The Costs and Benefits of an Excellent Education for America's Children – Technical Appendix

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1 The Importance of Education

1.1 The Role of Education

This study investigates whether an investment in an excellent education for all America's children has a fiscal pay-off. The investment criterion is a simple one: public investments are worth making if the benefits exceed the costs. Even if education is expensive, poor and inadequate education for substantial numbers of our young may have consequences that are even more costly. Such an analysis goes beyond the more basic question of social justice. If life chances depend heavily on education, it is important that inequalities in education associated with race, gender, immigrant status, language, and handicap be redressed as a basis for equalizing opportunities in a democratic society. But, even beyond the issue of injustice is the question of whether a poor quality education has consequences for the larger society. Social science research shows that poor education imposes social burdens via lower incomes and economic growth, lower tax revenues, and higher costs of such public services as health, criminal justice, and public assistance. In this respect, it is possible to view efforts to improve educational outcomes for at-risk populations as a public investment that may have benefits for the entire society in excess of investment costs. This study provides a full estimate of the size of the financial burden imposed on the general population caused by failing to provide an excellent education for America's children.

1.2 What is an Excellent Education?

Precisely what constitutes an excellent education differs among observers. Some would argue that the U.S. should be at or near the top in student performance on international comparisons of achievement. Others would say that all students should meet meaningful levels of proficiency in mathematics, reading, writing, science, and social studies as measured by standardized testing. Others would focus on the ability of students to solve problems and to analyze complex situations in a critical manner.

We have chosen to use high school graduation as a <u>minimal</u> criterion for an excellent education. High school graduation is usually a prerequisite for engaging in further training and education as well as relatively stable employment and occupational advancement. High school graduation opens up a range of educational and training possibilities that would otherwise be closed to individuals. By viewing educational improvement in terms of raising educational attainments, our results comprise attributes

that lead to success beyond test scores. Non-cognitive attributes produced by schools may have a larger effect on adult behavior and success than test scores (Heckman et al., 2006). The advantage of comparing the costs and benefits across years of schooling is that they capture many of the cognitive and non-cognitive differences rather than simply those associated with achievement scores. Also, Rumberger and Palardy (2005) argue that a school's dropout rate should be considered as one of the indicators of school effectiveness.

Critically, we are far from close to fulfilling the basic goal of universal high school graduation. As we show below, there are many ways to measure high school graduation rates. But what is clear is that when using high school graduation as the minimal criterion in seeking educational excellence for all students, this criterion is not being met.[1]

1.3 The Cost of Inadequate Education

In this report we compare the public costs of raising high school completion across the population of 20-year olds with the public benefits of doing so. In other words, we conduct a benefit-cost analysis of the use of public resources. It should be noted that available data are not broken down into benefits and costs, but these measures must be derived by constructing models of interventions, estimates of their costs and improvements in educational outcomes, and the benefits of those enhanced outcomes. In this study we estimate costs through the identification of successful educational interventions. We estimate the benefits by exploring the consequences of a minimum of high school completion for students who would otherwise drop out by estimating the additional tax revenues and reductions in the costs of public health, criminal justice, and welfare associated with the additional education.[2]

[1] Another reason for choosing high school graduation as a minimal criterion is that administrative and social science surveys often include educational attainment measures (and rarely include test scores, data on student knowledge, or the quality of educational experiences). Thus, the availability of data on attainment permits us to link attainment statistically to a variety of outcomes which have public costs or benefits.

[2] Levin (1972) calculated the social costs of failing to ensure high school completion for 25-34 year old males in 1970. Levin (1972) found that $1.2 trillion in lifetime income (2004 dollars), or 10% of national income, was lost by the failure to complete high school. The cost of this public investment was estimated at $200 billion. But, the additional tax revenues generated, $360 billion, would have easily covered these costs. (Estimates were also made of costs in public assistance, crime, political participation, health, and intergenerational mobility). Given the data sources and analytical methods available almost four decades ago, these estimates should be considered as provocative rather than indicative of current circumstances.

For this analysis we must rely upon available data that were not designed initially to address these purposes. Thus, the data are often in forms that must be transformed into measures of costs and benefits or adjusted in other ways to be useful. Estimates can differ according to these procedures. We have chosen "best estimates" by taking the most reasonable assumptions in making our calculations. Additionally, we examine what the outcomes would be using a range of other plausible assumptions to see if our conclusions would be modified. As we show below, we believe that the cost-benefit calculation is conservative and we perform sensitivity tests to see how our conclusions would vary under alternative scenarios.

The remainder of the report is organized as follows. Below we review more fully estimates of dropout rates and high school completion as well as post-secondary participation for additional high school graduates. Section 2 describes the search for interventions to improve high school graduation rates and the costs of five interventions that have proven effectiveness. Subsequent sections provide estimates of public benefits that result from additional education for high school dropouts with a specific focus on additional tax revenues, reduction in public health insurance costs, reduction in the public costs of criminal justice, and a reduction in the public costs of welfare. (There are other public benefits from an investing in education, such as informed citizenry, but we do not count these because of insufficient research). The final section combines this information in a benefit-cost analysis which reveals the considerable public benefits in excess of costs for improving the education of America's children.

1.4 High School Graduation Rates

There is no clear consensus on the definitions of high school graduation, completion, or dropout status.[3] Some students may complete high school but not graduate, i.e. complete school with a level of knowledge and skills that is deemed appropriate by age 18. Some may take an examination in lieu of completing secondary school, such as the General Educational Development (GED); but this may not fully capture what is learned by attending school (on the lack of equivalence between graduation and the GED, see Cameron and Heckman, 1993). Some may drop out and then return to school later. Further, states vary in the exit standards they impose on graduates. Increasingly, states

[3] See Swanson (2004); Barton (2005); Greene (2002); ETS (2004); Haney et al. (2004); Warren (2005); NCES (2003); Orfield et al. (2004); Kaufman (2004); Mishel and Roy (2006); and Holzman (2005).

are requiring students to pass an exit examination in additional to completing a specified set of courses.

Research studies typically use the same method for estimating graduation rates: the number of completers divided by the student population for a given age or grade cohort. However, some studies use contemporaneous figures (e.g., diplomas awarded relative to the age cohort size in a given year) and other studies use lagged figures (e.g., 12th grade graduates relative to the 9th grade age cohort three years earlier). Also, studies vary in how they account for private school enrollments, special education students, and migration.

Two population-level datasets – the Current Population Survey (CPS) of the U.S. Bureau of the Census and the Common Core of Data (CCD) of the U.S. Department of Education – are typically used. However, both have shortcomings for calculating graduation rates. Neither one is longitudinal or based on actual student transcripts, as recommended by Mishel and Roy (2006). The CPS has poor coverage (especially for black males) counts only the civilian non-institutionalized population but includes immigrants, and classifies GED-holders as high school graduates. In contrast, the CCD relies on public school administrative data, estimates 'event status dropout' in terms of on-time graduation rates, and classifies GEDs as dropouts. In addition, both self-reported and administrative data are likely to have significant measurement bias (misreporting and overstatement), particularly for individuals with low education levels.

Table 1.1
National graduation rates

Measure	Graduation rate (%)
High School Completion Rate [e]	67
Graduates/Pop. Rate [f]; Cumulative Prop. Index [a]; Basic Completion Ratio [a]	68
Diploma/Pop. Rate [c]	69
Diploma/Pop. Rate [d]; CCD Enrollment Rate [b]	70
NCES Rate [a]	80
Inverse Dropout Promotion Rate [a]	82

Sources: [a] Swanson (2004); [b] Greene and Forster (2003, App. Table 1) ; [c] Sum et al. (1998); [d] Barton (2005); [e] Warren (2005); [f] Haney et al. (2004).

Table 1.2
Public school graduation rates and high school dropout rates

	On-time graduation rate (%)	High school dropout rate (%)
Male		
White	71	8
Black	42	13
Hispanic	48	32
Female		
White	77	7
Black	56	9
Hispanic	59	22

Sources: Column 1 from Swanson (2004, Table 5) for 2001 school year.
Column 2 from Greene and Forster (2003, Appendix Table 1) ages 16-24.
Notes: Recipients of GED credentials are counted as high school completers.
Data based on sample surveys of the civilian noninstitutionalized population.

Notwithstanding these methodological issues, there is reasonable agreement on the high school graduation rate for public school students. Table 1.1 summarizes nine separate measures: seven report a rate of 67-70%; and two report 80-82%, but these have lower coverage rates of districts and schools so they may be overstated (Swanson and Chaplin, 2003). Given these measurements, we can conclude with reasonable confidence that roughly three out of every ten students will fail to graduate from high school on time.

There are significant differences in dropout rates by race and by gender (Kao and Thompson, 2003). Table 1.2 reports the figures for the two studies that tabulate on-time graduation rates and dropout rates by race and gender. (Graduation is an 'event' at a point in time and dropout is a status that changes over the lifetime.) Whether measured as an event or as a status, Table 1.2 shows that educational attainment is very low, especially for minority groups. Black male public high school graduation rates are 42%; this compares to 48% for Hispanic males and 71% for white males. The disparities are smaller for females, although they follow the same pattern: black females graduate at a rate of 56%, Hispanic females 59%, and white females at 77%.

1.5 Attainment for the Cohort of 20-year Olds

To model the economic effects of high school graduation we focus on a single age cohort. Specifically, we use the Current Population Survey (CPS) for educational attainment levels for the current cohort of 20 year olds. We choose age 20 to allow for those who do not graduate on time. Throughout, we produce information on costs and benefits per individual student.

The distribution of attainment is given in Table 1.3. We adjust the raw figures to account for persons who are incarcerated (and are not counted in the CPS) and for those who have earned a GED (as this is not equivalent to a regular high school diploma). We separate persons by gender and by race/ethnicity – white, black, Hispanic, and other.

A considerable number of males are not high school graduates. Of the 2.3 million males aged 20, 0.5 million are dropouts, with 0.6 million having completed high school and another 1.1 million attending or having completed college. The overall male dropout rate is 23%. After accounting for those who graduate late from high school, this rate corresponds to the national estimates reported in Table 1.1 above. The dropout rate is much higher for black and Hispanic males than for white males.

Table 1.3
Educational attainment of the population aged 20 (thousands)

	<9th grade	9-11th grade (GED)	High school	College level	Total	Dropouts (%)
Male	**63**	**450**	**638**	**1,101**	**2,252**	**23%**
White	18	194	402	749	1,362	16%
Black	6	69	99	127	301	25%
Hispanic	38	168	104	48	358	58%
Other	1	19	33	177	230	9%
Female	**33**	**259**	**508**	**1,183**	**1,983**	**15%**
White	6	100	297	822	1,225	9%
Black	0	71	96	129	296	24%
Hispanic	25	63	81	114	283	31%
Other	2	26	33	118	179	16%

Sources: Current Population Survey (March 2005).
Notes: 9th-11th grade includes those persons with a GED. College level includes those persons with some college and those with at least a BA degree. Dropout percentages include all persons with less than high school education. Race-specific adjustments for rates of institutionalization are from Raphael (2004): the average rate for blacks and other [whites] is 9% [2%]; for those with less than high school education it is 23% [4%]. Race-specific adjustments for GED receipt are from Rumberger's (2004) analysis of NELS (2000): of all graduates, 15% [8%] of blacks and other [whites] are GED-holders.

The bottom panel of Table 1.3 shows a similar pattern for females. There are 0.3 million dropouts, which is 15% of the age cohort. For white females, less than one in ten is a dropout. For black females, one in four is a dropout; for Hispanic females the ratio is almost one in three.

Importantly, many of the Hispanic and other-race persons are immigrants, some of whom did not attend U.S. schools as children. Although a large fraction of the

immigrant population has less than 9th grade education or did not complete high school, this cannot be fully addressed by educational reforms within the U.S. The individual-level figures we present below do not depend on the numbers of immigrants without a high school education. In the aggregate analysis, we present results which may be applied to U.S.-born persons only.

1.6 Increased Educational Attainment after High School

Increasing the numbers graduating from high school will also enable and motivate more individuals to attend college. These may be the same individuals the intervention targeted, or they may be individuals who were previously high school graduates. College enrollment and college completion depends on many factors (e.g. occupational choice, region, parental education). Being a high school graduate is typically a prerequisite for college enrollment. Therefore, we derive an 'expected high school graduate', one who is a high school graduate but also has some probability of progressing on to college and completing a degree.

Table 1.4
College attendance and completion rates by age 20

	Attendance rates for lowest quartile in reading (%)		Completion rates for lowest third of socioeconomic status (%)	
	2-year college	**4-year college**	**2-year college**	**4-year college**
Male				
White	18	12	64	56
Black	17	16	48	49
Hispanic/other	18	9	55	53
Female				
White	24	6	58	65
Black	21	10	47	54
Hispanic/other	21	6	48	57

Sources: For attendance, 1988 National Educational Longitudinal Survey. For completion rates, 1996/2001 Beginning Postsecondary Students Longitudinal Study (NCES, 2002, Table 311).
Notes: College attendance as of 1994 for those aged 20 who are in the lowest quartile for reading. College completion rates within five years of first enrollment.

Table 1.5
Expected high school graduate progression rates

	Highest level of attainment conditional on high school graduation (Probability)		
	High school	**Some college**	**BA or above**
Male			
White	0.80	0.12	0.07
Black	0.75	0.17	0.08
Hispanic/other	0.77	0.18	0.05
Female			
White	0.81	0.14	0.05
Black	0.83	0.11	0.06
Hispanic/other	0.85	0.11	0.04

Notes: Probabilities derived from Table 1.4. Those who fail to complete 4-year college are classified as 'some college'.

Progression on to college – conditional on high school graduation – can be divided into attendance and completion, both of which may vary across race and gender. Table 1.4 shows the respective rates. Attendance rates are calculated directly from NELS-1988, a longitudinal survey following students who were in 8th grade in 1988. Focusing only on those who are in the lowest quartile for reading, 2-year college attendance rates are 17-18% for males and 21-24% for females; attendance rates at 4-year colleges are 9-16% and 6-10%, respectively. For completion rates we use tabulated results from the Beginning Postsecondary Students Longitudinal Study, which follows persons through five academic years from college entry in 1995. Here we restrict the analysis to those in the lowest third of socioeconomic status. Completion rates at 2-year colleges are 64% for whites, 43% for blacks, and 55% for Hispanic/others for males; for females, they are 58%, 47%, and 48% respectively. At 4-year colleges approximately 50% of all males and 60% of all females complete their degree within five years.

Using these progression rates we construct an 'expected high school graduate' by race and gender. Approximately 80 out of 100 new high school graduates are expected to terminate their education after high school. Between 11 and 18 would continue to complete some college and between five and eight would go on to obtain at least a BA degree. These probabilities, by gender and race, are reported in Table 1.5. Based on persons from the most disadvantaged backgrounds, these are very conservative progression rates. They reflect the fact that only education levels are being changed, not ability or family resources. Importantly, they indicate that inducing

dropouts to graduate will yield a further upgrading of education into college resulting in an extra set of economic benefits.

1.7 Aggregate Effects of More High School Graduates

In order to get a sense of the aggregate economic burden of having large numbers of high school dropouts it is necessary to describe an entire age cohort. We consider the 'target group' to be those persons aged 20 who would be high school graduates if effective educational interventions were provided.

Table 1.6
Increase in educational attainment for persons aged 20

	Increase in educational attainment if 50% of those aged 20 with 9th-11th grade education became high school graduates		
	High school	**Some college**	**BA or above**
Male	**175,470**	**34,335**	**14,225**
White	77,600	11,640	6,790
Black	25,875	5,865	2,760
Hispanic	64,680	15,120	4,200
Other	7,315	1,710	475
Female	**107,790**	**15,800**	**6,410**
White	40,500	7,000	2,500
Black	29,465	3,905	2,130
Hispanic	26,775	3,465	1,260
Other	11,050	1,430	520

Notes: Cohort numbers from Table 1.3. College progression derived from Table 1.5.

