Accounting for Risk of Non-Completion in Private and Social Rates of Return to Higher Education*

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ABSTRACT

Conventional studies of the private and social rates of return to a Bachelor's degree focus on the earnings difference between Bachelor degree holders and high school graduates, and find that there are large rates of return for degree recipients. The estimates in these studies, however, do not take into account the risk of not completing a degree. In this study, we begin by reviewing the methodology used in conventional studies of the private and social financial benefits from college, and show how it can be modified to take into account the risk of not completing college and the timing at which students may depart college. We test the sensitivity of our findings to whether students attend a public or private institution, the growth rate of real earnings, and the price paid by students. Our approach also takes into account the impact of differences in unemployment rates by education level on future benefits. Overall, we find that the financial return for all college attendees is still large, but is lower than for only those who earn a Bachelor's degree.

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INTRODUCTION

There is substantial debate in the U.S. among academics, policymakers, and media commentators as to whether higher education policy should focus on advocating for increased—or even universal—college attendance (Fain 2012; Lederman 2013; Samuelson 2012; Vedder 2012; Williams 2012). On one side of the debate are politicians including President Obama and organizations such as the Lumina Foundation that are calling for more students to attend college. In his 2012 State of the Union address, President Obama described higher education as an "…economic imperative that every family in America should be able to afford." (Williams 2012). Likewise, the American Council on Education (ACE) argues that "higher education is essential and has an extraordinary payoff." (Fain 2012). Going to college is seen by many as a means for individuals to improve their economic and non-monetary well-being, and produce spillover benefits to society (Psacharopoulos 2008; McMahon 2009).

The other side of the debate features those who assert that the so-called "college-for-all" push is, as noted by media commentator Robert Samuelson (2012) "…the largest mistake in educational policy since World War II." Critics of the policy argue that because many students are not prepared to do college-level work, they face a significant risk of failing to graduate. The dropout issue not only reduces the private return to attending college for students who leave college before graduation because they incurred costs with little in return, but it also reduces the social return due to the societal resources spent to support their college education.

Numerous studies have been published in academic journals that estimate the average internal rate of return realized by students and society from completing various levels of education. These studies compare the financial benefits that come from having a Bachelor's degree, for example, relative to the cost of obtaining the degree to find the private and social rates of return from making the investment. Similar calculations are made for Associate degree recipients.[1] The appeal of these studies is that they utilize readily-available labor force data on average salaries by educational attainment, apply fairly straightforward calculations, and can be explained to a wide range of education stakeholders.

The vast majority of studies using this approach have concluded that on average there are large financial payoffs for students from obtaining a college degree (summaries of findings from international studies can be found in Cohn and Geske 1990; Psacharopoulos 1973, 1981, 1985, 1994; Psacharopoulos and Patrinos 2004). The benefits are reflected in the fact that data from the Census Bureau have shown that the median earnings for workers increase along with educational attainment (see Figure 1). The income gaps widen when all
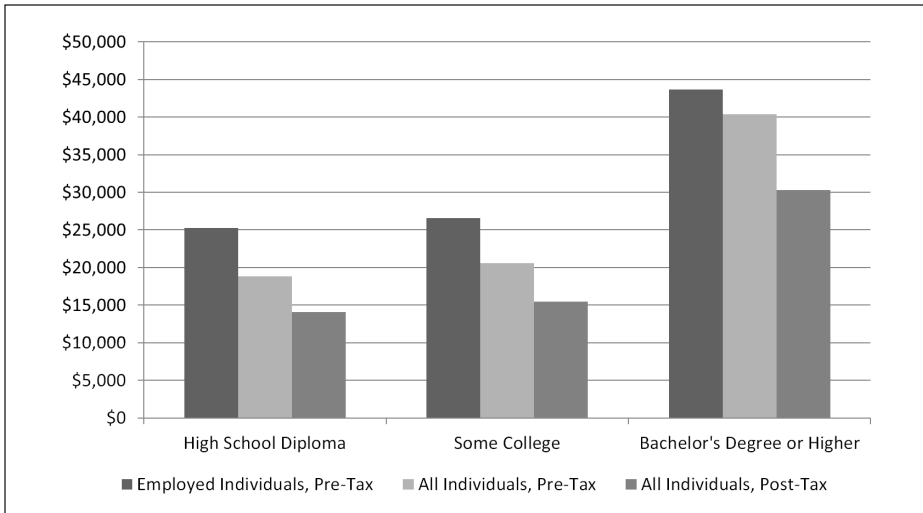
Figure 1. Median Total Money Earnings in 2011 by Education for Individuals Ages 25–34

Source: U.S. Census Bureau, Current Population Survey, 2012 Annual Social and Economic Supplement. The first bar in each group represents the pre-tax median total money earnings for individuals ages 24-34 who reported being employed in 2011. The second set of bars in each group is the pre-tax median earnings for all individuals in the age group 25-34, including those who reported no earnings. The final set of bars in each group is an estimate of the post-tax median earnings, assuming that individuals paid a 25% tax rate on earnings. The values used for the second and third sets of bars were calculated by the authors.

individuals are included in the calculations because unemployment rates are negatively correlated with educational attainment. These gaps persist regardless of whether incomes are expressed in pre-tax or post-tax dollars.

The financial payoff from having a Bachelor's degree is commonly shown as the annualized rate of return on costs of investing in college that yield the future benefits, or the "internal rate of return" (IRR). Studies have consistently found that there are often double-digit rates of return for individuals ("private IRR") from having earned a Bachelor's degree. Psacharopoulos (2008), for example reported that the private IRR from earning a Bachelor's degree in the United States was 15.1%. Likewise, McMahon (2009), Psacharopoulos and Patrinos (2004), and others have concluded that although the rates of return to society ("social IRR") were smaller than the private IRRs, they were still positive and sizable.[2] Both the private and social IRRs from degree completion compare favorably to other investments where a 10% annual return is the general standard (McMahon 2009; Cohn and Hughes 1994). These conclusions also held for primary and secondary education, and Associate's degrees (Psacharopoulos and Partinos 2004; McMahon 2009).

The financial benefit from having a Bachelor's degree can also be described in terms of the (inflation-adjusted) dollar gain in expected lifetime income. Despite

differences in the time periods examined and the assumptions made about incomes and their growth rates, reports in the media and trade publications in the last decade have found that the income gain from having completed a Bachelor's degree is approximately $1 million in future inflation-adjusted dollars (Baum, Ma, and Payea 2010; Carnevale, Rose, and Cheah 2011; Day and Newburger 2002).

While the rates of return studies have received considerable attention from policymakers and the general public over the years, one aspect of these studies that is often overlooked is that the estimates only apply to those students who completed college, and not all those who initially attended college. The distinction between college attendance and completion is potentially important because many students who decide to attend college do not earn a degree (Bowen, Chingos, and McPherson 2009; Cunha 2009). This may have implications for the private and social IRRs and dollar income gains because it has been shown that incomes rise slowly with years of education, but much faster with degree completion (Belman and Heywood 1997; Gullason 1999; Bitzan 2009).

