College IRR

Almost everyone thinks a college education today is expensive, but they still underestimate how much it really costs. The tuition, fees, and books are tens of thousands of dollars, but that is just out-of-pocket cost.

Even more costly is foregone income. Instead of going to college, you could be working and earning money. Adding opportunity cost to out-of-pocket cost yields a total cost of hundreds of thousands of dollars over four years.

There is no doubt about it—college is really expensive!

If it is so expensive, why do people go to college? Because there is a strong positive relationship between education and earnings—the more educated you are, the more money you make, on average.

But exactly how much more do college grads earn? Figure 4.6 shows the college wage premium (as a percentage over high school wage) is about 75%.

Notice that Figure 4.6 shows a great deal of variation in the college wage premium for different demographic groups. Asians have the highest excess returns for college.

Figure 4.6 also shows that, after covid, the college wage premium has fallen. This is due to higher wages for workers without a college degree after the pandemic.

One thing the chart does not show is the college wage premium by major. College graduates with degrees in quantitative fields such as Business Analytics earn higher incomes, on average, than non-quant majors.

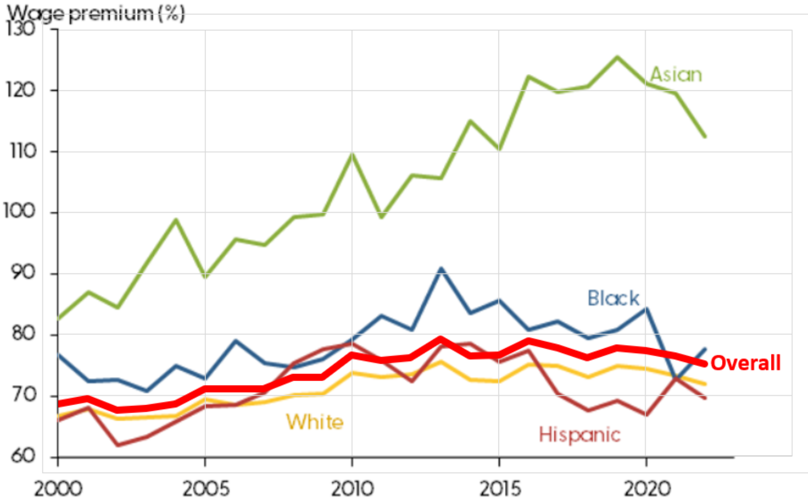

Figure 4.6: The college wage premium over time.
Source: Bengali, et al., 2023.

The college wage premium chart is focused solely on the higher incomes earned by college graduates. It does not capture any of the other benefits from a college education: access to more and better jobs, lower unemployment and poverty rates, longer and healthier lives, higher savings rates for retirement, and better educated children.

We will ignore these other benefits and consider only the higher incomes earned by college graduates. This is weighed against the cost of college, which we know is high and has been rising rapidly. So, is college still worth it? We will compute the college internal rate of return (IRR) to answer this question.

Visualizing the College Decision

Figure 4.7 is a stylized graph (it accurately represents a relationship without actual data) that displays the costs and benefits of college. It shows that college grads make more over their lifetimes. It also captures that both paths grow, but college grows faster.

The three letters in Figure 4.7 label three areas in the chart. A represents the tuition, books, and fees a college student pays. Notice how the college student starts out negative because of these expenses.

B represents the income the college student does not earn while they are in college. As mentioned above, this foregone income is even greater than the schooling payments.

Finally, C represents the gains from college in terms of higher income over a person's lifetime. This adds up to hundreds of thousands of dollars, but remember that these are future dollars.

A person deciding whether or not to go to college needs to weigh the out-of-pocket (-A) and opportunity (-B) costs versus the excess returns (+C) from going to college instead of working right out of high school.

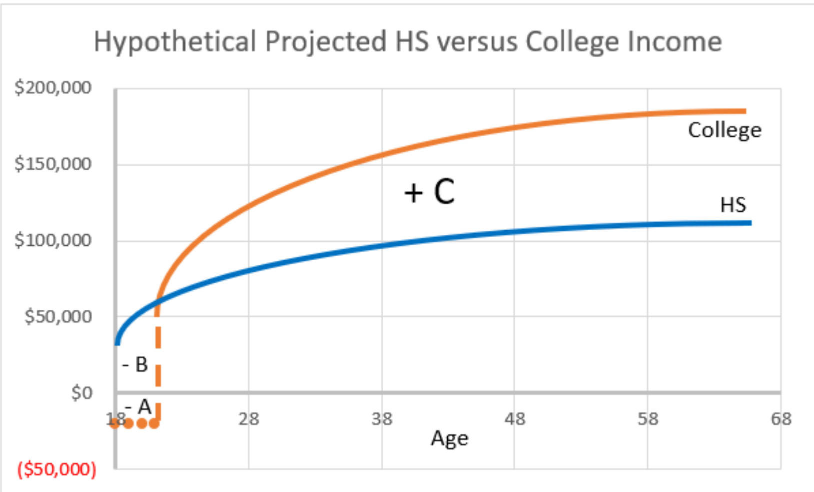

Figure 4.7: A Stylized Graph of the Decision to Attend College
A = out-of-pocket costs; B = opportunity costs; C = excess returns