Aspirationally, we wish to find ways for all students to graduate from high school and to receive an excellent education. However, the literature on the causes of dropouts suggests that this will not be accomplished by even the most promising educational interventions. Both statistical studies and surveys of dropouts suggest that the quality or type of education received is not a sole factor (Rumberger, 2004). Family problems, frequent residential moves and school mobility, limited cognitive or physical abilities, psychological problems, pregnancies, and financial constraints all exert pressure on students to drop out. Experts agree that a more complete response will require not only changes in schools, but the combined support and additional resources of families and communities. Based upon our reading of the literature and expert opinion, we believe that about half of the school dropout rate can be influenced by the effective school interventions that we identify below.[4]

[4] Although it is beyond the scope of this report, we are of the mind that other strategies can further reduce dropouts, but they will draw more heavily upon policies for providing support and

Therefore, we report aggregate results based on a reduction of the dropout rate by 50% for those persons who currently have 9th-11th grade education.[5] This is still a very large number of persons as each age cohort contains 450,000 males and 259,000 females who are dropouts. The effect on educational attainment – accounting for those who would progress on to college – is shown in Table 1.6. If successful, a 50% reduction in the dropout rate would mean 354,030 new high school graduates. The spread by race/ethnicity is given in the table. Most of these persons would terminate their education after high school, but 34,000 males and 16,000 females would progress on to some college education and 14,000 males and 6,000 females would obtain a four-year college degree. These changes in the distribution of attainment are applied below in the aggregate simulations of economic benefits.

resources to families and communities in conjunction with schools (Rumberger, 2004; Rothstein 2004; Levin and Belfield, 2002).

[5] Those with less than 9th grade attainment are not included in the aggregate analysis as educational interventions of the types considered below are unlikely to be sufficiently effective for these individuals. Moreover, we lack information on the types of interventions (and their costs) that would address this small group.

2 Interventions to Raise High School Graduation

2.1 Possible Interventions

The first challenge is to find educational interventions that would help all children attain high school graduation. Although many children live in circumstances that facilitate learning, many others are in families with low incomes, poor housing, inadequate nutrition, and insufficient dental and health care and, therefore, are unable to benefit from good instruction (Rothstein, 2004). Additionally, only about 10% of the waking hours from birth to 18 are spent in school. Therefore, much learning takes place outside of school (Levin and Belfield, 2002). Furthermore, educational strategies to improve learning do not have a highly predictable science in terms of providing assurance on what children from different backgrounds will learn. Although there is general agreement on what makes for a good school environment, not all children will succeed from exposure to the same conditions. Educational strategies and reforms may benefit students differentially according to gender, race, or other factors. Yet, in an age of evidence-based decision-making there is an increasing knowledge-base on school effectiveness that enhances the quest for providing an excellent education for all of America's children.

In order to identify effective interventions for increasing high school graduation rates, we undertook a search of the overall literature on high school completion. This included searches of journal articles in such data bases as JSTOR and ERIC, as well as the use of internet search engines (Google and Yahoo), and the library resources at Columbia University. Of particular interest were evaluation studies of interventions that had been used to increase high school graduation for students in at-risk situations.

Of the hundreds of articles and reports that emerged in this process, very few met the criteria that we had set of showing promise of increasing high school graduation rates on the basis of rigorous and systematic evaluation.[6] In some cases the evaluations of interventions were non-existent or were of very poor quality. Although there are many educational interventions that claim to show positive results, few are based upon careful and rigorous evaluations. Many look at changes in outcomes over

[6] We were especially interested in studies based upon experimental or quasi-experimental methodologies or a credible econometric design. Few use experimental designs with random assignment; quasi-experimental studies with strong design to ensure equivalent groups for comparison; or rigorous statistical and econometric methods to identify effects of interventions (for an overview, see Levin and McEwan, 2001, 115-129; for a full explanation, see Shadish et al., 2002).

time without adjusting for changes in student characteristics, attrition, and other factors which may influence outcomes. Others utilize a comparison school without adjusting for differences in student demography. Some evaluations suggested that there was little educational impact from the examined intervention.

Five studies met our criteria of using a credible evaluation design and yielding improvements in the rates of high school graduation. Other interventions – small schools, vouchers, charter schools, or accountability programs – may yield educational improvements, but as yet there exists no strong evidence. We focus on interventions that have demonstrated effectiveness. The specific interventions supported by research studies are summarized in Table 2.1. Two of the alternative interventions take place at pre-school, one takes place in elementary school, one in high school, and one is implemented across the K-12 years.

Table 2.1
Interventions to increase high school graduation rates

Intervention		Details of the intervention
PPP	Perry pre-school program	1.8 years of pre-school composed of: a center-based program for 2.5 hours per day per weekday (Oct.-May), with a child:teacher ratio of 5:1; home visiting for 1.5 hours per weekday; and group meetings of parents. Program targeted to disadvantaged African American children aged 3-4.
CPC	Chicago child-parent center program	Center-based pre-school program including: parental involvement, outreach services, health/nutrition services. The program was based in public schools and targeted to disadvantaged African American children.
CSR	Class size reduction	4 years of schooling (grades K-3) in which class size is reduced from 25 to 15.
TSI	Teacher salary increase	10% increase in teacher salaries for all years K-12.
FTF	First Things First	Comprehensive school reform with three components: small learning communities (350 students) with dedicated teachers; family advocate system; and instructional improvement efforts.

The Perry Preschool program (PPP) is a high quality pre-school program that was the focus of an experimental study using random assignment (Belfield et al., 2006). Participants were 3 or 4 years of age. The program was in session from October to May of each year and focused on three components: a center-based program for 2.5 hours each weekday morning with a child:teacher ratio of from 5:1 to 6.25:1 with teachers trained in special education and early childhood development; home visits by teachers for 1.5 hours a week to work with parents; and parent group meetings. Participants from

the program were followed up through their school years and beyond. The experimental participants showed superior educational and other outcomes along many dimensions including graduation rates.

The Chicago child-parent centers (CPC) provide early childhood education and family-support services emphasizing mathematics and reading skills, using high staff-student ratios and parental education. (The CPC pre-school program includes both a pre-school and a school-age program, but we focus on the element with the most powerful effects). The evaluation strategy used a quasi-experimental design to compare the performance of CPC participants with a matched control group of non-participants and employed co-variate adjustments to ensure comparability of groups. Members of both groups were followed through to age 20 (Reynolds et al., 2002). High school graduation rates and other educational performance measures of the CPC participants exceeded those of the control group.

Class size reduction (CSR) is a popular strategy that has been traditionally used to improve educational outcomes. However, rigorous evaluations of class size reductions are rare. Fortunately, a large-scale study experiment of reductions in class size was mounted in Tennessee, the so-called Project STAR (Finn and Achilles, 1990). This intervention is modeled here as one example of class size reduction strategies. The methods and results of Project STAR have been examined and largely endorsed by two independent studies (Mosteller, 1995; Krueger, 1999). Students were randomly assigned to larger classes that averaged 22 students to smaller ones that averaged about 15 students for up to four years duration, kindergarten to third grade. Longitudinal follow-up of students found that those in smaller classes for more years had higher test scores and were more likely to graduate from high school than students assigned to larger classes. The largest effects were found for minorities and students from the lowest socioeconomic backgrounds (Finn and Achilles, 1999; Finn et al., 2005).

It has long been argued that we can attract better teachers at higher salaries, and that such teachers will improve student educational results. Presumably the higher salaries generate a more talented teaching force. The teacher salary increase (TSI) study by Loeb and Page (2000) estimated the effects of raising teacher salaries using state data with a ten-year time lag. Although the research design was not experimental, it is a high quality controlled observational study showing the benefits of high quality teaching in raising high school graduation.

First Things First (FTF) is the only high school reform among the effective interventions that demonstrates an effect on high school graduation rates (Quint et al., 2005). It is a particularly important case because it reflects closely the present wave of urban high school reform, with an emphasis on small learning communities, instructional improvement, and teacher advocacy for each student. (Another example of small learning communities at the high school level is the Institute for Student Achievement model).[7] For FTF, small learning communities require that schools or sub-units of schools with which students and faculty are affiliated are limited to no more than 350 students. Additionally, key teachers remain together for several years. Each student is matched with a staff member who meets with the student regularly, monitors student progress, and works with parents to support student success. Instructional improvement focuses on high expectations and rigor in the curriculum as well as engaging approaches that focus on state standards. The research design was an interrupted time-series on data from the site that has accumulated the most extensive FTF experience: Kansas City, Kansas. The evaluation showed higher graduation rates as well as benefits in terms of student attendance and test scores in mathematics and reading.[8]

In each of these five cases we believe that the interventions have shown positive impacts on graduation rates, and that the interventions are replicable. Moreover, the studies have shown larger effects for minorities and low-income families who are most at-risk of dropping out. However, they may not apply to all students equally. In the case of PPP and CPC, almost all of the participants were African American. In the case of CSR, we use the mean effect across the experimental group. The TSI figures are for all groups. For FTF, about half of the students were African American and another 39% were Hispanic.

2.2 The Public Costs of the Interventions

Each of the interventions has overall costs that must be considered in a benefit–cost analysis. First, we estimate the input costs of delivering the interventions based on the resources used. Since our overall analysis is designed to compare the public benefits of

[7] See www.studentachievement.org for further details. As such reforms develop they are more likely to be formally evaluated in relation to changes in high school graduation rates.

[8] One caution here is that implementation in Kansas City showed a high level of commitment to the reform. Schools in other districts that were evaluated did not have this level of commitment or implementation, and their results were much weaker. Thus, replication of results for this reform requires a high degree of commitment to implementation.

additional high school graduates with the public costs, we need to calculate the public cost per additional graduate. Obviously, the cost of an additional graduate will be much greater than the average cost per student receiving the intervention, as some students would graduate without the intervention. Our concern is how many additional students will graduate as a consequence of the intervention and the cost associated with producing each additional graduate.

The costs of the intervention per additional graduate are not the only public costs of higher graduation rates. Each additional graduate obtains more years of high school than dropouts. Thus, we must consider the additional public costs for the extra years of high school for each additional graduate as well as the costs of progression on to college.

Thus, the three components of public cost per additional high school graduate are: (i) public cost per additional graduate of the intervention; (ii) public cost of additional years of high school for each additional graduate; and (iii) public cost of post-secondary education for each additional graduate that continues beyond high school. We calculate the total public cost for each intervention using present values for a person aged 20 in 2004.[9] Present values signify the cumulative value of costs (or benefits) adjusted for their timing. In this study they are calculated using a discount rate of 3.5%, as recommended by Moore et al. (2004). To reflect greater uncertainty and the lower valuation of future benefits, we also apply a discount rate of 5% for sensitivity testing.

Cost Per Intervention

The direct program costs for each intervention are summarized in Table 2.2. These are obtained either from the primary sources or from our own calculations (based on the program ingredients).

For the Chicago child-parent center program (CPC) we use the cost estimates reported in Temple and Reynolds (2006). This program has a powerful effect on reducing special education and grade retention during school years. The associated cost-saving is deducted from the overall program cost. Therefore, the total program cost

[9] Present values are used to ensure that money flows at different times can be compared. The use of present values is known as 'discounting'. Discounting is necessary because $100 received immediately is worth more than $100 received a decade later. (This equation is separate from whether there is inflation or not). For example, the immediate $100 could be invested, and after ten years it would be worth more. Discounting also reflects the certainty of money now versus the uncertainty of money later. Thus, a discount rate must be applied to all money streams, with streams discounted more the further they are from the initial investment time (Levin and McEwan, 2002).

per participant is $2,726 in 2004 dollars. Accounting for inflation and expressed as a present value, the cost per student is $4,728.

Table 2.2
Direct program costs per student for each intervention

Chronology				Cost per student				
Year	Time Period	Grade	Age	Chicago Parent-Child Centers	Perry Pre-school	Teacher salary increase	Class size reduction	First Things First
1988	-16	preK	4	$2,726	$7,227	-	-	-
1989	-15	K	5	-	-	$178	$2,019	-
1990	-14	1	6	-	-	$174	$2,093	-
1991	-13	2	7	-	-	$170	$2,172	-
1992	-12	3	8	-	-	$168	$2,227	-
1993	-11	4	9	-	-	$166		-
1994	-10	5	10	-	-	$163	-	-
1995	-9	6	11	-	-	$160	-	-
1996	-8	7	12	-	-	$157	-	-
1997	-7	8	13	-	-	$154	-	-
1998	-6	9	14	-	-	$150	-	$1,158
1999	-5	10	15	-	-	$147	-	$1,167
2000	-4	11	16	-	-	$141	-	$1,179
2001	-3	12	17	-	-	$136	-	$1,200
2002	-2	college	18	-	-	-	-	-
2003	-1	college	19	-	-	-	-	-
2004	0	college	20	-	-	-	-	-
Present Value at age 20 (d=3.5%)				$4,728	$12,532	$2,865	$13,075	$5,493
Present Value at age 20 (d=5%)				$5,952	$15,776	$3,302	$15,654	$5,863

Notes: CPC and PPP costs are net of the cost-savings to the education system from reduced grade retention and special education (Temple and Reynolds, 2006; Belfield et al., 2006).

For the High/Scope Perry Pre-School Program (PPP) we use cost estimates reported in Belfield et al. (2006). Again, this program has powerful impacts on special education and grade retention and we deduct these cost-savings. The annual cost per student is $7,227, assuming that the program is delivered to an individual of pre-school age. Taking a present value by the time that person reaches the age of 20, the program cost per student is $12,532.

For the intervention to increase teacher salaries (TSI) there are no reported costs. Our cost calculations are based on the average teacher salary in 2004 of $46,597 (BLS, 2006) and class sizes of 25. Each teacher receives a 10% increase in pay. In nominal dollars, increasing teacher salaries will cost $140-$180 per year per student.

The total present value cost of this intervention over the K-12 school years is therefore $2,865.

For the intervention to reduce class size (CSR) there are no reported costs of the ingredients used in Project STAR (the intervention on which we base our class size impacts). A national study puts the annual instructional cost of reducing class size to 15 at approximately $1,400 per student.[10] In the case of CSR the median class size in the experiment was reduced from 24 pupils to 15, a decrease of 9 students per class (Finn and Achilles, 1999). In order to ascertain the cost, the additional teachers and classrooms necessary were calculated for every 100 students and national cost averages were applied. For classrooms the construction costs were obtained for 2004 and were amortized over 30 years at 5% interest to obtain an annual cost. Teacher salaries and benefits for 2004 were used for teacher costs. In present values, the per-student cost is $13,075.

Finally, First Things First is a bit more complex since it requires a range of additional resources. Data were obtained from a report for Kansas City, Kansas, the most important application of the FTF intervention (Quint et al., 2005). The following changes took place to provide the FTF intervention. First, class sizes were reduced from 26 to 20 students. For each 350 students, additional personnel were added including a counselor, a technical assistant, and a special education teacher. Costs for the additional personnel were derived from the Bureau of Labor Statistics (BLS, 2006). Additional classrooms were required to accommodate the reductions in class size along with the additional common facilities space for serving such classrooms. The construction costs were amortized over 30 years at 5% to obtain annual costs.[11] Assuming a high school size of 2,600 students, delivering FTF would require the following additional ingredients: 12.22 additional math and language arts teachers; 11.8 small learning communities composed of a counselor, assistant, and special education instructor; and 12.2 additional classrooms. The cost per year per student is $1,160-

[10] Brewer et al. (1999) estimate the instructional costs (excluding facilities costs) of reducing class size to 15 students; they estimate 45% more classes would be needed at a cost of $1,400 per student per year. State-level estimates for Wisconsin, Michigan, and California range from $435 to $2,000 per student per year (Molnar et al., 1999; Harris and Plank, 2000; and Ogawa et al., 1999). Krueger (1999) estimates the costs of Project Star to be 47% of annual per student expenditures in public schools. The intervention is assumed to be delivered for four years from kindergarten to third grade.