Viewed in this way, going to college is a risky investment for individuals and society, because there is the chance that students may not complete a degree and realize large personal gains (or generate them for society) over their lifetimes. Vedder (2012) explains the problem as follows:

> "The 'college-for-all' crowd…argues, correctly, that the average college graduate earns more than the average high-school one. But that calculation fails to use a more appropriate measure…to analyze the return to college. Specifically, if 45 percent or so of students fail to graduate in six years, earnings comparisons unadjusted for the high risk of dropping out are totally inappropriate."

Borrowing language from the experimental design literature, attending college can be viewed as a treatment that is experienced by subjects (students). When basing the IRR calculation on the earnings difference between Bachelor degree holders and high school completers, researchers focus on only those students who began and successfully completed the treatment (i.e., earned a Bachelor's degree). However, there are many students who begin treatment and do not successfully complete it, and the financial returns for them may be different from only those students who earn a Bachelor's degree.

What is needed, then, is a way to estimate the private and social IRRs for all students who begin the treatment of attending college. This is particularly important if policymakers use estimates of the financial benefits to entice more students to go to college. Hussey and Swinton (2011) have shown how the risk of not graduating can be incorporated into the return on education in econometric studies using a Mincerian earnings equation; however, the internal rates of return

formulas have not also been modified to take non-completion risk into account.

In this study, we show how to calculate the private and social internal rates of return to all students who attend, rather than complete, college. Our approach makes adjustments for the risk of not earning a Bachelor's degree, and the timing at which students drop out of or graduate from college. Although we focus on the IRRs to pursuing a Bachelor's degree, the same methodology could also be applied to other education levels. We proceed as follows. In the next section, we review the methodology used in traditional studies of the return from earning a Bachelor's degree, and describe how this approach can be modified to account for the risk of not completing college and the timing of graduation or dropping out of college. Using available data, we estimate the average private and social IRRs and the dollar benefits and costs to students from pursuing a Bachelor's degree, and conduct sensitivity tests for the assumptions about income growth, the type of institution attended, and the net prices paid by students. We then conclude with a discussion of the policy implications from this work.

FINANCIAL BENEFITS FROM COLLEGE COMPLETION

The most frequently-used theoretical framework for studies of the financial benefit from college is the economic model of education as an investment in human capital. Human capital can be thought of as the collective skills and attributes that a person brings to the labor market (Walsh 1935; Becker 1975), or hours spent outside of the labor market that generate private and external social non-market benefits (McMahon 2009). Economists including Mincer (1958), Schultz (1961), Becker (1962), and others introduced the idea that education is an investment in one's human capital, and thus years of education at the primary, secondary, and postsecondary levels should be rewarded in competitive labor markets. Cohn and Geske (1990) provide a thorough overview of the development of this literature. Researchers measure the financial benefits from college in several ways. Some researchers use data on average earnings by degree level to estimate the average financial benefit from completing a degree. There have been many studies in which the financial benefit is expressed in the form of the internal rate of return, which represents the annual return that would be needed on education expenditures to yield the future benefits (Ashworth 1997; McMahon 1991, 2009; Menon 2008; Psacharopoulos and Patrinos 2004; Psacharopoulos 1973, 1981, 1985, 1994, 2008). It is common for researchers to measure both the financial private IRR (to the student) and the social IRR (to society). For example, Psacharopoulos and Patrinos (2004) note that the average private and social IRR from higher education in OECD countries are 11.6 percent and 8.5 percent, respectively.

Reports produced by agencies such as the College Board use a similar approach to the IRR studies but instead focus on the dollar benefits received by students with a Bachelor's degree (Baum, Ma, and Payea 2010; Carnevale, Rose, and Cheah 2011; Day and Newburger 2002). Studies sponsored by The Georgetown University Center on Education and the Workforce (Carnevale, Rose, and Cheah 2011) and the College Board (Baum, Ma, and Payea 2010) have found that the future lifetime earnings for Bachelor degree recipients was close to $1 million higher than for those who did not go to college. These findings are consistent with McMahon's (2009) estimate of a $1.1 million increase in lifetime benefits to students from completing a Bachelor's degree. Because these reports often do not subtract the costs of investing in college from their benefit calculations, the figures cited represent gross and not net private benefits.

Both the IRR and the net lifetime dollar gain from investing in higher education provide useful information to students and policymakers. The private and social IRRs have the advantage of being comparable across nations, education levels, time, and investment options. At the same time, students and their families are interested in the expected lifetime dollar benefit from college as well as the IRR from the investment because two alternatives with the same IRR may yield different dollar benefits. For example, the private IRR from completing an Associate's degree is often found to be higher than the private IRR from completing a Bachelor's degree (e.g., McMahon 2009). However, those who chose to earn an Associate's degree instead of a Bachelor's degree would expect to receive, on average, smaller dollar gains over their lifetime because there is less human capital accumulated due to the shorter time frame in college. Likewise, the dollar benefits from different college choices may be similar (such as public and private institutions), and yet have different IRRs due to cost differences.[3]

The IRR and dollar benefit calculations often do not take into account many of the non-market benefits that individuals and society may receive due to education. Education may provide students and their families with a range of consumption benefits that are separate from increases in future earnings (Jacobs, McCall, and Stange 2013). It is possible that education could lead to improvements in health and other aspects that are important to individuals and yet difficult to translate into dollars. These non-market benefits could also spill over to the rest of society, leading to positive externalities from education. However, as noted by Psacharopoulos and Patrinos (2004, p.117), these externalities "…are often hard to identify and even harder to measure." As a result, the figures typically produced in IRR studies underestimate the total private and social benefits to education. We refer readers to McMahon (2009) for a comprehensive analysis and review of the literature, as well as efforts to measure various non-market benefits to higher education.

Another approach to examining the financial benefits from college is to use data on individual students to estimate the earnings gap for people with different levels of educational attainment but the same values of other characteristics that may affect earnings using a Mincerian wage equation (Mincer 1974). Much of the literature on college benefits fall into this category (Bitzan 2009; Brewer, Eide, and Ehrenberg 1999; Christiansen, Joensen, and Nielsen 2007; Dale and Krueger 2002; Heckman, Lochner, and Todd 2008; Lemieux 2006; Singh 2010; Tuor and Backes-Gellner 2010). There have also been many studies that have attempted to quantify the return to higher education outside of the U.S. (Asadullah 2006; Benhabib and Spiegel 1994; Denny and Harmon 2001; Menon 2008; Shafiq 2007; Tilak 2007).

