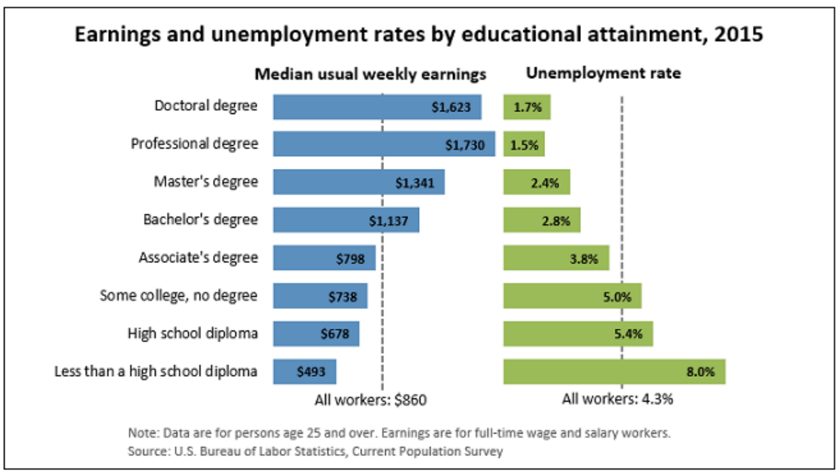
Human Capital Investment[1]
Instructional Primer[2]

1.1 Introduction

An investment in one's education is one of the three primary forms of human capital investment[3] and has long yielded impressive increases in productivity for the individual and economy. These individual gains have traditionally been measured as changes in the trajectory of one's income, but also include the less easily measured improvements in personal utility as higher levels of educational attainment are positively correlated with improvements in health, longevity of personal and familial relationships, civic engagement, recreation, and creativity and negatively correlated with incarceration, chemical dependency, and tobacco use.

However, as higher education has become costlier and middle class incomes have stagnated, much has been written with respect to the long-term economic gains available from higher education. Some well-regarded pundits have even called into question whether or not investments in higher education can be justified on economic merits alone. In response to growing pressure placed on higher education to justify its existence, Drew Faust, President of Harvard University, offered unequivocal support for human capital investments but continued on to suggest we need to begin focusing on justifying the cost of higher education based on its positive externalities rather than its financial merits alone[4].



Such support is statistically based as can be observed through earnings and unemployment reports prepared by the US Bureau of Labor Statistics[5] evidencing positive correlations between increased educational attainment and employment rates. We may also note differences between starting levels of pay for Associate's versus Bachelor's degrees by Pay Percentile as reported by Career News[6] in which the income premium obtained by earning a

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[1] This primer is intended to present an abbreviated discussion of the included economic concepts and is not intended to be a full or complete representation of them or the underlying economic foundations from which they are built.
[2] This primer was developed by Richard Haskell, PhD, Assistant Professor of Finance, Bill & Vieve Gore School of Business, Westminster College, Salt Lake City, Utah (2016)
[3] The three primary forms of Human Capital Investment are investments in education, healthcare, and migration
[4] http://www.harvard.edu/president/speech/2014/case-for-college
[5] http://www.bls.gov/emp/ep_chart_001.htm
[6] http://www.payscale.com/career-news/2009/10/4-year-vs-2-year-college-degrees-how-does-the-pay-compare

Bachelor's degree ranges from 34% - 68%, with wage differentials ranging from $4,400 - $12,200 annually.

Pay Percentile	Associate's Degree Experienced Pay	Bachelor's Degree Experienced Pay	Bachelor's Premium	Associate's Degree Starting Pay	Bachelor's Degree Starting Pay
10th	$29,600	$39,600	34%	$21,000	$25,400
25th	$39,100	$54,100	38%	$26,700	$32,900
50th	$52,100	$75,000	44%	$35,100	$43,200
75th	$69,200	$106,000	53%	$46,700	$56,900
90th	$90,100	$151,000	68%	$61,600	$73,800

While these differences in earnings and employment rates do not expressly address the cost or investment side of higher education, they do inform decision making with respect to the type of degree one may choose to obtain and the assist in determining associated benefits from such attainment. Understanding expected future income levels[7] is key to the decision making process and allows for a consideration of the higher education costs which may reasonably to borne while still yielding a positive investment result.

Bachelor's Degree Major	2016 Average Salary
Engineering	$64,891
Computer Science	$61,321
Math and Sciences	$55,087
Business	$52,236
Agriculture/Natural Resources	$48,729
Healthcare	$48,712
Communications	$47,047
Social Sciences	$46,585
Humanities	$46,065
Education	$34,891

With these benefit and cost structures as focal elements in the human capital investment scenario we're left to consider how one may reasonably make higher education investment decisions. As it turns out, the economic benefits of such an investment may easily be measured through the net present value equational form. In this form costs and benefits, discounted for rate and time, are included on the same side of the equation, with the resulting value informing us of the economic merits of such an investment. To motivate this equation, we may consider numerous variables, but at a minimum must evaluate the change in one's income as a result of the investment, the costs borne by the student or student household, the student's personal discount rate, expected length of education experience, expected duration of the student's eventual career, and a preferred accounting rule with respect to the timing of costs and benefits.