Figure 4.7 also makes clear that time is an important part of the problem. You cannot simply look at the graph and conclude that the area of the excess returns (C) is much bigger than the costs (A and B) so college is a good investment. The excess returns are in the future so we cannot directly compare them to the costs. In fact, every year on the *Age* axis is a dollar amount with different units.

To solve this problem correctly, we have to apply the concepts of present value and internal rate of return. We do so with a simplified version of the problem.

A Toy Model

STEP Insert a sheet in your *PVIRR.xlsx* workbook. Enter the labels *Age*, *HS*, and *College* in cells A1, B1, and C1, respectively. In cell A2 enter 18 and in cell A3 enter 19. Select the cells and fill down to age 64 (row 48). In cell B2 enter $40000 and in cell B3 enter the formula =*B2*. Fill it down. In cell C2 enter -$20000 (this is the out-of-pocket cost) and in cell C3 enter the formula =*C2*. Fill it down to cell C5 (representing four years of college). In cell C6 enter $70,000 and in cell C7 enter the formula =*C6*. Fill it down.

You have created a simplified version of the decision to attend college. Figure 4.8 is a chart of the data in columns A, B, and C. It does not display the subtlety of increasing income over time, but it does have the essential nature of the decision—the college path has investment upfront and starts out negative, but you are compensated for this by higher future earnings.

Notice also that our simplified problem's college income of $70,000 per year is 75% more than the high school graduate's $40,000—this reflects the real-world college wage premium of 75%.

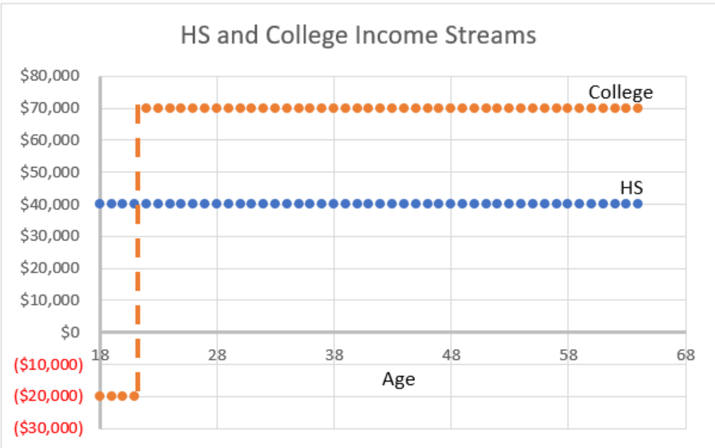

Figure 4.8: A Simplified Version of the Decision to Attend College

But how can we determine if the investment in a college education is actually worth it?

STEP Enter the label *College Project* in cell E1 followed by the formula = *C2* - *B2* in cell E2. Fill it down to cell E64.

Now we clearly see the nature of the investment project. You invest \$60,000 each year for four years (\$20,000 out-of-pocket and \$40,000 in opportunity costs) and in return you get \$30,000 each year until you retire.

How can we determine the quality of this project? That is easy with Excel.

STEP Enter the label *IRR* in cell G1 and in cell G2 enter the formula *=IRR(E2:E48)*.

10.5% per year is a pretty good rate of return. It is likely that you cannot do better than this with another project so you would make the human capital investment and go to college.

The problem can also be solved by computing the net present value. Using any discount rate less than the IRR will give a positive NPV and result in the same decision to go to college.

STEP Enter the label *dr* in cell I1 and the value 6% in cell I2. Enter the labels *PV HS* and *PV College* in cells J1 and K1, respectively. In cell J2, enter the formula =B2/(1+\$I\$2)^(A2-18) and fill it down to cell J48. In cell K2, enter the formula =C2/(1+\$I\$2)^(A2-18) and fill it down to cell K48.

The dollars in columns J and K can be added because they all have the same time dimension—age 18 dollars.

STEP Enter the label *sum of PV HS* in cell L1 and compute the sum of the present-valued high school dollars in cell L2. Enter the label *sum of PV College* in cell M1 and compute the sum of the present-valued college dollars in cell M2.