Private IRR from College Completion

To find the private IRR from completing a Bachelor's degree, consider a new college freshman who will be enrolled in college for T^1 years. The annual private costs from completing a Bachelor's degree $C(p)_t^c$ is defined as the net price of attendance plus the foregone post-tax earnings while in college:

$$(1) \qquad C(p)_t^c = P_t - F_t + (1 - tx^{na})I_t^{na}$$

where P_t = tuition and fees, F_t = grants/scholarships, = pre-tax income if not attend college, and tx^{na} = tax rate for non-college attendees. The student expects to receive a series of post-tax financial benefits from earning a Bachelor's degree for years $t=T^1+1$ until retirement in year $t=T^2$. The annual private benefit from Bachelor degree completion represents the average post-tax earnings difference between individuals with a Bachelor's degree and those with a high school diploma:

$$(2) \qquad B(p)_t^c = (1 - tx^c)I_t^c - (1 - tx^{na})I_t^{na}$$

where I_t^c = pre-tax income for Bachelor degree holders, and tx^c = tax rate for college completers. The so-called "full method" for calculating the inflation-adjusted private IRR from having a Bachelor's degree involves solving for the annual rate of return $(r(p)^c)$ that would be needed for the costs to generate the lifetime benefits, as in:

$$(3) \qquad \sum_{t=T^1+1}^{T^2} \frac{B(p)_t^c}{(1+i)^{t-1}(1+r(p)^c)^{t-1}} = \sum_{t=1}^{T^1} \frac{C(p)_t^c}{(1+i)^{t-1}(1+r(p)^c)^{t-1}}$$

where i = rate of inflation. To implement the full method for calculating the IRR, researchers must make assumptions about the average salaries (and their rates

of growth) for those with and without a Bachelor's degree, the rate of inflation, tuition and fees, financial aid, and tax rates.

Social IRR from College Completion

The social rate of return to completing a Bachelor's degree is found in much the same way as the private IRR. First, the social cost is obtained by adding public subsidies used to support a student's education (G_t) to private direct costs, and expressing indirect costs in pre-tax dollars:

$$(4) \qquad C(s)_t^c = P_t - F_t + I_t^{na} + G_t$$

The annual social benefit from Bachelor degree completion is measured as the pre-tax difference in earnings between those with a Bachelor's degree and those who did not attend college:

$$(5) \qquad B(s)_t^c = I_t^c - I_t^{na}$$

the added tax revenue represents a social benefit because it is used by governments to benefit others in society. Note that this does not fully capture other market and non-market benefits to society from higher education. Finally, the social IRR is the annual rate of return ($r(s)^c$) on social costs that is needed to yield social benefits:[4]

$$(6) \qquad \sum_{t=T^1+1}^{T^2} \frac{B(s)_t^c}{(1+i)^{t-1}(1+r(s)^c)^{t-1}} = \sum_{t=1}^{T^1} \frac{C(s)_t^c}{(1+i)^{t-1}(1+r(s)^c)^{t-1}}$$

ADJUSTING FOR THE RISK OF NOT COMPLETING COLLEGE

A limitation of the private and social IRR calculations (as well as the dollar gain in income estimates), however, is that they do not take into account the risk that students who attend college may not earn a degree. What is actually being captured in traditional studies is the financial benefit to individuals and society for only those students who begin and successfully complete the "treatment" of attending college.

The issue of non-completion has received considerable attention in recent years following the publication of *Crossing the Finish Line* (Bowen, Chingos, and McPherson 2009). It is clear that many students who begin college do not earn a Bachelor's degree. Nationally, only 55% of students who enroll in a baccalaureate-granting public college or university graduate from the same institution within

six years (National Center for Education Statistics 2012). After accounting for those students who transfer and graduate from other institutions (Ewell and Kelly 2009), close to one-third of students who pursued a Bachelor's degree at a public institution were still not successful in earning a degree.

It is also well-documented that there is a nonlinear relationship between education and earnings (Belman and Heywood 1991, 1997; Heywood 1994; Jaeger and Page 1996; Denny and Harmon 2001; Bitzan 2009). The phenomenon of earnings rising substantially with degree completion has been attributed by some to an increase in demand for skilled labor due to rising technological developments and global competition (Carnevale, Jayasundera, and Cheah 2012; McMahon 2009). Others have asserted that the wage premium for college graduates reflects actual or perceived human capital differences that are then rewarded in the labor market (Bitzan 2009; Hwang, Liao, and Huang 2013; Park 2011; Shabbir and Ashraf 2011). There may also be an option value with earning a Bachelor's degree because it makes available opportunities for graduate study which lead to additional higher earnings (Cunha 2009). Regardless of which explanation is correct, the nonlinear pattern between earnings and education means that those who earn a Bachelor's degree on average receive larger benefits than those who do not. This has implications for college attendees because their average income (and hence benefits) will be lower than those for college completers. On the cost side, those who drop out of college likely incur fewer costs than those who graduate because they may spend fewer years in college.

We now illustrate how to measure the private and social internal rates of return from attending college, rather than completing a Bachelor's degree. The model begins with a student who is making the decision whether or not to attend a baccalaureate-granting institution in pursuit of a Bachelor's degree. The student faces the cumulative probability of dropping out (d_t) or graduating with a Bachelor's degree (g_t) after each year. Accordingly, we modify both the benefits and the costs formulas to focus on the expected values for all students who attend college. The costs are adjusted to capture the expected durations in college for those who drop out and those who earn a Bachelor's degree. Similarly, the benefits are adjusted to take into account the lower expected future incomes from having attended college.

To do this, we first define the expected income from attending college as a weighted average of the incomes for those who earn a degree and those who do not, where the weights denote the cumulative probability of earning a Bachelor's degree or dropping out of college after each year:

$$(7) \qquad E(I_t^a) = d_{t-1}I_t^{nc} + g_{t-1}I_t^c$$

We obtain the annual private and social costs from attending college by multiplying the annual costs by the probability that the student will be enrolled each year:

$$(8) \quad C(p)_t^a = (1 - d_{t-1} - g_{t-1})C(p)_t^c - (1 - tx^{nc})d_{t-1}I_t^{nc} - (1 - tx^c)g_{t-1}I_t^c$$

$$(9) \quad C(s)_t^a = (1 - d_{t-1} - g_{t-1})C(s)_t^c - d_{t-1}I_t^{nc} - g_{t-1}I_t^c$$

For example, if 60% of students have left the institution after their fourth year due to dropout or graduation, then there is a 40% chance that a freshman will incur education costs in the fifth year. This modification also takes into account that not all students who begin college drop out or graduate at the same time. Among those who earn a Bachelor's degree, they may graduate in as few as three years or as many as eight years. Likewise, college attendees who drop out of college do so at various points in time.[5]