2.1 Change in one's income as a result of the investment

Central to the economic analysis observable through the net present value equation is the change in the student's income as a result of participating in the investment. This starts with a determination of the student's income capacity without an education ($W_{CURRENT}$) and extends to the student's expected wage income while in college ($W_{COLLEGE}$), upon entry into the labor market after college (W_{CAREER}), and expected increases in that income as the result of inflation (h) and merit (M) increases. While it is unlikely the

[7] http://time.com/money/3829776/heres-what-the-average-grad-makes-right-out-of-college/

student's income will remain constant after entering the labor market, to credibly calculate the net present value of the investment in human capital, the student must also consider *reasonable* merit increases in income consistent with the chosen career path and must consider historical and expected increases as the result of inflation, beginning with the period in which the analysis is calculated (example: if W_{CAREER} is calculated at the beginning of the education investment but the student expects to begin receiving the amount after completing the expected higher education degree, that income amount must be indexed for inflation during the education period). Selecting overly aggressive or passive values for these variables results in an unrealistic analysis of the investment.

It is important to have reasonable expectations with respect to these incomes and changes in income such that some research into the average income of higher education graduates of varying majors and degrees may be helpful. Decreased income while participating in college ($W_{CURRENT} – W_{COLLEGE}$) is considered a part of the investment, while increased income following reintroduction into the labor market ($W_{CAREER} – W_{CURRENT}$) are benefits. It is further important to expect that $W_{CURRENT}$ and $W_{COLLEGE}$ may also increase change by the annual inflation rate (h).

2.2 Costs borne by the student or student household

Those costs borne by the student or student household as a result of the educational investment must be considered part of the investment, but only to the extent the expenses would not have been incurred had the student not participated in the investment. Tuition, books, relocation ($ED_{EXPENSE}$), etc. would certainly be included as invested costs, while food, clothing, healthcare, etc. would only be included were the student to have not been responsible for them otherwise. Such expenses should be increased annually by an expected inflation rate (h).

2.3 Student's personal discount rate

At the heart of any discounted present value equation is the discount rate (r). In this case the rate is the student's required real rate of return (R) plus an anticipated inflation rate (h). The required real rate of return includes a return on the student's investment of time, discipline, effort, anxiety, and psychological costs associated with engaging in an investment in higher education. While some suggest the personal discount rate to be closely associated with the rate of inflation plus some modest return on invested capital (time and money), each student's discount rate is further informed by the opportunity costs (real and unobservable) associated the investment and may vary widely.

2.4 Expected length of education investment

As the cost of the investment is endogenized into the net present value equation, the number of annual periods (N_{ED}) during which the costs will accumulate must be identified. Again, this is where the student must be realistic in their expectations. While many students complete a Bachelor's Degree in four academic years, others take six years or more to earn the same degree. Others still complete the same degree in only two-three years having entered higher education with accumulated higher education course credits through participation in dual credit enrollment, Advanced Placement (AP), College Level Examination Program (CLEP) and International Baccalaureate (IB) programs. Further, while a Bachelor's Degree may be the focal degree of many colleges and universities, many students are satisfied with earning an Associate's Degree and others still go on to earn graduate degrees taking two-eight years of schooling beyond the completion of a Bachelor's Degree.

2.5 Expected duration of the student's eventual career

Just as the personal discount rate is central to the present value calculation, time holds a role of similar import. Students must consider the expected duration of their chosen career beyond the higher education investment experience (N_{CAREER}), during which the earnings resulting from the investment provide economic benefit to the student and student household. In this construction $N_{ED} + N_{CAREER} = t$ or the total number of years under analysis.

2.6 Preferred accounting rule

To adequately motivate the net present value equation, a decision must be made with respect to the timing of costs and benefit. Much of the expense of higher education comes at the beginning of each semester, though not at the beginning of each year, and incomes are typically realized at the end of given accounting periods, though typically not at the end of each year. While it is possible to construct an analysis including semi-annual, monthly, or even weekly periods, the greater the number of periods in each year of the analysis the more complex and lengthy the analysis becomes with only a modest increase in accuracy. In this analysis we'll suppose that the periods under consideration are annual, education costs are accounted for at the beginning of each period, and incomes at the end of each period.

3.1 The Equational Form

The Equational form for a net present value analysis is $NPV = \sum \frac{\beta_t\, x\, (1+(h+M))^{t-1}}{(1+r)^t}$, where $h + R = r$, the superscript (exponent) $t = N_{ED} + N_{CAREER}$, and the subscript t is simply a descriptor and is not an algebraic operator. In this construction β_t is the sum of costs and benefits for each particular accounting period as identified in sections 2.1 and 2.2 above.