[11] McGraw Hill School Construction Data at http://www.edfacilities.org/cd/dodge0507.pdf.

$1200 in nominal dollars and it is necessary to deliver the program for four years across grades 9 to 12.[12] In total, the present value cost of the program is $5,493 per student.

Costs of Additional Attainment

Additional attainment costs are reported in Table 2.3 and are taken from the *Digest of Education Statistics* (NCES, 2002, 2003). Public expenditure for a year of high school in 2000 was $8,589 (NCES, 2003, Table 168, nominal dollars). For those individuals who become high school graduates, two additional years of high school are assumed. In present values and accounting for inflation, the additional cost per high school graduate is therefore $19,592. Public expenditure per year in two-year colleges (net of tuition and fees payable by students) in 2000 was $7,203 (NCES, 2002, Tables 312, 314, 334, nominal dollars). In present values and accounting for inflation, the additional cost per two-year (Associate) degree is therefore $15,927.

Table 2.3
Costs per student for additional attainment

Chronology				Costs per student for additional attainment		
Year	Time Period	Grade	Age	School costs	2-year college	4-year college
2000	-4	11	16	$8,589	-	-
2001	-3	12	17	$8,781	-	-
2002	-2	college	18	-	$7,502	$7,502
2003	-1	college	19	-	$7,624	$7,624
2004	0	college	20	-	-	$10,941
2005	1	college	21	-	-	$11,269
Present Value at age 20 (d=3.5%)				$19,592	$15,927	$37,756
Present Value at age 20 (d=5%)				$20,605	$16,276	$37,949
PV cost per additional HSG:[1]						
Present Value at age 20 (d=3.5%)					$24,735	
Present Value at age 20 (d=5%)					$25,813	

Notes: [1] This assumes that each high school graduate incurs expected costs which are the total of: two years of school; 1/12th of 0.5 years of 2-year college; 1/12th of 2-year college; 1/12th of 0.5 years of 4-year college; and 1/12th of 4-year college. Gender- and race-specific progression rates are given in Table 1.5.

Public expenditure per year in four-year colleges (net of tuition and fees payable by students) in 2000 was $10,203 (NCES, 2002, Tables 312, 314, 334, nominal dollars).

[12] The cost assumptions are as follows. Each teacher salary (with fringe benefits) is $56,009 annually. Each small learning community requires a counselor, a technical assistant, and a special education instructor. The respective annual salaries (with fringe benefits) are $61,494, $36,962, and $54,931. In addition, each 20-student classroom costs $29,292 (amortized over 30 years at 5%). This total cost must then be divided by 2,600 (the number of students in the school) to derive the per participant cost.

It is assumed that college degree-holders spend two years in the two-year college system and then progress for the next two years to the four-year college system. In present values and accounting for inflation, the additional cost per four-year college (BA) degree is therefore $37,756.

Each additional high school graduate has an expected probability of progression to higher education. This will result in costs to the state via subsidies for college. The cost in terms of attainment for each additional graduate is approximately $24,735, although the exact figure depends on gender and race because of differences in who goes to college (see Table 1.5 above).

Total Public Costs per Intervention

The total public costs are the sum of the program costs and the additional attainment costs, factoring in the impact of each intervention in raising graduation rates.[13] These figures are reported in Table 2.4 in present value terms at age 20 with a discount rate of 3.5% and 5%.

The top panel of Table 2.4 shows the estimated impacts on the graduation rates of each of the potential interventions assuming each intervention is delivered to 100 students. The educational effectiveness is based upon the evaluations of each of the reforms.[14] PPP is the most effective, with 19 new high school graduates. Increasing teacher salaries (TSI) would only yield 5 new graduates. In the case of TSI, the data are based upon state averages and may understate the improvement in graduation rates for minority students.

The bottom panels of Table 2.4 provide estimates of the total public costs per student served by the intervention and for each additional high school graduate. The costs per student refer to all students who benefit from the intervention. Some of these students would have graduated without the intervention. Costs per additional graduate refer to the public costs when divided by only the additional graduates that are produced. The costs vary significantly across the interventions, with a range of $59,000 to $144,000. The lowest cost per additional graduate is found for FTF, the only

[13] We have not included any deadweight losses from raising tax revenues to pay for these interventions. Deadweight losses are incurred to raise tax revenues to pay for services that are needed because of inadequate education. Therefore, including deadweight losses on the costs of the interventions would require inclusion of such losses on the benefits side too.

[14] Since they occur at different educational levels, the interventions could be combined to have interactive effects. For example, the impact of CSI on student achievement appears to be greater the higher the salary of teachers. Presumably, higher quality teachers associated with higher salaries are able to use smaller class size more productively (Peevely et al., 2005).

intervention implemented at the high school level and the intervention least affected by adjusting to present value at age 20 because of the brief duration from high school to that age. CPC shows the second lowest cost followed by TSI and PPP.

Table 2.4
Additional high school graduates and total costs per student and per high school graduate

	Interventions to raise high school graduation				
	Chicago Parent-Child Centers	**Perry Pre-school**	**Teacher salary increase**	**Class size reduction**	**First Things First**
Impacts per intervention:					
Students in intervention	100	100	100	100	100
New high school graduates	11	19	5	11	16
	Present Values at Age 20 (d=3.5%)				
Per student:					
Intervention costs	$4,728	$12,532	$2,865	$13,075	$5,493
Per new graduate:					
Intervention costs	$42,979	$65,959	$57,301	$118,862	$34,331
Attainment costs[1]	$24,735	$24,735	$24,735	$24,735	$24,735
Total costs	$67,714	$90,694	$82,036	$143,597	$59,066
	Present Values at Age 20 (d=5%)				
Per student:					
Intervention costs	$5,952	$15,776	$3,302	$15,654	$5,863
Per new graduate:					
Intervention costs	$54,105	$83,034	$66,032	$142,306	$36,647
Attainment costs[1]	$25,813	$25,813	$25,813	$25,813	$25,813
Total costs	$79,918	$108,847	$91,845	$168,119	$62,460

Notes: [1] This assumes that each high school graduate incurs expected costs which are the total of: two years of school; 1/12th of 0.5 years of 2-year college; 1/12th of 2-year college; 1/12th of 0.5 years of 4-year college; and 1/12th of 4-year college. For gender- and race-specific college progression rates, see Table 1.5.

The final panel reports the present value costs using a 5% discount rate. The method applied is the same as above and the rankings are unchanged. The effect is to raise the costs per new high school graduate to between $62,000 and $168,000.

3 The Effect of Education on Earnings

3.1 Introduction

The impact of education on earnings is one of the most intensively tested relationships in economics. As educational attainment increases, so do earnings and, importantly, so do tax revenues. As noted by Carneiro and Heckman (2003, 148-149), "By now there is a firmly established consensus that the mean rate of return to a year of schooling, as of the 1990s, exceeds 10% and may be as high as 17 to 20%." Consequently, when individuals are not adequately educated the state is losing potential income tax revenues.

Empirical research has also established that the earnings benefits from education are genuine. That is, they are not attributable either to the possession of an education credential or to unmeasured characteristics such as ability or aptitude (see the review by Rouse, 2005). The effect of education appears to be causal not simply correlational.

Although there is a growing consensus regarding the overall return to schooling, much less is known about how the estimated returns to schooling vary across the population. There is evidence that, at least for males, the education–earnings relationship grew stronger for all races from 1979 through 2000 (Barrow and Rouse, 2005).

Below we report earnings and income tax payments for the cohort aged 20 in 2005 across four education levels: high school dropout, high school graduate, some college, and BA or above. We separate these differences in earnings across race and gender to identify possible differences across individuals to calculate the consequences per graduate. We then calculate the aggregate gain in tax revenues if the dropout rate is reduced by 50%.

3.2 Data and Method

The data for earnings from not completing high school comes from the March Current Population Survey (CPS), a monthly labor market survey of approximately 50,000 households across the United States. The survey provides some of the most current information on income and wages for a national sample of households and individuals over the previous year. Data from 2003 and 2004 are combined to ensure a sufficient sample size. The sample only includes those who completed at least 9th grade for the

estimates of income and tax revenue losses. All figures are weighted using the sampling weights provided by the Bureau of Labor Statistics. Finally, all monetary figures are inflated to 2004 dollars using the Consumer Price Index for Urban Consumers (the CPI-U).

The March CPS does not separately identify individuals who graduated from high school from those with a GED. Also, it only includes the civilian non-institutionalized population. Consequently, the GED misses the potential effects of high school graduation that are realized through the military and the income losses that accrue to the institutionalized population, such as those in jails and prisons. We adjust for differences in incarceration rates by race and gender below, although this turns out to affect the final figures only slightly. The March CPS has many advantages. First it has individual reports of many kinds of income (such as that derived from wages and interest), in addition to social insurance (such as unemployment insurance) and transfer payments. Second, it has a measure of annual earnings. Annual earnings are comprised of an individual's hourly wage, the number of hours worked per week, and the number of weeks worked per year. It therefore implicitly accounts for both the compensation an individual receives for his time (which labor economists typically believe reflects the individual's productivity or usefulness to the employer) and how much the individual worked. If completing high school makes an individual more "productive" because of the skills he has acquired, this will be reflected in annual earnings. If completing high school provides individuals with access to more stable employment such that they are employed for more hours per week and more weeks per year, this will also be reflected in annual earnings.[15]

Tax revenue gains associated with high school graduation are estimated using a computer program administered by the National Bureau of Economic Research called the TAXSIM model (version 6). TAXSIM is a set of programs and data sets that allow one to simulate an individual's U.S. federal and state income taxes. We used the tax calculator, a program that recreates each year's federal and state tax law and the March CPS to obtain a sample of individuals and their income sources. Because the income on the March CPS represents the previous calendar year, we simulate tax contributions using the tax laws for 2002 and 2003 (as such we calculate tax revenues based on the tax law in effect at the time the income was earned).

[15] We do not count differences in earnings across youth up to age 20. These earnings are typically low, sporadic, and interrupted by school and college commitments. For high school dropouts, the CPS records very high proportions are not in the labor force.

While the March CPS was designed to carefully account for an individual's sources of income, it does not collect data on expenses. Thus, the tax simulations do not adequately account for expenses such as rent, property taxes, child care, and mortgage interests which can be deducted from tax liabilities. Further, while capital gains and losses are reported in the March CPS in 2003, they were not reported in 2004. (And, the CPS undercounts the number of high school dropouts, leading to underestimates of the losses.) That said, in aggregate, the simulated tax revenues come quite close to the actual revenues reported by the Internal Revenue Service (IRS). For the both the 2003 and 2004 CPS (tax years 2002 and 2003) the simulated federal tax revenues are only 1% lower than those reported by the IRS.[16]

Finally, in the U.S., tax filing is by the family (unless one is single or a married couple filing separately). And, in the CPS, one can recreate the "families" which are subunits of households. The problem is that once one has calculated the total taxes paid by a family, it is impossible to then extract the liability due to each individual (particularly since some aspects of the tax code are specific to the family unit). As a result, to calculate the difference in taxes paid between high school graduates and high school dropouts, we generate two estimates. One assumes all individuals do not live in families and are "single". In this way, we calculate the tax revenues to society based on the individual's income alone.[17] The simulations based on (all) individuals generates a total federal income tax that is slightly higher than that produced using families and is 1% greater than that reported by the IRS. The second estimate is based on tax payments made by the family for which we have assumed that if there is a male present, he is the head of the household. We determine the race, sex, and age of the "family-unit" based on the race, sex, and age of the family. The advantage of this estimate is that it incorporates tax revenues that accrue as a result of differing family structure via educational attainment. The disadvantage is that the tax payments also include those made by the spouse of the head of the household. This method produces a more conservative results, and taxes that are 1% lower than those reported by the IRS.

[16] The comparison IRS data were from the *Internal Revenue Service Data Book, 2004*, Publication 55B, Washington, DC, Issued March 2005 (Table 7), http://www.irs.gov/taxstats/article/0,,id=102174,00.html.

[17] The degree to which this over or understates the tax revenue gains from graduation will depend on the extent to which families receive benefits (such as food stamps) which depend on the size of the family, take deductions (or credits) that rely on the family structure (e.g., the child care credit), and on the size of the "marriage penalty" since more educated individuals are more likely to be married.

In order to calculate differences in property taxes paid by educational attainment we analyze the Decennial Census of the United States. Based on the 5% sample of the 2000 Census, we calculate that households headed by an individual aged 21-64 who is a high school dropout contributed about $150 less in property taxes in 1999 (in 2004 dollars) than households headed by individuals who had completed a high school degree but no further schooling, and about $570 less than those with a high school degree or college education (Ruggles et al., 2004).[18] We also calculate sales tax payments weighted by state. Together, property and sales taxes (conservatively) amount to 5% of total income.

3.3 The Economic Value of Education

Table 3.1 shows simple cross-sectional differences in labor market status across education levels by gender and ethnicity. For both genders and all races employment rates are higher and unemployment rates are lower. For example, across white female high school dropouts 46% are employed and 6% are unemployed; for white female college graduates, the respective figures are 78% and 2%. In fact, college-educated females of all races are employed at rates equal to those of high school graduate males.

Table 3.1
Labor market outcomes (aged 21-64)

	High school dropout	High school graduate	Some college	BA degree or more
Males:				
Employment (%):				
White	71	79	81	89
Black	49	66	70	83
Hispanic	70	78	69	85
Other	71	79	77	88
Unemployment rate (%):				
White	8	6	5	3
Black	11	9	8	4
Hispanic	9	7	6	4
Other	9	7	6	4
Average annual earnings:				
White	$22,846	$33,877	$40,305	$79,116
Black	$13,495	$21,768	$29,557	$53,820
Hispanic	$21,367	$23,981	$26,009	$54,164

[18] The estimates for property taxes must be interpreted cautiously. First, the causality between education and property tax payments is unknown. Second, property taxes are based on housing values; one can only determine payments made jointly by the household and not those made by one individual. Third, while renters do not directly pay property taxes, they do so indirectly through rent and these calculations do not include such contributions. Fourth, many states offer property tax relief for low-income home owners which may not be included in the Census figures.

Other	$22,286	$30,128	$34,889	$69,662
Ratio average annual earnings:				
White	1.00	1.48	1.76	3.46
Black	1.00	1.61	2.19	3.99
Hispanic	1.00	1.12	1.23	2.55
Other	1.00	1.35	1.56	3.12
Females:				
Employment (%):				
White	46	65	72	78
Black	46	63	70	84
Hispanic	51	57	64	65
Other	48	62	69	73
Unemployment rate (%):				
White	6	4	3	2
Black	11	7	6	3
Hispanic	6	5	4	3
Other	6	5	4	3
Average annual earnings:				
White	$7,779	$16,451	$20,404	$35,623
Black	$10,035	$14,225	$19,524	$40,624
Hispanic	$9,827	$14,528	$17,250	$38,964
Other	$8,555	$15,723	$19,209	$36,889
Ratio average annual earnings:				
White	1.00	2.11	2.62	4.58
Black	1.00	1.42	1.95	4.05
Hispanic	1.00	1.45	1.71	3.93
Other	1.00	1.86	2.28	4.34

Source: March Supplement of the *Current Population Survey*, 2003 and 2004.
Notes: Annual earnings include those with zero earnings. Employment and unemployment rates are based on populations, not labor force size. No adjustment for incarceration rates.