For benefits, the private and social benefits from having attended college thus become:

$$(10) \quad B(p)_t^a = (1 - tx^{nc})d_{t-1}I_t^{nc} + (1 - tx^c)g_{t-1}I_t^c - (1 - tx^{na})I_t^{na}$$

$$(11) \quad B(s)_t^a = d_{t-1}I_t^{nc} + g_{t-1}I_t^c - I_t^{na}$$

Putting the costs and benefits together, the private and social internal rates of return for all students who attend college are the annual rates of return on costs that yield the benefits, as in:

$$(12) \quad \sum_{t=T^1+1}^{T^2} \frac{B(p)_t^a}{(1+i)^{t-1}(1+r(p)^a)^{t-1}} = \sum_{t=1}^{T^1} \frac{C(p)_t^a}{(1+i)^{t-1}(1+r(p)^a)^{t-1}}$$

$$(13) \quad \sum_{t=T^1+1}^{T^2} \frac{B(s)_t^a}{(1+i)^{t-1}(1+r(s)^a)^{t-1}} = \sum_{t=1}^{T^1} \frac{C(s)_t^a}{(1+i)^{t-1}(1+r(s)^a)^{t-1}}$$

The dollar benefits of attending college are thus lower than the dollar benefits from earning a Bachelor's degree. Likewise, the costs from attending college should be less than the costs for Bachelor degree completers because students who graduate early or drop out spend less time in college. If both the costs and benefits of attending college are lower than the costs/benefits from completing college, then the private and social IRRs from attending college may be higher or lower than those for completing college.

ESTIMATIONS

We used this framework to estimate the impact on private and social IRRs from adjusting for the risk of non-completion. The hypothetical student in these calculations was assumed to begin attending college at the age of 18, enroll in college for a maximum of six years, and retire at age 65.[6] Table 1 shows the parameters that we used in this estimation. We conducted separate calculations for public and private baccalaureate-granting institutions.

The data for graduation and retention rates were taken from the *Digest of Education Statistics 2011* (National Center for Education Statistics 2012). The graduation rates for years 4, 5, and 6 were set equal to the average graduation rates for the 2004 freshman cohort, adjusted to account for the 10.2% of students who transferred to other institutions and graduated within six years (Ewell and Kelly 2009).[7] We assumed that the graduation rates for all other years were zero.[8] The dropout rates for year 1 were set equal to the average dropout rate reported for the 2006 cohort. The dropout rates for years 4 through 6 were assumed to be zero, and the sums of dropouot rates for years 2 and 3 were set equal to the average percentage of students who had not either graduated from college after six years or dropped out after their first year.[9]

For costs, we relied on data from the College Board's *Trends in College Pricing 2012*. We used the average tuition and fees for students attending a baccalaureate-granting college or university in 2012 ($8,655 for in-state public institutions, $29,056 for private not-for-profit institutions) for the price of attendance. Likewise, we used the average grants and scholarships in 2012–13 for students attending baccalaureate-granting institutions as the measures of financial aid received. The 10-year average growth rates in net tuition and fees from 2003–12 (6.9% at public institutions and 0.2% at private institutions) were used as estimates of the future growth rates in net tuition and fees. Government support for a student's education was estimated as federal, state, and local revenues (excluding grants and contracts) per FTE student in 2009.[10]

For benefits, we began with data on incomes in 2011 for individuals ages 25–34 from the *Current Population Survey*. We recalculated the pre-tax median total earnings for three groups of individuals ages 25–34 by degree level (Bachelor's degree or higher, some college, high school) by adding in those individuals who did not report earnings. The category "Bachelor's degree or higher" was used to capture the average value for all Bachelor's degree holders because this reflects what a student might expect from pursuing the degree.[11] By recalculating the median incomes, we can take into account the effects of differences in employment rates by educational attainment on earnings. We then estimated post-tax incomes by subtracting 25% to account for taxes.[12] Social financial benefits are assumed to be captured by the added tax payments due to

Table 1. Parameters Used in Calculations of Benefits from Attending College

Category	Public Institutions	Private Not-for-Profit Institutions
Graduation Rate After Year 1	0%	0%
Graduation Rate After Year 2	0%	0%
Graduation Rate After Year 3	0%	0%
Graduation Rate After Year 4	37.3%	58.4%
Graduation Rate After Year 5	22.3%	13.5%
Graduation Rate After Year 6	6.6%	3.7%
Dropout Rate After Year 1	22.0%	20.5%
Dropout Rate After Year 2	8.0%	3.0%
Dropout Rate After Year 3	3.8%	1.0%
Dropout Rate After Year 4	0%	0%
Dropout Rate After Year 5	0%	0%
Dropout Rate After Year 6	0%	0%
Average Tuition and Fees	$8,655	$29,056
Percent Tuition/Fees Covered by Grants/Scholarships	66.4%	54.0%
Annual Growth Rate in Net Tuition/Fees	6.9%	0.2%
Government Instructional Support in Year 1	$10,682	$3,093
Annual Growth Rate in Government Support	0%	0%
Pre-Tax Income: BA Degree or More	$40,367	$40,367
Pre-Tax Income: Some College, No BA Degree	$20,572	$20,572
Pre-Tax Income: High School Diploma	$18,797	$18,797
Income Tax Rate (All Groups)	25.0%	25.0%
Annual Growth in Income: BA Degree or More	4.1%	4.1%
Annual Growth in Income: Some College, No Degree	2.7%	2.7%
Annual Growth in Income: High School Diploma	2.7%	2.7%
Annual Rate of Inflation	2.4%	2.4%
Discount Rate for Time Preference	0%	0%
Retirement Age	65	65
Current Age	18	18

Notes: Graduation rates for years 4, 5, and 6 were based on data for full-time, first time freshmen at public and private institutions for the 2004 cohort (source: *Digest of Education Statistics 2011*). The sum was adjusted upward by a total of 10.2% to account for transfers who graduate from other institutions (source: Ewell and Kelly 2009). The dropout rates after year 1 were taken from the 2006 cohort (*Digest of Education Statistics 2011*). We assumed that all students who did not drop out after year 1 or graduate after years 4, 5, or 6 dropped out in years 2 and 3. Average tuition and fees and the percentage of tuition/fees covered by grants were for the year 2012 (source: *Trends in College Pricing 2012*). The growth rates in net tuition/fees were set equal to the averages for years 2003-12 (source: *Trends in College Pricing 2012*). Estimated government instructional support is defined as federal, state, and local revenues for non-grant activities for 2009 (source: *Digest of Education Statistics 2011*). Pre-tax median incomes for all workers were obtained from U.S. Census Bureau, Current Population Survey, 2012 Annual Social and Economic Supplement Data. These were adjusted to take into account individuals without earnings and then converted to estimates of post-tax incomes assuming a tax rate of 25%. Assumptions of income growth rates were based on estimated growth rates for years 1983-95 (Arias and McMahon 2001). Annual rate of inflation was set equal to the average percentage increase in the CPI between 2003 and 2012.

college. We acknowledge, however, that there may be other financial and non-financial social benefits as well. We used the average increase in the Consumer Price Index from 2003–12 (+2.4%) as the projected rate of inflation for adjusting future dollar estimates. The annual growth rates in real salaries for all those who did not earn a Bachelor's degree were set equal to +0.3%, and we let the growth rate in real incomes for those with a Bachelor's degree equal +1.7%. These rates were based on the average real growth rates from 1983–95 presented by Arias and McMahon (2001). Finally, for simplicity we assume that there is no discount rate for time preference. Cohn and Geske (1990) note that some studies have used discount rates of up to 5% per year in their calculations of net benefits. Adding a time preference discount rate would reduce future inflation-adjusted costs and benefits, but would not affect the IRR estimates.