With a discount rate of 6%, the college income stream is worth \$826,135 present-value (age 18) dollars which is more than the \$660,975 produced by the high school option. Thus, you would go to college.

Figure 4.9 offers a good way of understanding and remembering what present value is all about. Present value operates like scrunching an accordion, compacting the x axis values back to the origin. Present value brings the dollars at different ages back to age 18 so that they can be compared.

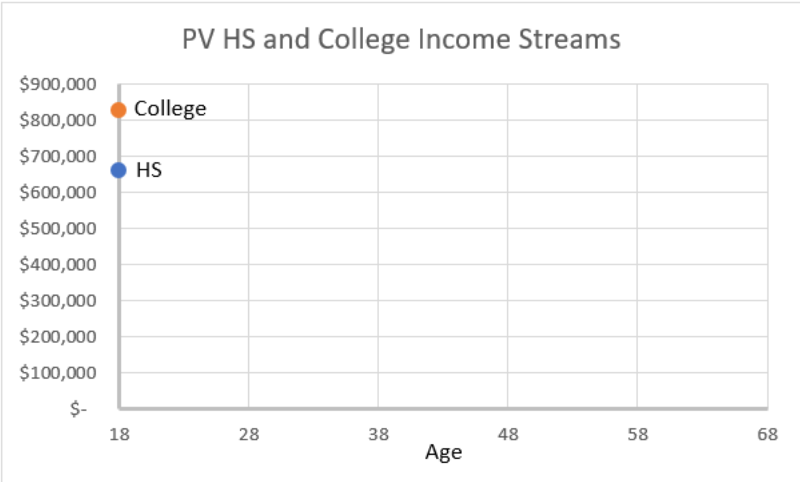

Figure 4.9: Visualizing present value.

Unlike Figures 4.7 and 4.8 that show dollar values over time, Figure 4.9 removes the time element from the graph. It adds up the present value at each year and shows the sum as a single dot at Age=18.

Notice how the PV and IRR methods agree. With a discount rate of 6% both green-light college. PV because the PV of the college stream at 6% is greater than the PV of the high school stream and IRR because 10.5% is greater than 6%.

STEP Change the discount rate in cell I2 to 11.5%. What is the optimal decision now?

PV says not to go to college because the present value of the college stream is less than the high school stream. IRR is also flashing a red light since the IRR of 10.5% is less than the discount rate of 11.5%.

STEP Enter the formula =*G2* in cell I2. What happens?

You just showed that Excel's IRR function is working as advertised. The sum of the present values of the two streams are identical when the discount rate is 10.5% so this is the IRR. PV says it is an absolute tie so flip a coin on going to college and IRR says the same thing because IRR = discount rate.

Did you notice that we never added the dollars in columns B and C? That would be a silly thing to do, right?

Loose Ends

There have been many, many estimates of the rate of return to college. Usually, college IRR estimates are pretty high. Even though college costs are rising fast all around the world, the demand for skilled labor is such that college remains a good investment for most people.

While college is still a good investment for most people, rising costs definitely lower the college IRR.

Just like the college wage premium has substantial variation when disaggregated into groups (as shown in Figure 4.6) , college IRRs vary across groups. For example, male college IRR is usually lower than female IRR because male opportunity cost is often higher. Young, unskilled men have greater access to construction and farm jobs. Not surprisingly, a greater percentage of women than men go to college.

One critical aspect of the college IRR is that you have to finish. The absolutely worst possible move is to go to college for several years, pay tens of thousands of dollars in out-of-pocket and opportunity costs and not graduate. Now you have made an investment (and perhaps have student debt) and the return is really low because college only pays off with higher wages if you have a college degree.

The risk of going to college and not graduating is a serious issue. Correctly modeling the college IRR to include the riskiness of the investment in college is the focus of much research.

Takeaways

People with college degrees earn more, on average, than those without. This makes sense because very few people would go to college if they did not get a return on their investment.

College is an investment, it is called human capital, and it has an IRR. In fact, it is usually quite high and going to college for many people is a sound financial decision.

PV and IRR are two ways to make a decision about an investment with costs and returns over time. They yield the same answer.

The present value method brings all of the expenses and returns over time to the present. If the net present value is greater than zero, the investment is a winner at that given discount rate. Choosing the discount rate can be complicated.

The internal rate of return is the discount rate that sets the NPV = 0. The IRR is a measure of the quality of an investment. If the IRR is greater than the discount rate, the investment is a winner.

References

Bengali L., Sander M., Valleta R., and Zhao C. (2023) "Falling College Wage Premiums by Race and Ethnicity" *FRBSF Economic Letter* www.frbsf.org/economic-research/publications/economic-letter/2023/august/falling-college-wage-premiums-by-race-and-ethnicity