The differences in earnings across education levels are significant. (These earnings figures count all persons, with the unemployed having zero earnings). A white male dropout earns $23,000 annually. By comparison, a white male high school graduate earns 48% more, a person with some college education earns 76% more, and a college graduate earns 346% more. Similar effects obtain for males of all races. Although earnings are lower, the effect of education is particularly strong for females. With higher labor market participation rates and absolute earnings, college-educated females earn four times more than high school dropouts.

3.4 Lifetime Earnings and Income Taxes Paid by Education Level

Table 3.2 reports the lifetime consequences of education on incomes and consequently on income tax payments. These figures are taken from the age profiles of earnings up to age 65 by gender and race. They are adjusted for incarceration probabilities and

assume that productivity growth is 1.5% per annum and future values are discounted at a rate of 3.5%.

Table 3.2
Present value of lifetime earnings and income taxes paid by education level

	High school dropout	High school graduate	Some college	BA degree or more
Pre-tax earnings				
Male: white	$627,309	$948,829	$1,163,871	$2,014,395
Male: black	$339,312	$637,248	$896,403	$1,484,879
Male: Hispanic	$602,188	$718,901	$825,696	$1,551,717
Male: other	$617,791	$861,714	$1,035,743	$1,839,095
Female: white	$234,689	$478,531	$604,101	$986,279
Female: black	$299,907	$420,249	$576,040	$1,150,174
Female: Hispanic	$271,708	$415,833	$558,289	$1,088,361
Female: other	$248,715	$454,776	$586,744	$1,024,956
Income taxes paid				
Male: white	$211,677	$357,600	$460,991	$853,916
Male: black	$130,102	$231,843	$338,371	$609,529
Male: Hispanic	$183,662	$255,967	$346,317	$751,107
Male: other	$201,063	$319,093	$417,543	$814,964
Female: white	$76,822	$156,494	$233,852	$424,542
Female: black	$82,463	$144,886	$216,823	$469,938
Female: Hispanic	$73,073	$139,454	$175,833	$404,682
Female: other	$75,402	$150,038	$211,870	$417,018

Source: March Supplement of the *Current Population Survey*, 2003 and 2004.
Notes: 2004 dollars. Figures corrected for incarceration probabilities. Assumes 1.5% productivity growth in earnings and a discount rate of 3.5%. Taxes paid based on the average of taxes paid by individuals and taxes paid by families.

The top panel of Table 3.2 shows the amount earned across education levels. In absolute terms there are big differences at each education level. Over the lifetime each white male high school dropout earns a present value total income of $627,000; this rises to $949,000 for those who are high school graduates and $2,014,000 for college graduates. Black male dropouts earn $339,000, which is less than the average female high school graduate; importantly, it is only one-fifth of the earnings of a black male college graduate. Hispanic and other-race male dropouts do relatively well, earning over $600,000. But they too earn considerable more if they graduate from high school or progress on to college. For females, the absolute differences in lifetime earnings are lower but the disparities across education levels are equally strong. High school dropouts earn $235,000-$300,000 over the lifetime compared to approximately $1,000,000 for college graduates.

Table 3.3
Present value of lifetime earnings and income taxes paid beyond high school dropout

	High school dropout	High school graduate	Some college	BA degree or more
Earnings				
Male: white		+$321,520	+$536,562	+$1,387,086
Male: black		+$297,936	+$557,091	+$1,145,567
Male: Hispanic		+$116,713	+$223,508	+$949,529
Male: other		+$243,923	+$417,952	+$1,221,304
Female: white		+$243,842	+$369,412	+$751,590
Female: black		+$120,342	+$276,133	+$850,267
Female: Hispanic		+$144,125	+$286,581	+$816,653
Female: other		+$206,061	+$338,029	+$776,241
Income taxes paid				
Male: white		+$145,923	+$249,314	+$642,239
Male: black		+$101,741	+$208,269	+$479,427
Male: Hispanic		+$72,305	+$162,655	+$567,445
Male: other		+$118,030	+$216,480	+$613,901
Female: white		+$79,672	+$157,030	+$347,720
Female: black		+$62,423	+$134,360	+$387,475
Female: Hispanic		+$66,381	+$102,760	+$331,609
Female: other		+$74,636	+$136,468	+$341,616

Source: March Supplement of the *Current Population Survey*, 2003 and 2004.
Notes: 2004 dollars. Figures corrected for incarceration probabilities. Assumes 1.5% productivity growth and a discount rate of 3.5%. Taxes paid based on the average of taxes paid by individuals and taxes paid by families.

The bottom panel of Table 3.2 reports the differences in total income tax payments. These mirror the differences in earnings. Over the lifetime a male dropout will pay $130,000-$212,000 in income taxes. A male high school graduate pays $232,000-$358,000; and a male college graduate pays $610,000-$854,000. For females, the effect of education is equally strong, but the absolute values are lower. High school dropouts contribute $74,000-$82,000 in income taxes. High school graduates contribute $190,000-$234,000 and college graduates $409,000-$470,000.

Table 3.4
Present value of lifetime federal and state taxes paid beyond high school dropout

	High school dropout	High school graduate	Some college	BA degree or more
Federal income taxes paid				
Male: white		$77,544	$138,063	$400,624
Male: black		$45,539	$103,943	$265,435
Male: Hispanic		$32,236	$82,880	$336,427
Male: other		$60,378	$117,155	$376,301
Female: white		$31,294	$75,518	$184,377
Female: black		$25,256	$57,685	$194,027
Female: Hispanic		$34,222	$45,082	$179,758
Female: other		$32,404	$63,987	$182,627
State income taxes paid				
Male: white		$13,115	$25,058	$65,201
Male: black		$16,311	$27,101	$68,502
Male: Hispanic		$9,906	$23,395	$78,610
Male: other		$11,899	$24,428	$70,282
Female: white		$7,693	$16,723	$40,645
Female: black		$8,419	$17,036	$52,198
Female: Hispanic		$6,449	$10,044	$35,547
Female: other		$7,222	$14,193	$38,714

Source: March Supplement of the *Current Population Survey*, 2003 and 2004.
Notes: 2004 dollars. Figures corrected for incarceration probabilities. Assumes 1.5% productivity growth and a discount rate of 3.5%. Taxes paid based on the average of taxes paid by individuals and taxes paid by families.

Table 3.3 shows the differences in earnings and income taxes paid beyond high school graduation. Male high school graduates earn $117,000-$322,000 more than dropouts; for those with some college the differential is approximately $500,000 and for college graduates it is over $1 million. For females, high school graduates earn $120,000-$244,000 more than dropouts. College graduates earn $752,000-$850,000 more. For income taxes, male graduates contribute $90,000-$146,000 more than dropouts; those with a college degree contribute $479,000-$642,000 more. For females, the differences are smaller: high school graduates pay $62,000-$80,000 more and college graduates pay approximately $350,000 more.

Table 3.4 reports the same information as the bottom panel of Table 3.3 – lifetime present value differences in taxes over a high school dropout – but separates out federal and state tax payments. (Some tax payments cannot be identified by government agency). By far the larger proportion of total income taxes paid goes to the federal Treasury; only around 10%-20% goes to state treasuries.

Table 3.5
Total present value lifetime tax revenue gains

	Discount rate 3.5%
Total taxes paid per expected high school graduate:[1]	
Average	$139,086
Male: white	$202,726
Male: black	$157,569
Male: Hispanic	$118,991
Male: other race	$168,572
Female: white	$109,100
Female: black	$94,331
Female: Hispanic	$85,041
Female: other race	$96,723
Aggregate effect if the dropout rate is reduced by 50%:[2]	
Total taxes paid	$49.241 bn
Income tax payments	$46.896 bn
Federal income tax payments [3]	$23.817 bn
State income tax payments	$5.320 bn

Notes: [1] Total tax payments includes income, sales, and property tax. Sales tax and property tax are calculated as 5% of income. [2] For the cohort aged 20, there are 354,030 new expected high school graduates. [3] Itemized federal payments only. An expected high school graduate is one who probabilistically either: terminates education after graduation; completes some college; or completes a BA degree. Gender-specific and race-specific progression rates are applied from Table 1.5.

The absolute earnings and tax differences allow us to calculate the lifetime present value total taxes paid per 'expected high school graduate'.[19] We include property tax and sales tax to the income tax amount paid. The amounts are reported by gender and race in Table 3.5 using a 3.5% discount rate.

The top panel of Table 3.5 shows that regardless of race or gender there is a significant lifetime increase in tax payments from graduating from high school. The amount is higher for males at $119,000-$201,000 than for females at $85,000-$109,000; this gender disparity reflects both lower earnings and lower participation rates of females. Notably, the difference in tax payments by educational attainment is actually greatest for whites: although white male dropouts earn more than black or other-race dropouts, they earn proportionately less than white male graduates. Similarly, the effect on taxes paid for females is largest among whites.

The bottom panel of Table 3.5 presents the aggregate effects on total tax payments, assuming that the dropout rate is reduced by 50%. The aggregate increase

[19] An expected high school graduate reflects the probability that, conditional on high school graduation, some persons will attend and complete college. See Section 1 for more information.

in tax revenues would be $49.24 billion if income, sales and property taxes are included. The increase in income tax payments alone would be $46.9 billion and most of these income tax payments are accrued at the federal level.

4. The Effect of Education on Health Expenditures

4.1 Education and Health

There is evidence that increases in educational attainment cause reductions in mortality, changes in health behaviors, and presumably improvements in health outcomes (reviewed in Groot and van den Brink, 2004; Muennig, 2005; Cutler and Lleras-Muney, 2006). High school graduates live about 6 to 9 years longer than high school dropouts (Wong, 2002). Given that education appears to improve health, it may also reduce costs within government funded health insurance programs.

Government health insurance programs are the largest item in the national budget, and costs within these plans are increasing at 2 to 3 times the general rate of inflation (CMS, 2004). The two largest national programs are Medicaid and Medicare.

Eligibility for Medicaid is mostly based on means-tested formulas (Iglehart, 1999a). Given that education is causally associated with higher earnings, increased attainment should lower Medicaid enrollment. In addition, U.S. citizens under the age of 65 who qualify for social security disability income also qualify for Medicare. Therefore, to the extent that educational attainment reduces the probability of becoming disabled in the future, it should also proportionately reduce Medicare enrollment, thereby further reducing public sector costs.

It is intuitive that if education reduces the chance of adverse health events, it will also reduce costs among those who qualify for Medicaid despite their higher educational attainment. Indeed, persons with disabilities have per enrollee costs that are three times higher than those of non-disabled enrollees (CMS, 2000; Iglehart, 1999b; Keehan et al., 2004). However, lower morbidity and mortality among more educated persons does not necessarily translate into lower costs among active enrollees. While disability decreases as educational attainment increases, those with more education are more likely to seek care than those with less education, largely offsetting the fiscal benefits of educational attainment (Newhouse and Rand Corporation, 1993). Moreover, less educated people may be more likely to die young, thus reducing the rolls of government health insurance programs (Rogot et al., 1992; Sorlie et al., 1995). Therefore, even if improving educational attainment results in improvements in health, it may not reduce expenditures among those who remain enrolled in government health insurance programs.

Finally, more educated people are more likely to have jobs that offer private health insurance. At present, $6 to $14 billion in tax payments go toward providing care

to the uninsured when they become ill (Thorpe, 2005). However, employer expenditures on private health insurance plans are, in turn, tax deductible; in 1999, employer deductions reduced federal tax revenues by approximately $76 billion (Office of the President, 1999).

In sum, successful education interventions will almost certainly produce savings in the public sector. However, these savings are probably limited to reductions in enrollment in government-funded programs, and there is considerable uncertainty surrounding the extent of such savings. The most conservative approach to estimating the effects of education on government health insurance expenditures is to calculate reductions in expenditures on means-tested programs. Given that larger gains may be realized via reductions in Medicare eligibility for those under age 65, the most complete estimate of the effects of educational interventions on public sector medical costs will also include potential reductions in Medicare and state program costs.

Here we quantify the total reduction in expenditures that arise from reductions in the rolls of government health programs for persons aged 20 to 65, focusing on all government programs and then, in a separate analysis, Medicaid alone. Data is also presented on intangible gains in years of perfect health, which government agencies may value above and beyond reduced payouts. All analyses focus on the impact of advancing a high school dropout to a high school graduate (factoring in college progression). Savings are therefore presented per additional 'expected high school graduate'.

4.2 Data and Method

To obtain expenditures, health-related quality of life scores, and the probability of enrolling in private or public insurance by educational attainment, we use the 2003 Medical Expenditure Panel Survey (MEPS). The MEPS is a nationally representative sample of over 31,000 non-institutionalized civilian subjects. The 2003 MEPS over-sampled Hispanic and black subjects. In addition to collecting detailed socio-demographic characteristics (including highest education completed) and medical expenditures, the MEPS contains an instrument capable of producing health-related quality of life scores. After eliminating non-US-born subjects, those aged under 25 and over 65, and subjects with missing values, the sample is 12,299 subjects. (Immigrants are ineligible for Medicaid and Medicare in most states).

Five separate analyses were conducted. The first examined per capita Medicaid enrollment and costs alone. The second examined per capita Medicare enrollment costs. The third compared per capita state health expenditures (insurance and otherwise). The fourth examined private insurance rates. The fifth examined health-related quality of life (a measure of morbidity). Results are presented for Medicaid alone (since it is a means-tested program) and for Medicaid and Medicare added together.[20] All analyses controlled for the highest educational level completed, gender, ethnicity, and age. These covariates were then used to predict public health insurance enrollment rates using logistic analysis. Analysis included only U.S.-born persons, with those with a GED counted as high school graduates. Enrollment rates, in turn, were used to estimate overall program costs to the federal government by multiplying enrollment rates by per enrollee costs. The product of the probability of being insured by a public plan and the mean per enrollee cost is referred to as the per capita costs.

The use of logistic regression to predict changes in Medicaid enrollment requires the following assumptions: (a) education produces an increase in wages; (b) the magnitude of this increase in wages is similar to that predicted using logistic regression; and (c) the skills provided by the increase in educational attainment will not be used to overcome bureaucratic barriers to enrolling in Medicaid. There is strong evidence supporting assumptions (a) and (b) (Rouse, 2005). To the extent that these assumptions hold, regression can be used to predict the percentage change in Medicaid enrollment.

An alternative approach to estimating public expenditures among those who have and have not received an educational intervention is to regress enrollment in Medicare on relevant covariates. As with Medicaid only models, years of educational attainment can then be used to predict changes in insurance enrollment. The assumptions associated with this analysis are: (a) education reduces the incidence of those conditions for which eligibility for Medicare is determined; and (b) regression produces a reasonable estimate of the magnitude of the effect of education on those conditions.

Evidence from one very small randomized controlled trial and various instrumental variable analyses suggests that regression may underestimate the extent to

[20] Analysis of state health expenditures was excluded. Logistic regression analyses on state insurance program enrollment showed an association between educational attainment and enrollment, but the association was not statistically significant.

which education produces health (Belfield et al., 2006; Lleras-Muney, 2005). However, there is also considerable variability in the association between education and specific conditions. For instance, a small number of conditions have a higher prevalence among the more educated, and it is conceivable that some conditions have a higher incidence among the more educated as well (Cutler and Lleras-Muney, 2006). Data are lacking on conditions that tend to qualify subjects for Medicare.