In Table 2, we conducted separate calculations for public (columns 1–3) and private not-for-profit (columns 4–6) baccalaureate-granting institutions. For each type of institution, we present figures for all those who attend college, only those who earned a Bachelor's degree, and only those who did not earn a Bachelor's degree. The calculations for only Bachelor degree recipients are similar to the approach taken in private and social IRR studies. The first rows in each section provide the average expected gross benefits for each group. The second rows contain the expected costs for each group. The net financial benefits are shown in the third rows, and the rates of return are presented for each group in the last rows. Because data were not available on earnings differences by education and type of institution, we restricted incomes by education level to be the same for public and private institutions.

Beginning with private returns, although the net dollar gains were notably lower for all college attendees than for only completers, they were still positive and substantial. For students attending public institutions, the net benefit was about $826,000 in inflation-adjusted future dollars, which is more than $400,000 (or about one-third) less than what was found for only those who earn a Bachelor's degree. This translated into a private IRR of 14.1% for students attending public institutions, which was smaller than private IRR for only degree completers (19.9%). For students attending private institutions, the private IRR (12.3%) was lower than that for students attending public institutions, even though the average dollar benefit was larger (~$920,000). The dollar gap between the expected benefits for all attendees versus Bachelor degree recipients in private institutions was about $100,000 smaller than for public institutions. The private IRR for private college attendees was smaller than that for Bachelor degree recipients (15.4%). Note that the private costs for all college attendees were lower than for degree completers because there is the chance that some students who begin college will leave early due to graduation or attrition.

Table 2. Private and Social Rates of Return to Pursuing a Bachelor's Degree

Category	Public Institutions			Private Not-for-Profit Institutions		
	All Those Who Attend College	Only Those Who Earn a Degree	Only Those Who Do Not Earn a Degree	All Those Who Attend College	Only Those Who Earn a Degree	Only Those Who Do Not Earn a Degree
Private Costs and Benefits						
Gross Benefit	$876,073	$1,336,030	$58,486	$1,000,268	$1,344,465	$62,473
Cost	($49,602)	($69,872)	($16,200)	($79,650)	($106,765)	($24,051)
Net Benefit	$826,471	$1,266,158	$42,286	$920,617	$1,237,700	$38,422
Private IRR	+14.1%	+19.9%	+5.4%	+12.3%	+15.4%	+4.3%
Social Costs and Benefits						
Gross Benefit	$1,168,098	$1,781,374	$77,981	$1,333,691	$1,792,620	$83,297
Cost	($92,330)	($134,376)	($34,959)	($102,276)	($136,738)	($30,478)
Net Benefit	$1,075,768	$1,646,998	$43,021	$1,231,415	$1,655,882	$52,819
Social IRR	+12.0%	+15.6%	+3.2%	+12.6%	+15.8%	+4.6%

Notes: All estimates assume that the student is 18 years old and retires at age 65. Estimations assume that the student will remain enrolled for a maximum of six years, after which the student has either earned a Bachelor's degree or not. Direct cost includes tuition and mandatory fees minus average grants and scholarships from all sources. Indirect cost is the income that could have been earned during time in college if paid at the post-tax median total earnings for all high school graduates ages 25–34. All future dollar figures are adjusted for inflation and assume a 0% discount rate for time preference.

We found that a similar pattern held for the social benefits of attending college. For both types of institutions, the social benefits in future dollars for all college attendees were notably smaller than the benefits from earning a degree. As expected, the social costs were higher than the private costs due to the addition of government support to social costs. The impact of governmental support on costs was uneven, however, because public institutions have a higher reliance than do private institutions on government support. Likewise, the use of pre-tax dollars in the social benefit calculations resulted in social benefits being greater than private benefits. The net effect was that the private rates of return were above the social rates of return for public institutions, but not for private institutions.

Not surprisingly, the results were not quite as favorable for students who went to college but did not earn a Bachelor's degree. On average, their private and social financial benefits were still positive but small. The private IRR for non-graduates was 4.3% at public institutions and 4.6% at private institutions, and the net future dollar benefits were between $38,000 and $52,000. Although the private and social IRRs for all college attendees compared favorably to the 10% benchmark commonly used for other investments, the rates of return for non-completers failed to meet this threshold.

SENSITIVITY TESTS

The simulations that we conducted were based upon a series of assumptions about key parameters in the model, a number of which may be arguably set to different values. In this section, we conduct sensitivity tests to determine how our findings would be affected by two of these factors: (1) the assumed growth rate in earnings for Bachelor degree recipients, and (2) the net prices paid by students.

Sensitivity to Income Growth Rates

In our simulations, we based the rates of growth in real incomes on the results presented by Arias and McMahon (2001). They calculated the average income growth rates for people in different age groups and found that for the years 1983–95, the average rates of growth in real incomes (all ages combined) were approximately +0.3% for those without a Bachelor's degree and +1.7% for those with a Bachelor's degree. As noted by Arias and McMahon (2001), these rates are better than using cross-sectional earnings differences by age group to infer growth rates because what is needed for the simulations are estimates of how a person's income is likely to change over the life cycle. The growth rates in real incomes can clearly affect the private IRR and dollar benefits from going to

college, and it is challenging to accurately forecast how earnings by degree level will change in the future.

Given the importance of this issue, we conducted sensitivity tests where we varied the gap in annual growth rates in real incomes between Bachelor degree holders and all others from 0% to 2.0% per year. The results are summarized in Table 3. In general, we found that for every 0.5% increase in the assumed growth rate premium in real salaries for Bachelor degree recipients, the private and social IRRs increased by about one percentage point. This held for both public and private institutions. In short, the assumed growth rate in real incomes does matter, but for a range of estimates the private and social IRRs from attending college are still large relative to other investments.

Sensitivity to Net Prices

The average tuition/fees and financial aid that we used overlook the fact that some students pay substantially more than these amounts to attend college. Tuition and fees at many private, baccalaureate-granting institutions in 2012–13 exceeded $50,000/year (College Board 2012). Likewise, students attending an out-of-state public institution face tuition/fee rates that are two to three times as high as in-state rates for the same institution. Even students attending their in-state public institutions may pay $10,000 or more in tuition and fees per year. Financial aid awards also vary across individuals, depending on the student's academic merit, financial need, and other factors.

