.025** (0.001)	-0.007 (0.032)
					Health Limitation	**-0.025** (0.0013)	**-0.074** (0.035)
						OLS	2SLS
Oreopoulos (2006)	U.S. Censuses (1950-2000)	Natives Born 1901-56, Ages 25-84 at Time of Survey	State-Level Compulsory Schooling Laws	Average Years of Education	Disability that Limits Personal Care	**-0.014** (0.0003)	**-0.025** (0.006)
					Disability that Limits Mobility	**-0.020** (0.0004)	**-0.043** (0.007)
						OLS	2SLS
						Women / Men	Women / Men
Kenkel, Lillard & Mathios (2006)	National Longitudinal Survey of Youth, 1979 Cohort	Born 1957-64 Observed in 1998 (Oversamples Minorities & Poor Whites)	High School & GED Requirements & Policies	High School Graduate Indicator (GED results not reported here)	Currently Smoke	**-0.194** / **-0.226** (0.030) (0.029)	-0.102 / **-0.229** (0.124) (0.088)
					Obese	0.005 / 0.013 (0.029) (0.026)	-0.021 / -0.008 (0.139) (0.082)
						OLS	Risk of Induction / Risk of Induction x Risk of Being Killed
de Walque (2007)	National Health Interview Survey - Smoking Supplements (Various years 1983-1995)	Natives born 1937-56, aged 25+ at the time of the survey	Risk of Induction in Vietnam War	Number of Years of Education Above High School	Currently Smoke	**-0.040** (0.004)	-0.038 / **-0.040** (0.020) (0.019)
					Stopped Smoking	**0.041** (0.002)	0.051 / **0.066** (0.031) (0.029)
				Indicator for College Graduate or More	Currently Smoke	**-0.173** (0.015)	-1.169 / **-0.181** (0.642) (0.087)
					Stopped Smoking	**0.178** (0.010)	2.190 / **0.297** (1.395) (0.133)
						OLS	2SLS
Grimard & Parent (2007)	Current Population Survey Tobacco Supplements (1995, 1996, 1998, 1999)	White native-born citizens at least age 25, born 1935-74	Vietnam Draft Cohort Indicator (Born 1945-50)	Years of Education	Currently Smoke Every Day	**-0.055** (0.002)	**-0.136** (0.024)
					Ever smoked	**-0.043** (0.002)	**-0.111** (0.029)

Notes: Standard errors in parentheses. de Walque (2007) provides t-statistics rather than standard errors; standard errors are calculated as the reported estimates divided by reported t-statistics. 2SCML reflects the two-stage conditional maximum likelihood estimator. Estimates in bold are statistically significant at 0.05 level

Table IV: Channels through which Education Improves Health

Channel	Private Costs	Benefits Private or Public?
1. Reduce Stress	None	Private
2. Better Decisionmaking Ability/Use of Inputs	None	Private
3. Better at Gathering/Interpreting Information	None	Private
4. Health Insurance	Financial	Private
5. Healthier lifestyle		
a. Safety Precautions (e.g. seatbelts, smoke alarms)	Utility, Financial	Private
b. Diet	Utility, Financial	Private
c. Exercise	Utility, Financial	Private
d. Non-Smoking, Alcohol Moderation, Avoiding Drugs	Utility, Saves Money	Private
6. Healthier/Safer Employment	Lower Wages	Private
7. Healthier Neighborhoods	Housing Prices	Private
8. Healthier Peers and Friends	None	Public