3.2 Example

Suppose a high school senior is considering making an investment higher education with the following calculations present the Net Present Value analysis based on a set of assumed values. These values inform the values for β_t with notations as follows:

$\boldsymbol{\beta_t}$	**Notation**
β_0	$-ED_{EXPENSE}$ as an upfront cost (accounted at t = 0)
β_1	$-ED_{EXPENSE}*(1+h) - W_{CURRENT}*(1+h) + W_{COLLEGE}*(1+h)$
β_2	$-ED_{EXPENSE}*(1+h)^2 - W_{CURRENT}*(1+h)^2 + W_{COLLEGE}*(1+h)^2$
β_3	$-ED_{EXPENSE}*(1+h)^3 - W_{CURRENT}*(1+h)^3 + W_{COLLEGE}*(1+h)^3$
β_4	$-ED_{EXPENSE}*(1+h)^4 - W_{CURRENT}*(1+h)^4 + W_{COLLEGE}*(1+h)^4$
β_5	$-W_{CURRENT}*(1+h)^5 + W_{COLLEGE}*(1+h)^5$
β_6	$W_{CAREER}*(1+h)^6 - W_{CURRENT}*(1+h)^6$
β_7	$W_{CAREER}*(1+h)^7*(1+M)^1 - W_{CURRENT}*(1+h)^7$
$\beta_{8\ thru\ 40}$	The equation for β_7 is repeated annually through $t = 40$ with incrementing exponents

t	β_t	Present Value β_t	$\sum \frac{\beta_t}{(1+r)^t}$
0	-$40,000.00	-$40,000.00	-$40,000.00
1	-$58,140.00	-$54,336.45	-$94,336.45
2	-$59,302.80	-$51,797.36	-$146,133.81
3	-$60,488.86	-$49,376.92	-$195,510.74
4	-$61,698.63	-$47,069.59	-$242,580.33
5	-$18,769.37	-$13,382.30	-$255,962.63
6	$22,523.25	$15,008.19	-$240,954.44
7	$23,490.62	$14,628.78	-$226,325.66
8	$24,492.95	$14,255.12	-$212,070.54
9	$25,531.41	$13,887.40	-$198,183.14
10	$26,607.21	$13,525.76	-$184,657.38
11	$27,721.59	$13,170.33	-$171,487.06
12	$28,875.85	$12,821.22	-$158,665.84
13	$30,071.30	$12,478.52	-$146,187.32
14	$31,309.32	$12,142.29	-$134,045.02
15	$32,591.33	$11,812.60	-$122,232.42
16	$33,918.78	$11,489.47	-$110,742.96
17	$35,293.19	$11,172.92	-$99,570.04
18	$36,716.11	$10,862.97	-$88,707.07
19	$38,189.14	$10,559.61	-$78,147.45
20	$39,713.93	$10,262.84	-$67,884.62
21	$41,292.21	$9,972.61	-$57,912.01
22	$42,925.73	$9,688.90	-$48,223.11
23	$44,616.31	$9,411.67	-$38,811.43
24	$46,365.84	$9,140.87	-$29,670.57
25	$48,176.24	$8,876.43	-$20,794.13
26	$50,049.51	$8,618.30	-$12,175.83
27	$51,987.73	$8,366.40	-$3,809.43
28	$53,993.01	$8,120.67	$4,311.24
29	$56,067.56	$7,881.01	$12,192.25
30	$58,213.65	$7,647.36	$19,839.61
31	$60,433.60	$7,419.61	$27,259.23
32	$62,729.82	$7,197.69	$34,456.92
33	$65,104.82	$6,981.50	$41,438.41
34	$67,561.16	$6,770.93	$48,209.35
35	$70,101.48	$6,565.91	$54,775.26
36	$72,728.51	$6,366.32	$61,141.58
37	$75,445.09	$6,172.07	$67,313.66
38	$78,254.10	$5,983.06	$73,296.72
39	$81,158.56	$5,799.19	$79,095.91
40	$84,161.56	$5,620.34	$84,716.25
	NPV	$84,716.25	
	IRR	8.80%	

$W_{CURRENT}$	25,000
$W_{COLLEGE}$	8,000
W_{CAREER}	45,000
h	0.02
M	0.01
$ED_{EXPENSE}$	40,000
R	0.05
N_{ED}	5
N_{CAREER}	35

Note that the accumulated total of the present values of the discounted cash flows in year 40 is equal to a Net Present Value of $84,716.25. The decision rule for a Net Present Value equation is $NPV >=< 0$, and in this case the NPV of $84,716.25 suggests a return on the investment in education of $84,716.25 greater than the expected return or personal discount rate. This equates to an Internal Rate of Return (IRR) of 8.80% compared to the expected 7% (r = R+h = .055 + .015 = .07).