As a result, the net dollar benefits and the private and social IRRs for some students may be lower than that found for the average student who attends college. How large would the net benefits of attending college be for even those students who pay higher prices? Table 4 presents the results from several simulations of

Table 3. Sensitivity of Rates of Return from Attending College to Income Growth Rate

Premium in Real Income Growth Rate for Bachelor's Degree	Public Institutions		Private Not-for-Profit Institutions	
	Private IRR	Social IRR	Private IRR	Social IRR
+0.0%	+11.3%	+9.3%	+9.5%	+9.8%
+0.5%	+12.3%	+10.3%	+10.6%	+10.8%
+1.0%	+13.4%	+11.3%	+11.6%	+11.8%
+1.5%	+14.3%	+12.2%	+12.5%	+12.8%
+2.0%	+15.3%	+13.1%	+13.4%	+13.7%

Notes: The simulations use all of the values described in Table 1, except that the premium in the annual real growth rate in incomes for individuals with a Bachelor's degree or higher (versus not having a Bachelor's degree) was varied from +0.0% to +2.0%.

variations in prices paid by students. In each case, we began with the same values used previously for an 18-year old student attending a baccalaureate-granting institution. However, we assumed that the student did not receive any grants or scholarships, and thus had to pay the full sticker price. We then set the tuition/ fees each year at public institution equal to $10,000, $20,000, $30,000, and at $30,000, $40,000, or $50,000 for private institutions. The table provides estimates of the resulting private and social net financial benefits and rates of return.

Despite the increase in net prices paid by students, the future dollar benefits for all college attendees still covered costs and were large. For students attending out-of-state public institutions, even when they had to pay $30,000/year and had no portion covered by financial aid, the net benefit from attending college only fell by about 10%. For students attending private institutions, the reduction in net benefits was greater, but the remaining future dollar benefit was still about $815,000. As the net prices reached high levels, the private and social IRRs fell below the 10% benchmark used to compare education investments to other alternatives (see McMahon 2009). Overall, attending college and paying the full price remains a good, if not spectacular, investment choice in terms of the private returns one might expect.

CONCLUSIONS AND IMPLICATIONS

In this study we showed how the approach commonly used to estimate the private and social internal rates of return from having a Bachelor's degree can be modified to examine the average returns to attending, rather than graduating from college. The changes involved taking into account the risk that students face when they enroll in college, in that they may not be successful in earning

Table 4. Sensitivity of Rates of Return to Attending College to Tuition and Financial Aid

Institution Type	Tuition/Fees Paid	Grants and Scholarships	Private Benefits		Social Benefits	
			Net Benefit	Private IRR	Net Benefit	Social IRR
Public Institutions	$8,655	66.4%	$826,471	+14.1%	$1,075,768	+12.0%
	$10,000	0%	$805,528	+11.9%	$1,054,824	+10.8%
	$20,000	0%	$775,996	+9.8%	$1,025,292	+9.4%
	$30,000	0%	$746,465	+8.4%	$995,761	+8.4%
Private Not-for-Profit Institutions	$29,056	54.0%	$920,617	+12.3%	$1,231,415	+12.6%
	$30,000	0%	$872,961	+9.4%	$1,183,758	+10.1%
	$40,000	0%	$844,311	+8.2%	$1,155,108	+9.1%
	$50,000	0%	$815,661	+7.3%	$1,126,458	+8.2%

Notes: All simulations assume that the student is 18 years old and plans on retiring at age 65. Simulations assume that the student will remain enrolled for a maximum of six years, after which the student has either earned a Bachelor's degree or not. All future dollar figures are adjusted for inflation and assume a 0% discount rate for time preference.

a Bachelor's degree. We also showed how adjustments can be made to costs using year-specific dropout and graduation rates for the expected duration of students in college. The data requirements for making these adjustments are not substantially more cumbersome than those needed to conduct traditional rates of return calculations.

Is attending college a good financial investment for the average student and for society? We found that the private and social IRRs for all who attend college were smaller than for only those who graduated. Adjusting for the risk of non-completion and the timing of departure from college reduced both the benefits and costs from attending college. Although the dollar benefits for all college attendees are notably lower than those for degree completers, they are still more than $800,000 in future (inflation-adjusted) dollars. Thus, our findings tend to support the policymakers who advocate for increased access to higher education.

At the same time, going to college is not as good of a financial investment for those students who do not earn a degree. Students are taking a risk in going to college because there is no guarantee that they will receive a Bachelor's degree and the higher earnings that normally accompany degree completion. We found that the expected net benefits for those who attend college but do not earn a degree were very small, and could even be negative if they pay above-average prices or have more lucrative labor market opportunities that do not require a college degree. Those who advocate for "college-for-all" should acknowledge that individuals who are at high risk for not earning a degree or certificate may experience low or negative gains from going to college, and that for these individuals other options such as Associate's degrees, on-the-job training, and apprenticeships may in some instances be better for them and society than enticing them to pursue a Bachelor's degree.

With regard to net price, our sensitivity tests show that even those students who pay the full price and receive no aid would, on average, still experience good if not spectacular rates of return, and large average dollar benefits, from going to college. This is important in light of the negative publicity that is often given to institutions with very high tuition rates. Lost in the discussion is the point that it is very common for students to receive at least some financial aid to offset the cost of attendance. In fact, institutions often base financial aid offers at least in part on the difference between the cost of attendance and the family's expected financial contribution. Higher education policymakers should work to ensure that students have access to loans to help pay the fraction of price that is not offset by grants and scholarships. The concern with loans, however, is that students with higher probabilities of not earning a Bachelor's degree face a greater chance that they will not be able to cover the loans with higher earnings from going to college.

There are several limitations to this analysis that should be noted. The calculations we made represent average benefits and costs, and thus the rate of return for individual students will likely differ from these quantities. The income values that we used, for example, are averages over large numbers of individuals and institutions, and are not guaranteed payouts. Second, the estimates are based on assumptions about the critical parameters in the model, any of which may change for particular students. Although we have conducted sensitivity tests for several of the more important parameters in the model, differences in other parameters in the model may also have an effect on the private and social benefits from attending college. Third, the values shown here underestimate the true private and social values of going to college because they do not include the non-market benefits from college, or the additional retirement benefits that may be due to college attendance. Fourth, not all students follow the pattern of first-time freshmen who attend college full-time, and their benefits/costs may be different. This is particularly relevant for the study of students who attend two-year colleges in the hope of earning an Associate's degree or transferring to a four-year institution to earn a Bachelor's degree. Finally, the difference in results between public and private institutions would change if there is a difference in average earnings for graduates of public and private institutions.