Source: Lochner 2011

Table V: Effects of Years of Education on Health and Mortality by Outcome

Study	Country	Outcome Details	Sample Average	Estimated Effect	Effect as % of Average
A. Mortality					
Mazumder (2008)	U.S.	10-Year Mortality Rates	0.213	0.006	2.8%
Lleras-Muney (2005, 2006)	U.S.	10-Year Mortality Rates	0.106	-0.063*	-59.4%
Clark & Royer (2010)[a]	U.K.	Prob. of Dying b/w Ages 45 & 69	Women: 0.146 Men: 0.221	0.004 0.012	2.7% 5.4%
Albouy & Lequien (2009) [b]	France	37-Year Mortality Rate	Ages 15-42: 0.07 Ages 45-82: 0.40	-0.013 -0.063	-18.6% -15.8%
B. Self-Reported Health					
Mazumder (2008)	U.S.	Self-Report Fair or Poor	0.357	-0.082*	-23.0%
Clark & Royer (2010)	U.K.	Self-Report Fair or Bad Long Illness	0.25 0.46	-0.005 0.023	-2.0% 5.0%
Oreopoulos (2006, 2008)	U.K.	Self-Report Poor Health Self-Report Good Health	0.150 0.564	0.007 -0.01	4.7% -1.8%
Silles (2009)	U.K.	Self-Report Good Health No Long-Term Illness	0.661 0.685	0.064* 0.075*	9.7% 10.9%
Kemptner, Jurges & Reinhold (2010)	Germany	Long-Term Illness	Women: 0.15 Men: 0.20	0.013 -0.039*	8.7% -19.5%
C. Disability, Limited Mobility, Activity					
Mazumder (2008)	U.S.	Health Limitation	0.423	-0.074*	-17.5%
Oreopoulos (2006)	U.S.	Disability Limiting Personal Care Disability Limiting Mobility	0.092 0.128	-0.025* -0.043*	-27.2% -33.6%
Clark & Royer (2010)	U.K.	Reduced Activity Physically Active	0.16 0.44	0.014 -0.001	8.8% -0.2%
D. Smoking					
Clark & Royer (2010)	U.K.	Currently Smoke	0.27	-0.035*	-13.0%
Kenkel, et al. (2006)[c]	U.S.	Currently Smoke	Women: 0.26 Men: 0.27	-0.229* -0.102	-88.1% -37.8%
de Walque (2007)[d]	U.S.	Currently Smoke	0.40	-0.040*	-10.0%
Grimard & Parent (2007)	U.S.	Currently Smoke Every Day Ever Smoked	0.31 0.58	-0.136* -0.111*	-43.9% -19.1%
Kemptner, Jurges & Reinhold (2010)	Germany	Currently Smoke Currently Smoke Ever Smoked Ever Smoked	Women: 0.24 Men: 0.36 Women: 0.39 Men: 0.63	0.001 0.005 0.014 -0.012	0.4% 1.4% 3.6% -1.9%
E. Obesity					
Clark & Royer (2010)	U.K.	Obese	0.21	0.028	13.3%
Kemptner, Jurges & Reinhold (2010)	Germany	Overweight Overweight Obese Obese	Women: 0.44 Men: 0.66 Women: 0.13 Men: 0.16	-0.016 -0.034* 0.007 -0.028	-3.6% -5.2% 5.4% -17.5%
Brunello, Fabbri & Fort (2009)	10 European Countries	Overweight (Women) Obese (Women)	0.387 0.114	-0.044* -0.012	-11.4% -10.5%
Kenkel, et al. (2006)[c]	U.S.	Obese	Women: 0.27 Men: 0.25	-0.021 -0.008	-7.8% -3.2%

Notes: [a]Clark and Royer (2010) do not report IV estimates for the effect of education on mortality; values reported in table reflect RD estimated effect of 1947 reform on death rates between ages 45 and 69 divided by the effect of the reform on average years of completed schooling. [b]Mortality estimates for Albouy & Lequien (2009) are calculated from survival rates; mortality rates inferred from from Figures 1 and 2. [c]Kenkel, et al. (2006) estimates are for high school graduation rather than years of schooling. [d]Average smoking rates for de Walque (2007) inferred from Figure 1 for those with a high school degree. * denotes statistical significance at 0.05 level.

Education encourages entrepreneurship

In a comprehensive review of three decades of the effects of education on entrepreneurship, Unger, Rauch, Frese and Rosenbusch (2010) document a significant positive relationship between education and self-employment. Colombo and Grilli (2005) establish the importance of education and its relationship to venture capital and high tech startups. Davidsson and Honi (2003) demonstrate that education is critical for new startups, and Robinson and Sexton (1994) indicates that general education has a strong positive influence on entrepreneurship in terms of becoming self-employed and successful. Sockice (1993); Heckman (2006); Glaeser, Ponzetto, and Schleifer (2005), and Green and Ridell (2003) all

present strong statistical evidence that education is strongly and positively related to critical thinking and social skills; these skill sets are critical for entrepreneurial success. Shane and Venkatraman (2000) and Westhead, Ucbasaran and Wright (2005) show increases in education raise the likelihood of entrepreneurs in discovering and exploiting new business opportunities.

Education also explains why entrepreneurship rates differ across states; e.g., Gurley-Calvez, Hammon and Thompson (2010) establish that human capital is an important determinant of the individual decision to pursue entrepreneurship, and that increased education investment stimulates self-employment growth. The rise in entrepreneurship generated by gains in education will raise economic growth since entrepreneurs playing a crucial role in facilitating "knowledge spillovers" in the local economy (Audretsch and Keilbach, 2005; Camp, 2005; and Shrestha et al., 2007). Therefore, augmenting educational investment then will generate more start-ups, high tech startups, and economic growth in Colorado.

Conclusion

Overall, Colorado's effort to boost education achievement through early education initiatives such as preschool programs and hiring more teachers will lower class size, boost student educational achievement, and lead to improved schools. These educational programs add significant pecuniary and nonpecuniary benefits to Colorado's economy, and are not captured by standard economic impact modeling. Colorado gains when its children perform better in school, and investing in our schools today will improve Colorado's future.

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