Per enrollee costs (total expenditures among those actually enrolled in Medicare and Medicaid) were obtained from the 2003 MEPS and inflated to 2004 dollars. Because the MEPS does not capture all public investments, mean per enrollee costs were adjusted to account for two costs out of range in MEPS. First, MEPS excludes Medicaid payments to hospitals that serve a disproportionate share of the Medicaid population (and could not keep their doors open due to the low reimbursement rates for Medicaid patients). These payments totaled $15.5 billion, or 11% of the total Medicaid program costs, in 2001 (NCHS, 2005). Second, the MEPS figures tend to be about 7% lower than similar costs from the National Health Accounts, which is generally thought to be more comprehensive (Selden et al., 2001). After adjusting for these two factors, the 2005 mean cost for all Medicaid adult (aged 25-64) enrollees was $7,696 and the mean cost for all public sector users was $11,049. State expenditures were obtained directly from MEPS, and inflated using the medical portion of the Consumer Price Index. The average state expense per enrollee (or user) was $8,187.

To test for the magnitude of the link between education and life expectancy and morbidity, we calculate the 'quality-adjusted life year', or QALY. One QALY is a year of life lived in perfect health.[21] Annual QALYs were calculated by regressing health related quality of life on relevant covariates, and then predicting changes in health related quality of life by educational attainment.

However, improvements in health, as measured by the QALY, will also be accompanied by reductions in mortality. To the extent that education interventions reduce mortality rates, they increase costs to public sector insurance schemes because there will be more survivors using such plans.

[21] The QALY is comprised of two components: health-related quality of life (HRQL) and years of life gained. HRQL is a measure of morbidity that varies from zero to one, with zero equal to a state of death and one equal to perfect health (Gold et al., 1996). The HRQL score is used to adjust life expectancy to reflect years of life in perfect health. For instance, a population with an average HRQL of 0.8 and a life expectancy of 80 years would have a quality-adjusted life expectancy of 0.8 • 80 years = 64 QALYs.

To capture lifelong events, such as year-on-year changes in costs, changes in health, and changes in mortality by educational attainment a Markov model was generated. The model evaluated four groups: those with 9-11 years of education; high school graduates; those with some college; and college graduates. Subjects with 9-11 years of education were assigned age-specific mortality rates for persons in the general US population with less than a high school education (Hoyert et al., 2005). To obtain mortality rates for the four education categories, these age-specific mortality rates were multiplied by an education-specific age-adjusted risk ratio for mortality by educational attainment (Backlund et al., 1999). This model allows us to produce lifetime estimates of public returns to educational interventions. All analyses present data in constant 2004 US dollars. Past public costs were inflated at a rate of 8% (CMS, 2004). Future costs were discounted at a rate of 3.5%. The published risk ratios by educational attainment were adjusted for age, ethnicity, and gender. It was therefore necessary to assume that blacks and Hispanics have a similar relative risk of mortality be educational attainment as whites.

4.3 High School Graduation and Health

We begin with the health status differences by education level, as these are indicative of how education influences health. Two conclusions stand out. First, educational attainment is a very strong predictor of health. Second, the cumulative effects of education are dramatic. For example, the average 45-year-old college graduate is in better health than the average 25-year-old high school dropout. Therefore, we anticipate significant savings as a person's education level rises.

Table 4.1 presents enrollment rates in Medicaid and Medicare by educational attainment for those aged under 65.[22] For Medicaid, females are enrolled at much higher rates than males and blacks and, to some extent Hispanics, are enrolled at higher rates than whites. Across these groupings, however, the educational differences are very large. Roughly 25% of high school dropouts are enrolled in Medicaid, compared to 8% of high school graduates, 5% of those with some college, and 1% of those who have graduated from college. For Medicare, rates of enrollment are significantly lower, but the effect of educational attainment is still powerful. High school dropouts are enrolled at an

[22] Private health insurance enrollment varied from 28% for dropouts to 6% for college graduates. High school graduates were about twice as likely to have health insurance as high school dropouts. It was assumed that these changes in private health insurance enrollment would minimally affect net public sector revenue flows.

average rate of 8%. That rate is halved for graduates and those with some college. For college graduates, the Medicare enrollment rate is only 1%.

Table 4.1
Predicted public health insurance plan enrollment rates by plan type

	Less than high school	High school graduate	Some college	College
Medicaid coverage (%):				
Male: white	15.0	4.6	2.6	0.5
Male: black	31.9	11.3	6.7	1.4
Male: Hispanic	20.3	6.5	3.7	0.8
Male: other	22.4	7.5	4.3	0.9
Female: white	28.4	9.7	5.7	1.2
Female: black	51.3	22.2	13.8	3.1
Female: Hispanic	36.4	13.4	8.0	1.7
Female: other	38.7	15.1	9.2	2.0
Medicare coverage (%);				
Male: white	8.0	4.0	3.6	0.9
Male: black	12.8	6.5	5.9	1.5
Male: Hispanic	7.9	3.9	3.5	0.9
Male: other	9.6	4.8	4.3	1.1
Female: white	6.1	3.0	2.7	0.7
Female: black	9.8	4.9	4.4	1.1
Female: Hispanic	5.9	2.9	2.6	0.7
Female: other	7.3	3.6	3.2	0.8

Source: MEPS (2004).

These coverage rates translate into annual per capita cost, as shown in the top panel of Table 4.2. These are per capita costs, although most persons receive no public health insurance these reported costs are averages across the population. By gender and race, the amounts are significantly higher for dropouts. On average, per capita costs are $2,750 per dropout, falling to $1,040 for graduates, $740 for those with some college, and $170 for those with a college degree.

Point-in-time differences in health status, coverage, and costs are substantial when aggregated over the future life of a person aged 20. The lower panel of Table 4.2 shows lifetime government health insurance expenditures by education level. Over a lifetime, the average high school dropout accrues significantly more in government health expenditures over graduates and the college-educated. The differences hold across gender and race, with the largest difference being for black females. The average expenditure per dropout is $58,500. This compares to $22,500 for graduates, $16,000 for those with some college, and $4,000 for college graduates.

Table 4.2
Predicted total per capita costs

	High school dropout	High school graduate	Some college	College
Annual:				
Male: white	$2,040	$788	$598	$141
Male: black	$3,868	$1,583	$1,164	$274
Male: Hispanic	$2,430	$925	$676	$156
Male: other	$2,779	$1,099	$813	$190
Female: white	$2,853	$1,073	$735	$165
Female: black	$5,028	$2,247	$1,553	$361
Female: Hispanic	$3,456	$1,352	$907	$203
Female: other	$3,779	$1,557	$1,065	$243
Lifetime:				
Male: white	$43,480	$17,011	$12,909	$3,065
Male: black	$82,442	$34,172	$25,127	$5,957
Male: Hispanic	$58,975	$23,336	$16,687	$4,044
Male: other	$61,632	$24,840	$18,241	$4,355
Female: white	$60,808	$23,163	$15,866	$3,587
Female: black	$107,166	$48,506	$33,525	$7,848
Female: Hispanic	$73,661	$29,186	$19,579	$4,413
Female: other	$80,545	$33,618	$22,990	$5,283

Note: Lifetime values based on a 3.5% discount rate.

Table 4.3
Total lifetime public health savings

	Per expected high school graduate
Per expected high school graduate	$40,505
Male: white	$27,938
Male: black	$52,065
Male: Hispanic	$37,801
Male: other	$39,004
Female: white	$39,646
Female: black	$62,748
Female: Hispanic	$46,523
Female: other	$49,229

Note: Lifetime values based on a 3.5% discount rate.

Table 4.3 reports the lifetime savings for an 'expected high school graduate' in terms of reduced public health expenditures by gender and race. For males, the expected savings range from $28,000 to $52,000. For females, the savings range from $40,000 to $63,000. Savings are greatest for African Americans. The average saving per expected high school graduate is $40,500.

These savings are substantial so we check for their robustness by varying a number of assumptions. Table 4.4 reports how the lifetime figures for an 'expected high school graduate' vary when different assumptions are made. For simplicity, the average across gender and race is used as the baseline. This saving per person is $40,500 using the same model as that for Tables 4.2 and 4.3, i.e. assuming educational attainment reduces mortality rates and a 3.5% discount rate. Alternative assumptions affect this baseline.

If the discount rate is raised to 5%, then the savings will be lower at $32,343 or by 20%. If there is no survival advantage to having additional education, the incremental returns increase very slightly to $40,772. (This number is higher because there are fewer surviving high school graduates relative to high school dropouts). The savings also increase if all subjects survived until age 65. (This scenario is compatible with some estimates of educational returns that do not account for premature mortality). Savings are up to $43,000.

Table 4.4
Total lifetime public health savings: Sensitivity analysis

	Per expected high school graduate
Baseline	$40,505
Discount rate 5%	$32,343
Without mortality differential	$40,772
Complete survival rate	$43,016
Income effect only	$30,425

The above figures represent both the state and federal contributions to all government health insurance under the assumption that additional educational attainment reduces enrollment in both disability-based and means-tested insurance programs. If additional educational attainment produced income benefits, but no health benefits, we would still see a drop in Medicaid enrollment, since this is a means-tested program. Under this assumption, an education intervention that produced one additional graduate would still save $30,400 over the lifetime of the average graduate. Overall, this sensitivity analysis shows that the baseline results are robust to different assumptions.

Finally, we calculate the aggregate cost-savings if the dropout rate falls by 50%. This change would generate 354,030 new expected high school graduates. The resulting savings would amount to $14.3 billion in public health care expenditures.

4.4 Conclusions

This Section examines the impact of effective education interventions on public medical expenditures. We find that each additional high school graduate will save approximately $40,500 in government health insurance expenditures over the lifetime of the expected graduate. Even if there is in fact no causal association between education and health, savings due to reduced Medicaid eligibility alone through increases in income will be about $30,400. Finally, while other desirable effects will be realized, such as increasing the rate of private insurance coverage, the net fiscal impact on government agencies of such effects will be minimal.

This study has a number of limitations beyond the necessary (but well-supported) assumption that education increases income. First, the magnitude of the effect of education on predicted government health insurance enrollment and health-related quality of life were derived using cross-sectional data. This gradient may be artificially reduced or inflated by endogeneity or reverse causality. However, there is strong evidence that linear regression does a very good job of predicting the effect size for income, and possibly health, seen in experimental settings (Rouse, 2005; Lleras-Muney, 2005). Second, insurance rates were generated by logistic regression analysis. While regression has been shown to be very good at predicting income gains associated with additional years of education, the same relationship might not hold for government health insurance enrollment rates. For instance, additional years of education may improve a persons' ability to navigate public bureaucracies. Therefore, those who receive an education intervention but remain within means-tested enrollment limits may be more likely to enroll. The analysis is only accurate to the extent that behavior patterns of those persons who respond to an education intervention by graduating from high school are similar to those of persons with a similar level of educational attainment. Notwithstanding these limitations, the returns to improved health just in terms of government health insurance expenditures appear significant.

5 The Effects of Education on Crime

5.1 The Influence of Education on Criminal Activity

This Section examines the fiscal consequences of increased criminal activity arising from inadequate levels of education across the US population. Higher educational attainment is associated with lower criminal activity either because it raises earnings or because it influences the tendency to commit crime.[23]

Empirically the association between education and crime is clearest when examining rates of incarceration. High school dropouts (or GED-holders) are disproportionately incarcerated: although less than 20% of the population, they represent 37% of federal prison inmates, 54% of state prison inmates, 38% of local jail inmates, and 33% of probationers (Wolf Harlow, 2003). In absolute numbers, persons without a high school diploma are: 56,000 of the 152,000 persons in federal prisons, 659,000 of the 1.21 million persons in state prisons, 253,000 of the 665,000 persons in local jails, and 660,000 of the 2.03 million persons on probation. (There are also 652,000 persons on parole). The effects are stronger for males than females, and they vary by ethnicity, but the correlation between education and crime holds for each subgroup of the population.

Crime imposes a significant and lasting economic burden (Anderson, 1999).[24] Moreover, the present value of savings from high school graduation may be substantial because most crime is committed in early adulthood (Brame Paquerio, 2003; Hansen, 2003). As crime may lead to arrest and a prison sentence, the economic consequences persist over time.

Below we calculate the economic burden arising from failure to ensure that individuals graduate from high school. First, we describe the economic consequences of crime and set down a method for calculating them. Second, we identify the causal effect

[23] See Farrington (2003) for an overview. Lochner and Moretti (2004) find a strongly negative effect of high school graduation on criminal activity across a range of crimes (see also Lochner, 2004; and for juveniles, Levitt and Lochner, 2001). Other studies testing for graduation's influence on crime report mixed or weak results: graduation does not necessarily reduce all types of crime (Bernburg and Krohn, 2003; Grogger, 1998; and Witte, 1997). Williams and Sickles (2002) find weak effects of high school graduation, but their models include graduation and years of schooling in the same model. For incarceration, Lochner and Moretti (2004) and Arum and Beattie (1999) find education has a beneficial effect.

[24] Although the crime rate fell in the 1990s, in part this was because of longer prison terms and increased likelihood of incarceration conditional on arrest (Levitt, 2004). This shifts, rather than necessarily reduces, the economic burden because potential criminals are incarcerated.

of education on criminal activity and incarceration. Third, we calculate an overall fiscal cost of crime attributable to low education levels for a single age cohort.

5.2 Data and Method

We isolate the cost items that compose the economic burden of crime from the perspective of government agencies (public sector). The burden to the private sector, though considerable, is not included in our calculations.

There are five main costs to government. First, there are costs to operating the criminal justice system for policing and for trials and sentencing. Second, there are costs for incarceration (including parole and probation). Third, there are costs to the state from restitution for victims, from medical care, and from lost tax revenues. Fourth, there are expenditures of government crime prevention agencies (e.g., budgets for DHS, DEA, ATF, INS). Finally, the government loses tax revenue because criminals do not fully participate in the formal labor market to earn income. Even as most criminals are employed, they must spend time planning crimes and cannot work whilst incarcerated (Western and Petit, 2000; Holzer et al., 2003). This last effect is partially captured by the earnings differentials derived by Rouse (This volume, Section 3); and information on resource use by criminals is not available. Therefore, we estimate costs for the first four items only.

The social burden of crime will also be significant. It should include the costs directly imposed on victims; transfers of assets from victims to criminals; avoidance costs by potential victims; and productivity losses from participating in criminal activity rather than work. Victims bear a considerable burden, particularly in impaired quality of life. Citizens incur costs to avoid being the victim of crime and in paying for insurance against possible crime. Finally, criminals expend time and resources in committing crimes and during incarceration; the opportunity costs of these actions may be considered. The calculation of this social burden is beyond the scope of this analysis.

The calculation of fiscal cost-savings from reduced crime has three stages. First, the impact of education on the commission of specific crimes and arrests and on the incidence of incarceration is derived. Both crimes and arrests are counted, because the number of crimes greatly exceeds the number of arrests (by a factor of at least eight, BJS, 2002ab; FBI, 2002). Data on specific crimes is taken from the annual *Uniform Crime Report* (FBI, 2004) and the *Sourcebook of Criminal Justice Statistics* (BJS, 2002a). Second, the unit costs per crime and per month of incarceration are calculated

using the governmental perspective. Third, the impact of raising high school graduation rates on crime is multiplied by the unit costs per crime averted; and a similar approach is used for incarceration.

We use a microeconomic approach because the effect of education varies according to the type of crime and because different crimes impose different economic burdens.[25] We examine the relationship between high school graduation and five specific types of crime: murder, rape/sexual assault, violent crime (defined here as robbery and aggravated assault), property crime (burglary, larceny-theft, motor-vehicle theft, and arson), and drug offenses (separate from the violent crimes that are often associated with drug trafficking).[26] These types of crime are selected because they impose high costs (either per crime or as a result of many such crimes being committed) and because they are strongly influenced by education levels. Although these five crime types represent approximately 30% of all crimes, the majority of other crimes are misdemeanors which impose relatively low public and social costs.