Further study is needed on the private and social return from attending two-year institutions. Our analysis suggests that both the dollar costs and benefits of attending a two-year college would be lower than the costs for only Associate degree completers, and hence the private and social IRRs may not change very much for all attendees. However, we would expect the reduction in benefits to be relatively small given that the average earnings for Associate degree holders is only slightly higher than the average earnings for those with some college education but no degree. Additional study should also focus on the private and social rates of return from attending college by gender and race/ethnicity.

Studies of the costs and benefits of going to college are valuable for academics, higher education policymakers, and students and their families. Because the internal rates of return are greater than that found for more traditional investments, and the expected future dollar gains are large, attending college is still a good investment for many students and society at large. It is important, though, to properly take into account the risk of not successfully earning a degree when making these calculations and the subsequent decision whether or not to go to college. If students base their attendance decision solely on the dollar benefits from earning a degree, then some will be substantially overestimating their dollar benefits and perhaps make the wrong personal decision.

Our study demonstrates how the risk of non-completion can be incorporated into traditional formulas for the private and social benefits of attending college, and that after doing so, there are still sizable financial benefits on average to students from pursuing a Bachelor's degree. The results highlight that both the dollar gain and internal rates of return provide useful information to policymakers and the general public about the private and social benefits that occur when students make the decision to go to college.

References

Arias, O., & McMahon, W. (2001). Dynamic rates of return to education in the U.S. *Economics of Education Review*, *20*, 121–138.

Asadullah, M. (2006). Returns to education in Bangladesh. *Education Economics*, *14*, 453–468.

Ashworth, J. (1997). A waste of time? (Private rates of return to higher education in the 1990s). *Higher Education Quarterly*, *51*, 164–188.

Baum, S., Ma, J., & Payea, K. (2010). *Education pays 2010*. New York: The College Board.

Becker, G. (1962). Investment in human capital: A theoretical analysis. *The Journal of Political Economy*, *70*, 9–49.

Becker, G. (1975). *Human capital: A theoretical and empirical analysis, with special reference to education*. Chicago: University of Chicago Press.

Belman, D., & Heywood, J. (1991). Sheepskin effects in the returns to education: An examination of women and minorities. *The Review of Economics and Statistics*, *73,* 720–724.

Belman, D., & Heywood, J. (1997). Sheepskin effects by cohort: Implications of job matching in a signaling model. *Oxford Economic Papers*, *49*, 623–637.

Benhabib, J., & Spiegel, M. (1994). The role of human capital in economic development: Evidence from aggregate cross-country data. *Journal of Monetary Economics*, *34*, 143–174.

Bitzan, J. (2009). Do sheepskin effects help explain racial earnings differences? *Economics of Education Review, 28*, 759–766.

Blau, F., & Kahn, L. (2007). The gender pay gap. *Economists' Voice*, *4*, 1–7.

Bowen, W., Chingos, M., & McPherson, M. (2009). *Crossing the finish line*. Princeton, NJ: Princeton University Press.

Brewer, D., Eide, E., & Ehrenberg, R. (1999). Does it pay to attend an elite private college? Cross-cohort evidence on the effects of college type on earnings. *Journal of Human Resources*, *34*, 104–123.

Carnevale, A., Rose, S., & Cheah, B. (2011, August). *The college payoff: Education, occupation, and lifetime earnings*. Washington, DC: Georgetown University, Center on Education and the Workforce.

Carnevale, A., Jayasundera, T., & Cheah, B. (2012). *The college advantage: Weathering the economic storm*. Washington, DC: Georgetown University, Center on Education and the Workforce.

Carnoy, M. (2010). Race earnings differentials. In D. Brewer & P. McEwan (Eds.), *Economics of education* (p. 109–118). Amsterdam: Elsevier.

Christiansen, C., Joensen, J., & Nielsen, H. (2007). The risk-return trade-off in human capital investment. *Labour Economics*, *14*, 971–986.

Cohn, E., & Geske, T. (1990). *The economics of education (3ʳᵈ edition)*. Oxford, UK: Pergamon Press.

Cohn, E., & Hughes, W. (1994). A benefit-cost analysis of investment in college education in the United States: 1969–1985. *Economics of Education Review, 13*, 109–123.

College Board (2012). *Trends in college pricing 2012*. Washington, DC: The College Board. Retrieved January 25, 2013 from *http://trends.collegeboard.org/sites/default/files/college-pricing-2012-full-report_0.pdf*.

Cunha, F. (2009). Crossing the finish line: A review. *Journal of Human Capital*, *3*, 354-378.

Dale, S., & Krueger, A. (2002). Estimating the payoff to attending a more selective college: An application of selection on observables and unobservables. *The Quarterly Journal of Economics, 117*, 1491–1527.

Day, J., & Newburger, E. (2002). *The big payoff: Educational attainment and synthetic estimates of work-life earnings.* Washington, DC: U.S. Census Bureau.

Denny, K., & Harmon, C. (2001). Testing for sheepskin effects in earnings equations: Evidence for five countries. *Applied Economics Letters*, *8*, 635–637.

Ewell, P., & Kelly, P. (2009). *State-level completion and transfer rates: Harnessing a new national resource.* Working paper, National Center for Higher Education Management Systems (NCHEMS).

Fain, P. (June 29, 2012). College for all? Politicians and pundits ramp up questions about value of degrees. Inside Higher Education. Retrieved June 29, 2012 from *http://www.insidehighered.com/news/2012/06/29/politicians-and-pundits-ramp-questions-about-value-degrees.*

Gullason, E. (1999). The stability pattern of sheepskin effects and its implications for the human capital theory—screening hypothesis debate. *Eastern Economic Journal*, *25*, 141–149.

Heckman, J., Lochner, L., & Todd, P. (2008). Earnings functions and rates of return. *Journal of Human Capital*, *2*, 1–31.

Heywood, J. (1994). How widespread are sheepskin returns to education in the U.S.? *Economics of Education Review*, *13*, 227–234.

Hussey, A., & Swinton, O. (2011). Estimating the ex ante expected returns to college. *American Economic Review*, *101*, 598–602.

Hwang, W., Liao, S., & Huang, M. (2013). Real option, human capital investment returns and higher educational policy. *Economic Modelling*, *31*, 447–452.

Jacobs, B., McCall, B., & Stange, K. (2013). *College as country club: Do colleges cater to students' preferences for consumption?* Working paper 18745. Cambridge, MA: National Bureau of Economic Research.

Jaeger, D., & Page, M. (1996). Degrees matter: new evidence on sheepskin effects in returns to education. *The Review of Economics and Statistics*, *78*, 733–740.