The calculations are reported for the cohort of individuals who are currently aged 20. We assume that new high school graduates may also progress to higher education, using the progression rates estimated in Tables 1.5 above. The calculations should be regarded as conservative: we omit the costs for crimes where we have limited data (as well as for the entire set of misdemeanors); and we do not include juvenile crime impacts (for our cohort, these are in the past). Present values are reported using a discount rate of 3.5%. All money figures are reported in 2004 dollars.

5.3 High School Graduation and Crime

Table 5.1 shows the absolute level of annual criminal activity by type of crime for the cohort of 20-year olds. Row 1 shows arrests for 557 murders, 803 rapes, 16,203 violent crimes, 49,646 property crimes, and 69,406 drugs-related crimes. Of these arrests, almost half (48%) involve individuals who have less than high school education. Given the population of high school dropouts, it is possible to calculate the number of arrests

[25] Adopting a per crime type approach allows for a disaggregated costing method, with more transparent assumptions and more rigorous sensitivity analysis. Using aggregate measures has the advantage that all costs may be accounted for, but the disadvantage that costs and crimes cannot be directly related. Our approach does not take into account general equilibrium or macroeconomic effects from reduced crime, but as we discuss below, these may not be significant.

[26] A sixth crime – child abuse – should be considered because of the significant burden it imposes. However, data are inadequate to perform an accurate costing exercise for this crime. Data limitations also preclude analysis of white-collar crimes such as fraud.

per dropout each year; these are given in row 3. Crime–arrest ratios are given in row 4, which allows for calculation of crimes per dropout (row 5).[27] The final two rows report the average sentence per arrest and the average months of parole per arrest. Sentences vary from 233 for murder to 52 for property crime; parole rates are proportionately lower.

Table 5.2 shows the effect of education on criminal activity. Row 1 shows the impact from becoming a high school graduate: rates of crime are reduced by 10%-20% across the types of crime. These impacts are based on estimates by Lochner and Moretti (2004).[28] They also adjust for college progression, assuming that crime effects are equivalent to incarceration effects. The lower part of Table 5.2 shows the corresponding effects on arrests, crimes, months sentenced, and months paroled.

5.4 The Costs of Crime

Aggregate estimates of the costs of crime focus mainly on the impact on quality of life and victim costs (see Miller et al., 1996; Anderson, 1999). They do not focus on the costs to the state or taxpayer.

In Table 5.3 we report our own calculations for these costs per arrest and per crime as appropriate.[29] Costs per arrest are trial/sentencing costs (not all arrests result in convictions, but the costs of a trial are still incurred). Criminal justice system (CJS) expenditures are adapted from estimates by Belfield et al. (2006) and BJS (2002ab) where total expenditures are divided by the numbers of crimes. Annually, $84 billion is spent on policing and $43 billion on judicial and legal services (NCJ, 2002; BJS, 2001).

[27] Official crime rates are considerably lower than victim-reported rates because many crimes are not reported. Also, there is no information on whether crime–arrest ratios vary by ethnicity. Finally, the UCR does not report crimes for 100% of the population; coverage is typically 93-96%. Table 5.1 uses a conservative estimate of the crime rate.

[28] Lochner and Moretti (2004) identify the impact of high school graduation on: rates of arrest (by crime type); and incarceration probabilities. Using pooled 1960-1980 Census and FBI data, the identification strategy is the change in compulsory schooling laws. Using NLSY and Census data, the identification strategy is a full set of background control variables. This is the best empirical evidence available. However, the data are (mostly) over 20 years old (such that incarceration rates are below current rates); and there is no adjustment for under-reporting of crimes by drop-outs. We therefore use population average relationships across race and gender.

[29] There are several empirical challenges. First, there are few sources for costs, either at the aggregate, per-crime, or per-criminal level. Only a few methods have been applied thus far. Also, a particular crime cannot be directly linked to a specific unit cost measure. Concatenating crime incidences with the costs of each crime is therefore somewhat imprecise. Throughout, the parameters of the model have been conservative and a consensus has been derived from independent sources and datasets where possible.

The former number depends on the number of crimes and the latter the number of arrests. Therefore, unit costs per arrest range from $12,991 for rape to $917 for drugs-related crimes. These are the costs from trial and sentencing, not from policing. Per crime (only some of which result in arrest), unit CJS costs for policing range from $24,127 to $1,703. (These cost estimates are lower than those derived from willingness to pay methods, Cohen et al., 2004).

Row 3 shows the costs to the government in payments to victims. These costs are: medical expenses not covered by the victims' insurance; losses directly arising from the crime, e.g. injury-related absence from work; and losses from time spent engaging with the criminal justice system. These losses are calculated using data taken directly from the National Crime Victimization Survey (NCVS), which reports medical expenses (and insurance probabilities) and days lost per crime. Medical expenses vary according to the severity of the crime. The numbers of days lost also vary per crime (from 2 to 13), and the government cost is the income taxes that would have been paid for these days of work. The NCVS is the only dataset available, but it significantly understates costs to victims.[30] Therefore, we add two additional costs to the state victim costs. From the Crime Victims Fund, Cohen (2005, 63) estimates that the average amount paid to each victim is $2,000. We apply this figure to murder, rape, and violent crime victims. From a longitudinal study of victims over 11 years, MacMillan (2000, Table 1) estimates that the annual loss of earnings associated with being the victim of a violent crime is 13%. We apply this factor to rape and violent crime victims; for murder victims, we assume that ten years of earnings as a high school graduate are lost (Rouse, 2005). The government loses the tax revenue from these lost earnings. (Again, this is conservative, in that no effects on victims' families are counted; an additional cost may arise if crime victims become eligible for income support, but there is insufficient data on this relationship). These public-funded victim costs range from $33,415 for murders to $555 for drugs-related offences.

[30] As reported by Cohen (2005) only expenses incurred within six months of the crime are reported (i.e., before most crimes have gone to trial), hospital bills are sent to insurers, and mental health costs are not included in the survey.

Table 5.1
Annual criminal activity by persons aged 20

	Murder	Rape	Violent crime	Property crime	Drug offenses
Arrests:					
Male: white	208	328	5,518	14,322	24,175
Male: black	250	289	5,729	8,462	17,084
Male: Hispanic	55	191	2348	12499	18299
Male: other	35	55	927	2406	4061
Female: white	21	2	1,140	6,079	4,345
Female: black	25	2	1,183	3,592	3,071
Female: Hispanic	6	2	510	5438	3385
Female: other	3	0	166	888	634
Total arrests	602	868	17,522	53,686	75,054
Arrests per high school dropout	0.000482	0.000694	0.014018	0.042949	0.060043
Crime - arrest ratio	1.7	3.5	2.3	6.5	10
Crimes per high school dropout	0.000819	0.002430	0.032240	0.279167	0.600432
Average sentence per arrest (months)	233	157	78	52	56
Average months parole per arrest (months)	90	48	35	23	48

Sources: UCR (2004, Tables 39, 42, 43a), adjusted for undersurvey; National Crime Victimization Survey (2003); Wolf and Harlow (2003); UCR (2003, Table 1); Belfield et al. (2006); Daly and Tonry (1997, Tables 2 and 8); Durose and Duncan (2003, Table 4).
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 0.48 (based on incarceration rates).

Table 5.2
Annual changes in criminal activity associated with expected high school graduation

	Murder	Rape	Violent crime	Property crime	Drug offenses
Impact per new expected high school graduate	-19.6%	-19.6%	-19.6%	-10.4%	-11.5%
Per new expected high school graduate:					
Change in arrests	-0.000094	-0.000136	-0.002747	-0.004467	-0.006905
Change in crimes	-0.000160	-0.000476	-0.006319	-0.029033	-0.069050
Change in months sentenced	-0.019794	-0.019231	-0.192871	-0.209040	-0.348010
Change in months paroled	-0.007646	-0.005880	-0.086545	-0.092460	-0.298295

Sources: Row 1: Lochner and Moretti (2004), adjusting for effects from higher college progression rates (1.27 for some college and 1.64 for degree holders). Rows 2-5 apply row 1 to the criminal activity reported in Table 5.1. Row 2 assumes a 90% conviction–arrest rate.

Table 5.3
Annual costs of criminal activity

	Murder	Rape	Violent crime	Property crime	Drug offenses
Unit costs per:					
Arrest	$12,089	$12,991	$2,578	$917	$917
Crime: CJS costs	$22,452	$24,127	$4,787	$1,703	$1,703
Crime: government-funded victim costs	$33,415	$9,115	$9,115	$555	$555
Crime: government agency costs	$0	$5,007	$0	$0	$496
Month of incarceration	$2,500	$2,500	$2,500	$2,500	$2,500
Month of probation/parole	$155	$155	$155	$155	$155

Sources: Costs per arrest and CJS costs per crime are taken from Belfield et al. (2006), and adapted from BJS (2002a). Government-funded victim costs are: medical treatments not covered by insurance; lost tax revenues from victim's incapacitation; and direct payments to victims by government agencies (e.g. for health). State medical expenses are taken directly from the reported medical expenses incurred by victims in the National Crime Victimization Survey (2003). Tax payments per day taken from Rouse (2005). Government agency expenditures are taken from ONDCP (2004) and www.usdoj.gov/ovw/. Incarceration and parole costs are calculated from: total direct expenditures for state institutional correctional activities in 1999 divided by the number of persons in state prisons in 1999 (BJS, 2002a, Tables 1.8, 6.12).

Table 5.4
Total annual cost savings per expected high school graduate

	Murder	Rape	Violent crime	Property crime	Drug offenses
Change in costs per expected high school graduate:					
Arrests costs	-$1	-$2	-$7	-$4	-$6
Crime costs	-$9	-$18	-$88	-$66	-$190
Incarceration costs	-$49	-$48	-$482	-$523	-$870
Parole costs	-$1	--$1	-$13	-$14	-$46
Total	**-$61**	**--$69**	**-$591**	**-$607**	**-$1,113**
Total change in costs per expected high school graduate – all crimes:					**-$2,440**

Notes: Calculations are derived from combining Tables 5.2 and 5.3.

Row 4 of Table 5.3 shows government agency costs per crime; these are costs of government programs that are specifically intended to prevent crimes. To estimate these costs we review all line-items in the Federal budget to apportion federal expenditures to particular crimes. With the exception of drugs-related crimes and violence against women, it is very difficult to identify specific line items that are directed at reducing specific crimes. However, expenditures to combat drug usage are substantial in total and those to combat violence against women are not trivial.[31] We assume that these expenditures (for rape and drugs-related crimes) could be reduced in proportion to the reduction in the numbers of crimes committed.

Incarceration costs must be added. These are very large: annually, $63 billion is spent on corrections (BJS, 2004). As shown in Table 5.3, the average monthly cost per inmate for incarceration is $2,500 and for parole is $155 (BJS, 2002a). Because there is no empirical evidence on education and probation rates, these costs are excluded from the analysis.

Overall, each crime costs the state the sum of rows 2 through 4. Each crime that results in an arrest costs the government the sum of rows 1 through 4 as well as amounts for rows 5 and 6 which depend on the months served in prison or on parole.

5.5 Cost Savings Calculations

The total annual cost savings per new expected high school graduate are reported in Table 5.4. This shows that the largest cost savings will be in the high volume crimes of violence and drugs, and that the main sources of savings are from lower rates of incarceration and crime reduction (policing). Per expected high school graduate, the cost savings across these five crime types are $2,440. This figure is large and is just for youth at age 20 and only for each additional expected high school graduate (i.e., family resources and local environments are not improved). Importantly, it does not include any beneficial impacts on juvenile crime. Yet research has shown that those with a greater attachment to school are less likely to commit crime during their school years.

This annual cost is summed over the lifetime and properly discounted to present values. These total present value cost savings per new expected high school graduate are reported in Table 5.5. These cost savings are based on the annual effects from

[31] There are costly federal and state programs to directly combat drug usage and trafficking (unlike for most other crimes). Excluding CJS and education costs, the federal government commits almost $8 billion annually in the war on drugs, with 60% being routed through the Departments of Homeland Security and Justice; as well, state governments commit $2.1 billion.

Table 5.4, taking account of the decay rate of crime according to age and the discounting of crimes that occur in the future. For the decay rate we follow the pattern of criminal activity reported by age (FBI UCR, 2004, Table 1): approximately, criminal activity peaks around age 20 and decays by a few percentage points each subsequent year. The discount rate applied is 3.5%. The lifetime is assumed to continue until age 65 but the model parameters are such that the economic consequences after age 45 are trivial.

Table 5.5
Total present value lifetime cost-savings from reduced criminal activity

Lifetime Cost-savings	Discount rate 3.5%
Per expected high school graduate	$26,566
Male: white	$30,188
Male: black	$55,528
Male: Hispanic	$38,322
Male: other	$30,188
Female: white	$8,262
Female: black	$8,552
Female: Hispanic	$8,269
Female: other	$8,262
Aggregate effect if the dropout rate is reduced by 50%	$9.405 bn

Notes: Annual criminal activity (see Table 5.1 above) is assumed to decay to zero by age 65. The decay rate is based on the actual incidence of crime for each age group (FBI UCR, 2004, Table 1). Cohort aged 20 includes 354,030 individuals with less than high school education.

Table 5.5 shows that the total present value direct cost savings to the government from generating one new high school graduate by age 20 is $26,600. There are significant differences in gender and race, with females imposing a considerably smaller burden than males. These differences arise because of differences in criminal activity, in arrests, and in the effect of education on crime. Given that these are conservative estimates, are based solely on the educational consequences and exclude juvenile crime, they appear sizeable.

Table 5.5 also shows the aggregate cost-savings if the dropout rate for this cohort is reduced by 50%. In the aggregate, the cost-savings for the entire cohort age 20 would be $9.4 billion.

6 The Effects of Education on Welfare Receipt

6.1 Education and Welfare

Greater educational attainment is associated with lower receipt of public assistance payments or subsidies. The relationship may be caused directly by lower rates of single motherhood or teenage pregnancy associated with high school graduation relative to dropouts.[32] The relationship may also be income-driven: more education produces higher incomes which reduce eligibility for means-tested programs. However, higher attainment among those who meet eligibility requirements increases the probability of receiving such payments because more educated persons are better able to navigate the welfare system and claim benefits to which they are entitled.[33] This navigation effect offsets somewhat the gains from reduced welfare entitlement.

Even with these opposing forces, the impact of education on welfare payments may still be significant. Annually, the federal government spends $168 billion and state governments spend $25 billion on the following need-tested benefit programs: cash aid, food benefits, housing aid, training, and energy aid (CRS, 2004, Table 1, fiscal year 2002, 2004 dollars). As incomes rise with education, eligibility for these payments will be reduced.

6.2 Data and Method

To estimate welfare costs we adopt a model derived by Waldfogel et al. (2005) for analysis of single mothers. First, we identify the impact of education in reducing non-elderly welfare receipt from three direct sources: Temporary Assistance for Needy Families (TANF); food stamps; and housing assistance.[34] We also count state welfare

[32] Most non-elderly welfare funding for TANF and housing assistance is for single mothers, so this direct effect may be significant. Also, our analysis excludes TANF 'child-only' cases, even as some of these may be a consequence of low parental education.

[33] See Osborne Daponte et al. (1999) and Bitler et al. (2003). This effect suggests that educational attainment is associated with a more efficiently targetted welfare system. For example, the overclaim rate for the Earned Income Tax Credit (EITC) may be as high as 32% of total claims. We do not impute a value to this efficiency in this analysis.