Lederman, D. (January 28, 2013). The college grad/employment mismatch. *Inside Higher Education*. Retrieved January 28, 2013 from *http://www.insidehighered.com/news/ 2013/01/28/are-college-graduates-underemployed-and-if-so-why.*

Lemieux, T. (2006). Postsecondary education and increasing wage inequality. *American Economic Review*, *96*, 195–199.

McMahon, W. (1991). Relative returns to human and physical capital in the U.S. and efficient investment strategies. *Economics of Education Review*, *10*, 283–296.

McMahon, W. (2009). *Higher learning, greater good: The private and social benefits of higher education*. Baltimore, MD: The Johns Hopkins University Press.

Menon, M. (2008). Perceived rates of return to higher education: Further evidence from Cyprus. *Economics of Education Review*, *27*, 39–47.

Mincer, J. (1958). Investment in human capital and personal income distribution. *The Journal of Political Economy*, *66*, 281–302.

Mincer, J. (1974). *Schooling, experience, and earnings*. New York: National Bureau of Economic Research.

National Center for Education Statistics (2012). *Digest of Education Statistics 2011*. Washington, DC: Institute of Education Sciences.

Park, S. (2011). Returning to school for higher returns. *Economics of Education Review*, *30*, 1215–1228.

Psacharopoulos, G. (1973). *Returns to education: An international comparison*. Amsterdam: Elsevier.

Psacharopoulos, G. (1981). Returns to education: An updated international comparison. *Comparative Education*, *17*, 321–341.

Psacharopoulos, G. (1985). Returns to education: A further international update and implications. *Journal of Human Resources*, *20*, 583–604.

Psacharopoulos, G. (1994). Returns to investment in education: A global update. *World Development*, *22*, 1325–1343.

Psacharopoulos, G. (2008). Funding universities for efficiency and equity: Research findings versus petty politics. *Education Economics*, *16*, 245–260.

Psacharopoulos, G., & Patrinos, H. (2004). Returns to investment in education: A further update. *Education Economics*, *12*, 111–134.

Samuelson, R. (May 27, 2012). It's time to drop the college-for-all crusade. *Washington Post*. Retrieved on June 29, 2012 from *http://www.washingtonpost.com/opinions/its-time-to-drop-the-college-for-all-crusade/2012/05/27/gJQAzcUGvU_print.html.*

Schultz, T. (1961). Investment in human capital. *American Economic Review*, *51*, 1–17.

Shafiq, M. (2007). Household rates of return to education in rural Bangladesh: Accounting for direct costs, child labor, and option value. *Education Economics*, *15*, 343–358.

Shabbir, T., & Ashraf, J. (2011). Interpreting sheepskin effects of investment in schooling. *Pakistan Journal of Commerce and Social Sciences*, *5*, 202–215.

Singh, A. (2010). Human capital risk in life-cycle economies. *Journal of Monetary Economics*, *57*, 729–738.

Tilak, J. (2007). Post-elementary education, poverty and development in India. *International Journal of Educational Development*, *27*, 435–445.

Tuor, S., & Backes-Gellner, U. (2010). Risk-return trade-offs to different educational paths: Vocational, academic and mixed. *Journal of Economic Studies*, *37*, 495–519.

Vedder, R. (June 6, 2012). Ditch…the college-for-all crusade. The Chronicle of Higher Education. Retrieved June 29, 2012 from *http://chronicle.com/blogs/innovations/ditch-the-college-for-all-crusade/32661.*

Walsh, J. (1935). Capital concept applied to man. *Quarterly Journal of Economics*, *69*, 255–285.

Williams, W. (June 26, 2012). How many college-educated janitors do we need? Charlotte Observer. Retrieved June 29, 2012 from *http://www.charlotteobserver.com/2012/06/26/3341588/how-many-college-educated-janitors.html.*

Endnotes

1. Although some studies have calculated separate IRRs for non-completers, the vast majority of studies focus solely on the financial benefits for only degree completers.

2. As noted by Psacharopoulos and Patrinos (2004), the lower social IRR is due in part to the difficulty in including market and non-market social benefits in the calculation.

3. Unlike for stocks and bonds, the expected dollar benefits for two individuals making the same decision regarding investing in college will not change with the net price that they pay.

4. Private and social IRR calculations typically do not account for the larger pension contributions that may also come with degree completion. As a result, these figures will further underestimate the true rates of return to degree completion.

5. NCES only reports the percentage of first-time, first-time freshmen who do not enroll at the same institution in the following year. It is not known what percentage of this group of non-returning students dropped out of college as opposed to transferred to another institution.

6. In this study, we do not perform separate analyses for IRR differences by gender and race/ethnicity; however, such analyses would be useful due to documented differences in earnings by gender and race/ethnicity (Blau & Kahn 2007; Carnoy 2010; McMahon 2009).

7. We distributed the 10.2% increase in graduation rates for transfers in proportion to the graduation rates for years 4-6 for each type of institution.

8. The 2006 cohort was chosen for dropout rates because it was closest reported by NCES to the cohort used for graduation rates. A small percentage of students graduate in fewer than four years or more than six years, and therefore the true probabilities of graduating in each of these years is non-zero. The effect on our calculations is likely to be minor, however due to the small number of students in these categories and the fact that they will offset each other to some degree.

9. The National Center for Education Statistics (2011) only reports dropout rates for the first year of college. The estimated dropout rates for years 2 and 3 were chosen so that students were more likely to drop out after their second year than their third year, and that all students were assumed to either graduate or drop out by the end of their sixth year. We acknowledge that these are only estimates, and that with better data the cost estimates may be improved. Because most students either drop out after year 1 or graduate after years 4, 5, or 6, however, the changes in expected costs from having more accurate data are likely to be minor.

10. We used only government revenues rather than total expenditures to avoid double-counting tuition revenues paid by students in our calculations of social returns. To better isolate support for students, we also excluded government revenues for research, and spending for auxiliaries that were arguably made for non-instructional services. For public institutions, government revenues included federal, state, and local appropriations and nonoperating grants. Because government revenues were reported differently for private institutions, we estimated these quantities for federal and local by applying the shares of public revenues for these purposes to the private revenue totals. We then assumed that all state revenues to private institutions fell into this category. We acknowledge, however, that arguments can be made for other revenue or expenditure categories being used to represent social costs.

11. In this sense, studies that use average earnings for only Bachelor's degree recipients are capturing the return for only the subset of students who earn a Bachelor's degree—and no more—during their lifetime. However, it could be argued that some of the value to having earned a Bachelor's degree is that it enables those who want to acquire graduate training and higher earnings to do so. The calculations that we present here could be replicated for only the subset of Bachelor's degree recipients who do not go to graduate school by using the appropriate income measure.

12. A more precise tax rate would take into account separate state and federal tax rates by income levels, as well as standard deductions. Due to the difficulty in finding a single rate that meets these conditions, we used a simple 25% tax rate is a rough estimate of the net tax rate faced by individuals in the United States.