[34] This restriction is imposed because of lack of data on other benefits. It means that the effects are likely to be considerably understated. We do not include other federal means-tested programs (such as education, services, job training, and energy aid). For TANF, less than half of expenditures are directly allocated to cash assistance. Economically important programs include: EITC ($29bn); Supplemental Security Income ($39bn); nutrition programs ($16bn). The effects of the EITC are complex: education will raise employment rates which will raise eligibility for the credit for some persons but reduce it for others (as their incomes rise above the threshold); for those who become newly eligible, they may have been on welfare previously so this would create extra savings. Plus, the effect of the EITC is captured in the income and tax analysis above.

payments assuming the same proportionate impact. Second, we calculate the monetary savings from reductions in welfare receipt over the lifetime for those who are 20-year old high school graduates relative to 20-year old dropouts.

Table 6.1
Welfare receipt by education level

	Less than high school	High school graduate	Some college or above
Temporary Assistance for Needy Families:			
Adult annual caseload ages 21-64	551,981	623,714	40,122
Percent of adult caseload:			
Male: white	1.5%	1.7%	0.1%
Male: black	1.7%	1.9%	0.1%
Male: other race	1.2%	1.3%	0.1%
Female: white	14.1%	15.9%	1.0%
Female: black	16.0%	18.1%	1.2%
Female: other race	11.1%	12.5%	0.8%
Total	45.4%	51.3%	3.3%
Housing assistance:			
Adult annual caseload ages 21-64	744,955	841,766	54,149
Percent of adult caseload:			
Male: white	6.0%	6.8%	0.4%
Male: black	6.8%	7.7%	0.5%
Male: Hispanic/other	3.5%	3.9%	0.3%
Female: white	10.7%	12.1%	0.8%
Female: black	12.1%	13.7%	0.9%
Female: Hispanic/other	6.2%	7.0%	0.4%
Total	45.4%	51.3%	3.3%
Food Stamps:[1]			
Adult annual caseload age 20	94,715	226,277	
Probability of receipt at age 20:			
Male: white	6.9%	3.7%	
Male: black	27.2%	17.6%	
Male: Hispanic/other	na	na	
Female: white	8.7%	5.3%	
Female: black	34.9%	23.5%	
Female: Hispanic/other	na	na	

Sources: TANF Annual Report (DHHS, 2005, Tables 10:19-10:22, 10:26); for housing assistance, Census (2003, Tables NC1-NC4); for food stamps, Barrett and Poikolainen (2006) and Rank and Hirschl (2005, Table 3).
Notes: Distribution by education for housing assistance based on TANF distribution. [1] Food stamp receipt for high school graduates includes those with higher education.

Social Security Income for disabilities may also be influenced by education (some of this effect is captured in the analysis on health). Also, welfare entitlements increase significantly for all individuals after age 65. But this period is not considered: after discounting, any differences after age 65 will be small.

Table 6.1 reports the numbers of adult cases for each of the three welfare programs, disaggregated by education, gender, and race.

Two million families received TANF payments in 2002. But 0.8 million of those were 'child-only' cases, so we focus on the 1.2 million adults aged over 20 who received payments. (This is conservative in that it assumes that there is no link between 'child-only' cases and parental education). The top panel of Table 6.1 shows significant differences in TANF receipt by education level: almost half of all recipients have less than high school education, a proportion much higher than their representation in the population; and those with any college education are very unlikely to receive welfare. TANF caseloads are predominantly female (approximately by a factor of ten), with black and other race groups also disproportionately represented.

Over 3.75 million families under the age of 65 received housing assistance in 2002 (Census). Again applying the conservative assumption that adult recipients do not influence any dependents' receipt, there are 1.6 million persons receiving housing assistance annually. The middle panel of Table 6.1 shows that more education is associated with less assistance. The distribution by gender and race shows that these persons are again predominantly female, but the difference is smaller than for TANF receipt.

The Food Stamp program served 9.6 million non-elderly adults in 2004 (Barrett and Poikolainen, 2006). Here too we apply a conservative assumption that these adults are not responsible for any food stamp receipt by children (no data are directly available on the relationships between adult recipients and child recipients). The bottom panel of Table 6.1 shows the distribution of food stamp receipt by gender and race for dropouts and graduates (or above) at age 20. Again, education is important for both males and females, with receipt rates 1.5 or 1.9 times higher for dropouts than for high school graduates. Over the life course for adults aged 20-65, 64% of dropouts will have used food stamps compared to 38% of high school graduates (Rank and Hirschl, 2005, 142).

Waldfogel et al. (2005) calculate the impacts of education on welfare receipt using the March Current Population Survey (2003). The CPS reports the distribution of caseloads by education level. For TANF, we apply the average from two estimates of impacts. The first takes the results from Jayakody et al. (2000), who estimate welfare receipt for single mothers conditional on family circumstances as of 1994. But because these estimates precede the 1996 welfare reforms, they may be less accurate for future cohorts. The second method therefore takes cross-sectional estimates from the CPS.

(An alternative approach using the raw distribution of TANF receipt by education level provides parallel results, DHHS, 2005). For food stamps, figures from Rank and Hirschl (2005) yield similar results.

Table 6.2
The effects of education on welfare receipts

	Impact on welfare receipt relative to high school dropout	
	High school graduate	**Some college or above**
Temporary Assistance for Needy Families	-39.5%	-62.0%
Housing assistance	-0.7%	-34.9%
Food stamps	-18.6%	-53.8%
All welfare spells (females only)	-68.3%	-91.3%

Sources: Waldfogel et al. (2005) based on CPS (2003) distributions. All welfare entries (females only) are taken from Grogger (2004).
Notes: Figures for TANF are the average from the CPS (2003) and Jayakody et al. (2000).

The relationship between education and welfare receipt is summarized in Table 6.2. High school graduation and college enrollment are strongly associated with lower welfare receipt, particularly for TANF and food stamps. Becoming a high school graduate reduces the probability of TANF receipt by 40% and of food stamps by 19%. The effect of being a college graduate is even stronger, at 62% and 54% respectively. For housing assistance, there is almost no effect of high school graduation, but receipt is lower by 35% for those with at least some college. A high-quality study by Grogger (2004) for females shows very strong effects across all types of welfare: graduates are 68% less likely and those with some higher education are 91% less likely to enter welfare rolls. (To be conservative, and because Grogger's relationships are only for females, we do not apply these relationships). Overall, there is likely to be a significant cost-saving from reducing welfare caseloads by raising high school graduation across all three programs.

6.3 Welfare Receipt and High School Graduation

We now combine these impacts with the unit costs of welfare. For TANF, the average monthly benefit is approximately $355 (DHSS, 2004). For food stamps, the average monthly payment to recipients is $85 (Barrett and Poikolainen, 2006, Table A1; higher estimates are reported by Waldfogel et al., 2005). However, these are the amounts received by the recipients; administrative costs must be added to assess the full fiscal burden. A conservative estimate of these administrative costs is 15% (for higher

estimates, see Belfield et al., 2006). For housing assistance, we apply the total budgeted expenditures in 2002 of $36,620 million (2004 dollars) across the 5,125,000 total households (CRS, 2004, 235). Annual spending per household is therefore $7,150, almost all of which is federally funded.[35] Per person, this amounts to $3,100 annually. State-level welfare payments are counted as a proportion of these federal payments.

Total costs per year are the calculated as the impact times the unit cost. These annual figures can be extrapolated to calculate lifetime effects of increasing educational attainment. Eligibility for these three programs is not based on age, although younger families with children are more likely to qualify. However, because TANF is time-limited, we assume no receipt after the cohort reaches the age of 40.[36] Lifetime figures are present values from the perspective of an individual currently aged 20. The discount rate is 3.5%.

Table 6.3
Cost-saving per expected high school graduate

	Present value lifetime cost-saving				
	TANF	**Food Stamps**	**Housing assistance**	**State-level welfare**	**Total**
Average per expected high school graduate	$1,254	$503	$819	$387	$2,963
By gender and race:					
Male: white	$150	$465	$464	$162	$1,240
Male: black	$494	$422	$1,954	$431	$3,301
Male: Hispanic/other	$112	$413	$483	$151	$1,160
Female: white	$2,852	$927	$577	$653	$5,009
Female: black	$4,794	$743	$2,250	$1,168	$8,954
Female: Hispanic/other	$2,008	$170	$545	$408	$3,131

Notes: Expected high school graduate adjusts for progression on to college (Table 1.5). Lifetime welfare cost-savings adjust for the decline in these forms of welfare receipt with age. State-level welfare payments are assumed to be proportionate to federal payments. The average per expected high school graduate is population-adjusted.

Table 6.3 shows the lifetime cost-saving per expected new graduate. The total per additional expected high school graduate is $3,000 over the lifetime. The largest proportion of the savings comes from reductions in TANF payments although there are non-trivial savings in housing assistance and food stamps as well. The total figure is

[35] Waldfogel et al. (2005) report a figure of $4,950 per single mother. But this does not include administrative costs.
[36] The method used here is annualized, so durations of welfare receipt are not important. TANF recipients average 29 months of receipt, but there is significant turnover in TANF caseloads, as well as intermittent use by families (and cycling across welfare programs). However, TANF receipt is time-limited (to five years), so we assume only a 20 year time horizon for this benefit. Food stamp receipt rates increase with age (Rank and Hirschl, 2005).

relatively low (compared to the other domains) because: welfare is time-limited; children and the elderly receive high proportions of welfare funds; and males do not receive much welfare (but they are a large proportion of all dropouts). Also, we have omitted benefits for other federal welfare programs where we have insufficient evidence. Nevertheless, the cost savings are still significant, particularly for female dropouts.

The aggregate effect if the dropout rate is reduced by 50% is substantial. Multiplying per graduate costs by the numbers of new graduates, the aggregate present value saving is $1.05 billion.

7 Cost-Benefit Analysis

7.1 The Aggregate Effects of High School Graduation

In this section we summarize the evidence on tax revenues, health costs, crime costs, and welfare costs to calculate the full consequences of failing to educate children to high school completion. These consequences per expected new high school graduate are summarized in Table 7.1.

Table 7.1
Present value lifetime economic benefits per expected high school graduate

	Discount rate 3.5%
Average economic benefit per expected high school graduate from more tax revenues, lower public spending on health care, crime, and welfare	**$209,121**
Economic benefit by gender and race:	
Male: white	$262,092
Male: black	$268,463
Male: Hispanic	$196,274
Male: other	$238,924
Female: white	$162,017
Female: black	$174,585
Female: Hispanic	$142,964
Female: other	$157,345

Notes: Benefits are gross, i.e. they do not account for the costs of additional educational attainment. An expected high school graduate is one who probabilistically either: terminates education after graduation; completes some college; or completes a BA degree (see Table 1.5 for race-specific and gender-specific probabilities). The average figure is adjusted for the gender and race population sizes. Health benefits are not adjusted for gender and race differences.

Each new high school graduate will, on average, generate economic benefits to the public sector in the amount of $209,000. These are gross benefits and do not acount for what it costs for the necessary educational interventions to raise the graduation rate or fund college progression contingent on graduation. The amounts vary by gender and race, with high school graduation providing a gross public saving of $196,000-$262,000 for males and $143,000-$175,000 for females. These differences are caused by many factors, including the strengths of educational effects on the various outcomes, the progression rates to college, and the involvement of the different populations in the labor market.

The individual analysis can be aggregated across each age cohort. The aggregate effects assume a reduction in the dropout rate of 50%, or 354,030 persons aged 20. The consequences are reported in Table 7.2.

Table 7.2
Present value lifetime economic benefits for current cohort aged 20

	Discount rate 3.5%
Aggregate benefit if the dropout rate is reduced by 50%:	
Income, sales, and property tax payments	$49.241 bn
Health cost savings	$14.340 bn
Crime cost savings	$9.405 bn
Welfare cost savings	$1.049 bn
Total	**$74.035 bn**

Notes: Some dropouts will progress on to college. For the cohort aged 20, there are 354,030 new expected high school graduates (see Table 1.6 for race-specific and gender-specific numbers). Benefits are gross, i.e. they do not account for the costs of additional educational attainment.

The total public sector economic impact if the dropout rate for a 50 percent reduction in the dropout rate for this cohort of 20-year olds is $74 billion. The benefits are spread across the four domains, although tax payments and criminal justice system cost-savings account for the majority of the savings. As with Table 7.1, these are the gross benefits without taking into account what it would cost to raise educational attainment to this extent. However, this amount is an annual figure in that each successive age cohort of 20-year olds will include dropouts who may experience the same outcomes over the lifetime. This means that the hypothetical gross public savings would be about $740 billion for ten successive cohorts. (Indeed, extrapolating from trends for more recent age groups, the gap in outcomes for subsequent cohorts of dropouts may be even larger.)

7.2 Comparing Costs and Benefits

The gross benefits of graduation must be compared with the costs of educational interventions required to bring about an improvement in high school completion rates. Table 7.3 shows the comparison. The first row shows the educational cost per new graduate, i.e. the sum of intervention and attainment costs for each of the five interventions which have been proven to raise graduation rates (see Section 2 above). These costs range between $59,000 and $144,000. The second row shows the average economic benefits per high school graduate, $209,000. The third row shows the benefit–cost ratio, i.e. the factor by which the benefits exceed the costs. Regardless of

the intervention, the benefit–cost ratios easily exceed one. (The purpose is not to rank these interventions but to establish whether or not they yield a positive return in terms of high school graduation).[37] The highest ratio yields economic benefits of $3.54 for every $1 invested. This is the First Things First intervention, a comprehensive high school reform with small learning communities and teacher advocates. The pre-school programs (Chicago and Perry) both have ratios of over 2, as does the intervention to increase teacher salaries. Reducing class size also yields a strongly positive return, with a benefit-cost ratio of 1.46.

Table 7.3
Net present value lifetime public cost-savings per additional high school graduate

	First Things First	Chicago Parent-Child Centers	Teacher salary increase	Perry Pre-school	Class size reduction
Per additional expected high school graduate:					
Costs (C)	$59,066	$67,714	$82,036	$90,694	$143,597
Benefits (B)	$209,121	$209,121	$209,121	$209,121	$209,121
Benefit/cost ratio (B/C)	3.54	3.09	2.55	2.31	1.46
Net present value (B-C)	$150,055	$141,407	$127,085	$118,427	$65,524

Notes: A discount rate of 3.5% is used.

An alternative economic expression is the net present value of the investment, i.e., the difference between the benefits and costs when these are expressed in a consistent time frame. These values are given in the final row of Table 7.3: the five interventions would generate a net present value of between $66,000 and $150,000. If we chose the median intervention – increasing teachers' salaries – then the net economic benefit is $127,000.

[37] Ranking is also inappropriate because we have not taken a comprehensive approach to evaluating the full benefits of each intervention. Our goal is to examine the economics of raising the high school graduation rate.

Table 7.4
Net present value aggregate lifetime public cost-savings from high school graduation

	First Things First	Chicago Parent-Child Centers	Teacher salary increase	Perry Pre-school	Class size reduction
Aggregate effect if:					
50% of dropouts became graduates	$53.124 bn	$50.062 bn	$44.992 bn	$41.927 bn	$23.197 bn
20% of dropouts became graduates	$21.250 bn	$20.025 bn	$17.997 bn	$16.771 bn	$9.279 bn

Notes: A discount rate of 3.5% is used. Net present values are benefits minus costs. Graduates are represented as 'expected high school graduates'. Dropouts are those who have obtained 9th-11th grade education. For this age cohort 50% is 354,030 and 20% of dropouts is 141,612 persons.

Table 7.4 shows the aggregate net present value from these educational interventions. Our baseline assumption is that half of those persons with 9th-11th grade education could become high school graduates if they received effective educational interventions. If this occurs, the aggregate net benefits per age cohort would range between $53.1 billion (with First Things First) and $23.2 billion (with an intervention to reduce class sizes). The median intervention generates $45 billion. This is an annual figure, in that it applies to each age cohort.

As noted in Section 1 above, many immigrants are high school dropouts who did not receive their entire K-12 schooling in the U.S. It is therefore inappropriate to include them in the aggregate analysis, so we assume a smaller increase in the high school graduation rate applicable to U.S.-born persons. If only one-in-five of these high school dropouts were to become a high school graduate, the net benefits would range from $21.3 billion to $9.3 billion.

7.3 Sensitivity Analysis

The net economic benefits of investments to raise high school graduation rates appear to be very large. In addition, we find that they are robust to alternative assumptions and further refinements. Box 7.1 summarizes our sensitivity testing.

It is possible that the net benefits are greater than we have shown. We have applied conservative methods in only isolating the evidentiary and causal impacts of education.[38] We have excluded the costs imposed by juvenile criminal activity and

[38] For example, health costs may be higher. Medicaid reimbursements tend to be much lower than the providers' operating costs, so some hospitals receive 'disproportionate share hospital

teenage pregnancy. And, we have excluded deadweight losses, i.e. the economic distortion imposed by raising taxes to pay for health, crime, and welfare services; these may be as high as 28 cents per dollar of tax raised.[39] We have also excluded intergenerational benefits and those to the family. It is also possible that public programs may be more efficiently delivered, as more education is associated with more efficient targetting of services. Finally, Schmitt and Baker (2006) present evidence that the Current Population Survey undercounts the numbers of persons in poverty (particularly for African Americans and Hispanics). This undercounting means that less of the low-educated are included in our data, biasing their average status upward.

Box 7.1
Sensitivity testing

Assumptions	Effect on net economic benefits
Educational interventions can be accurately targeted to at-risk groups	+++
Inclusion of juvenile benefits (crime, teen pregnancy)	++
Higher taxes to support added costs of dropouts imposes an economic distortion (deadweight loss) on taxpayers	++
Inclusion of intergenerational and family benefits from graduation	++
More efficient delivery of public services	+
Undercounting of persons in poverty	+
Fall in wages with more graduates in the labor market	-
Increase in the costs of delivering each intervention	- -
No college progression by high school graduates	- -
Higher discount rate	- -

Notes: Number of plus or minus signs indicates the approximate strength of the effect.

Below, we report two sensitivity tests from the list in Box 7.1. The first assumes that any future income is valued at a low rate, i.e. it is discounted more heavily. We use a 5% discount rate, noting that Moore et al. (2004) argue for 3.5% for public

payments'. These funds typically range from $15-$16 billion and were approximately 11% of all Medicaid program costs in 2001 (NCHS, 2005). Supplemental funds are also paid from county or state governments. In sensitivity testing we found that this raises costs by as much as 30%. Similarly, welfare costs may be higher: we have not included 'child-only' cases in our calculations.

[39] Fullerton (1991) estimates the marginal excess burden from labor taxes at 7-25 cents per dollar; Allgood and Snow (1998) estimate 13-28 cents as the marginal welfare cost per dollar of a lump-sum grant. This economic distortion applies both to raising revenues to pay for the educational interventions as well as to pay for health, crime, and welfare services. Nevertheless, it would increase the net present value.

investments. The second test assumes that none of the high school graduates progress on to college. As reported in Section 1, this is very conservative given the observed progression rates even for those from the most disadvantaged backgrounds.

Table 7.5
Alternative scenarios for net present values

Net present value	First Things First	Chicago Parent-Child Centers	Teacher salary increase	Perry Pre-school	Class size reduction
Best estimate[1]	$150,055	$141,407	$127,085	$118,427	$65,524
Scenario A: Lower value on future[2]	$98,402	$80,944	$69,017	$52,015	-$7,257
Scenario B: No new college enrollees[3]	$109,961	$101,313	$86,991	$78,333	$25,430

Notes: (1) See Table 7.2. (2) Discount rate of 5% is used. (3) All new high school graduates terminate their education after high school.

The results of these tests in terms of net present values are reported in Table 7.5, along with the best estimate from Table 7.2. Of course, applying each of these assumptions produces smaller net present values. Instead of a net economic gain of $150,000 from First Things First, the public benefits are $98,000 or $110,000. Only for one of the five interventions (class size reduction) would the costs exceed the benefits (and trivially so in the case of zero college enrolment). We have deliberately contrived the assumptions to be very conservative by selecting to test the most negative assumptions from Box 7.1. So the generally strong positive results give us confidence that educational interventions yield high public returns.

We also consider the possibility that general equilibrium effects will undermine the results. If large numbers of persons enter the labor market, wages will fall. However, there is no obvious correlation between the supply of educated workers and their wages; since the 1980s, demand-side changes have meant that the wages for skilled workers have kept rising even as their numbers have grown. The explanation for this may be skill-biased technical change or other economic factors, but the consequence is that wages may not fall if there are more graduates and they might even rise. Moreover, it is important to emphasize that 354,030 persons represent less than two-tenths of one percent of the U.S. labor market. Also, this new flow of workers will be spread over a number of years: roughly one-quarter of the high school graduates will go

on to college before entering the labor market. Finally, if the public benefit is returned in the form of lower payroll taxes, employment rates will further increase.

Several general equilibrium effects are possible if the crime rate falls substantially. One is where criminals impose congestion costs on each other; one fewer criminal would raise the returns to crime for the rest and crime would not fall proportionately (Cook, 1986). The second possible effect is where the absence of one criminal improves the efficiency of policing; the remaining crimes would be prevented or prosecuted at a higher rate and crime would fall more than proportionately. Third, higher attainment may raise one's ability to avoid being a crime victim. Fourth, fewer crimes may make the labor market more efficient: having a criminal record not only reduces own participation, but it also impinges – through statistical discrimination – on the job market prospects of others with similar characteristics (Pager, 2003; Raphael, 2004; Roberts, 2004). Fewer crimes by young adults will mean less labor market discrimination. However, there is very little evidence on the relative strength of these offsetting effects.[40]

Finally, alternative baseline assumptions may be applied. However, these would need to be substantiated by evidence, rather than applied *ad hoc*. Changes to two key assumptions would likely *raise* the returns to the investment. Throughout we have assumed that the interventions could not be perfectly targeted to at-risk groups: to produce new high school graduates it is necessary to deliver the intervention to vulnerable groups of students of which many would have graduated anyway. Thus, imperfect targeting means that the cost per new graduate is considerably above the unit cost of delivering the intervention to a student who can be more sharply targeted as having a very high probability of dropping out. If the interventions could be targeted more accurately, then the costs would fall, possibly by a large amount. In addition, we have assumed that for those persons who would have graduated anyway the benefits are zero: that is, there is no positive effect from more educational resources. Yet, it seems highly plausible that even those who were not at risk of dropping out would benefit (from pre-school, for example); indeed for most of these interventions there is evidence of benefits across all education levels and not just graduation. Changing a third key assumption would likely reduce the returns. We have assumed that the

[40] Similarly neutral general equilibrium effects may be anticipated in terms of health and welfare. Health services may be more efficiently delivered if there are fewer enrollees. Welfare systems may be more efficient if the welfare rate is lower. However, there is limited evidence on these relationships.

average cost stays constant as each intervention is scaled up. It is possible that the average cost for each intervention would rise if the intervention were to be implemented on a large-scale.[41] But, there is no evidence on how much unit costs would change, and they would need to double or triple to undermine the overall conclusion.

In summary, it seems unlikely that sensitivity tests using alternative assumptions would overturn the fundamental conclusion of this analysis – that the net present value of public investments to ensure high school graduation is significantly positive.

[41] However, it is possible that as know-how spreads across educational operations the cost would decline with increases in the productivity of the interventions (so more students would graduate).

8 Moving Forward

In this study we have found that the monetary value of the public benefits of reducing high school dropouts exceeds considerably the public costs of getting results through demonstratively successful educational interventions. In doing so we have attempted to be comprehensive in addressing the benefits of increased tax revenues as well as reductions in the costs of public health, criminal justice, and public assistance, and we have followed conventional economic procedures in estimating both costs and benefits. To some degree we believe that our estimates have been conservative in not including a wide range of benefits that cannot be easily measured such as improvements in civic behavior and intergenerational benefits associated with better education. Nor did we include benefits for students who did not graduate, but still improved their educational attainments and achievement as a result of the extra support received.

We followed relatively strict procedural rules in estimating benefits and costs. Most notably we selected only those interventions for which rigorous and credible evaluations were available and which showed positive impacts on reducing high school dropouts. Of the many different interventions for increasing high school graduation, we found only five that met these criteria. This process, although clearly supported by the mainstream authorities in evaluation (e.g. Mervis, 2004) may have led to conservative estimates of the public fiscal returns. The reason is that more recent and promising interventions were not considered in our study because of a lack of reliable information on their effectiveness. It is our hope that over time we will obtain excellent evaluations of their impact and that they will show even more powerful results than some or all of the interventions that we considered.

In this section we will suggest a number of potential candidates for increasing high school graduation that may have even more powerful effects than the interventions that were the focus of this study. However, that potential needs to be validated through rigorous evaluation before we can include it in our assessment of investment returns. In general, there is a convergence of agreement on a common set of features that lead to increased high school graduation rates and educational success: (1) small school size; (2) high levels of personalization; (3) high academic expectations; (4) strong counseling; (5) parental engagement; (6) extended-time school sessions; and (7) competent and appropriate personnel.

Small size describes a small school or a small program within a school in which students and staff are known to each other and accountable. Personalization refers to a caring environment in which every student is perceived as an important member of the community by both staff and other students and in which individual personal and academic needs are addressed. High academic expectations call for a demanding level of academic work that each student is expected to meet if given appropriate assistance. Strong counseling refers to the ready availability of personnel who can provide guidance and advice to students facing considerable personal challenges. Parental engagement enlists the efforts of the parent in support of the educational aspirations and accomplishments of their child and the school. Extended time refers to longer school days, weeks (Saturday classes) and school years to allow sufficient time for instruction and other activities designed to enable students to succeed. Competent and appropriate personnel refer not only to teaching qualifications of personnel, but also to their commitment to the mission of the school.

It is important to note that there is wide agreement that these types of changes should not be done on an individual basis, but should be done in combination to comprise a different type of school and schooling experience (Ferguson, 2005; Quint, 2006). For example, although there is a vigorous "small school" movement in the U.S., the evidence suggests that shrinking school size alone is unlikely to be adequate to improve educational outcomes in the absence of other changes (Darling-Hammond et al., 2006; Kuziemko, 2006). It is also important to ensure that institutional support is adequate to ensure that any interventions are implemented properly across larger groups of students (Glennan et al., 2004).

Among the five interventions that we reviewed in the cost-benefit framework, First Things First (FTF) has components that draw upon the features set out above. Perhaps it is not a coincidence that FTF also has the largest economic benefits relative to costs. Because FTF represents an investment in high school, there is a shorter period of time before the investment pays off relative to pre-school and elementary school investments. For this reason and its overall effectiveness, it shows the best results among the investments considered. Even so, FTF includes class size reduction, and it is conceivable that it could be even more effective if its students had a strong pre-school experience and a more selective draw of teachers through higher salaries. In this respect we believe that the overall model represented by the FTF results is one that should be evaluated further in its different forms.

One of the most complete versions of this model is that of the Institute for Student Achievement (ISA) which includes all of the features set out above (www.studentachievement.org). ISA has developed its approach in schools for more than a decade and served about 8,000 students in 32 partner schools in 2005. Although early evaluation information is promising on ISA, there is a pressing need for further evaluations using experimental and quasi-experimental methods to validate the magnitude of its educational effects. (An evaluation is being conducted by AED, 2006).

Other models that show promise along some educational dimensions, but have not yet been validated in their impacts on high school completion are Talent Development High Schools and Career Academies (Quint, 2006). Both have been subjected to rigorous evaluations and have shown other positive results in. One promising model of reform that operates in existing size high schools is Achievement Via Individual Determination (AVID) which was started in 1980 and is now found in more than 1,000 schools in 40 states (www.avidonline.org). AVID seeks out students in the middle of the academic distribution who are not doing the quality work that they are capable of and provides dedicated teachers and rigorous educational experiences for students willing to take on the AVID commitment. Intensive support is also received from college tutors. It, too, requires tighter evaluation studies before conclusions can be drawn on its effects, although less formal studies have found strong results.

A good case can also be made for accelerating the middle school and secondary curriculum to insure that all students experience a similar set of challenging courses with workshops and other instructional supports to support those students with particular learning needs. A rigorous, longitudinal evaluation of this reform in mathematics showed that even the most advanced students benefit, and those who entered middle schools with the poorest records are brought into a productive mainstream in which they take more advanced mathematics courses and improve substantially their mathematics achievement (Burris etal., 2006). In our view there are a large number of potential approaches that have promising evaluation support, even if it falls short of what is needed for a rigorous cost-benefit analysis. Thus, our results do not need to be narrowly assumed only for the smaller set of interventions that were included in our calculations. However, attempts should be made to initiate strong evaluations for all those reforms that show promise in order to include them in future cost-benefit studies.

A final point on policy intervention is the fact that not all must be initiated in the schools. A substantial amount of the variance in educational performance is associated

with influences in the home, school, and community (Rothstein, 2004). Studies of high school dropouts also confirm the importance of differences in conditions outside of the school. These findings suggest that the strongest programs for increasing high school graduation rates and subsequent college participation will combine interventions in the school with those in the family, neighborhood, and community (Van Dorn et al., 2006).

Raising Benefits and Reducing Costs

As mentioned above, we view our estimates as conservative assessments of the public returns to public investments in raising high school graduation rates. Even so, the returns are substantial and could be higher if benefits were increased and costs were reduced. Clearly the most direct way of raising benefits is to establish more powerful methods of improving high school graduation rates. We believe that more recent approaches such as those set out in the previous section may have even more potent impacts on improving educational results. If so, we can raise benefits by shifting to those that are shown to be most productive according to evaluation methods based upon high standards of validity.

With respect to costs, it should be noted that even if they are higher for some of the newer approaches that show promise, the higher costs may be offset by disproportionately greater results. We should also note that a substantial portion of the costs are derived from the additional years of schooling spawned by greater educational success rather than the interventions themselves. For example, in the case of First Things First (FTF) the present value of costs at age 20 attributed to additional years in the educational system is fully 70 percent as great as the cost of the intervention. Thus, a 10 percent increase in the cost of the intervention would amount to only about a 6 percent increase in the overall cost per new high school graduate.

But, one effective strategy that could cut the cost considerably would be if the intervention could be targeted to those students most likely to drop out or most likely to benefit from it. When the intervention is targeted to the entire school (including those students who would have graduated anyway), it requires more resources than if it were targeted to a particular group of vulnerable students. Thus, targeting the intervention or portions of the intervention, if possible, represents a way of reducing the cost for each additional student that graduates.

More Than Money

This study has shown that by focusing resources on students who are receiving inadequate education, it is possible to obtain benefits far in excess of the costs of those

investments. Increases in tax revenues and reductions in taxes paid into public health, criminal justice, and public assistance would amount to many billions of dollars a year in excess of the costs of educational programs that could achieve these results. But, it is important to note that this is more than just good public investment policy with monetary returns. A society that provides fairer access to opportunities, that is more productive and with higher employment, that has better health and less crime is a better society in itself. That the attainment of such a society is also profoundly good economics is simply an added incentive, albeit a large one.

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