

Annualized Salary Differences Between Public and Private School Attendees

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Abstract

This paper serves to answer the question of whether a private college education continues to serve as a significant boon to the wages of graduates over public college graduates. This analysis becomes more and more important as the price of college has continued to climb since the 1970's. Our hypothesis is that the annualized wages of public and private school attendees will be significantly different, we found using an OLS that private schools returned 3.77 percent higher wages for their graduates. However, when accounting for selection bias using a Hackman correlation, we found that private school attendees make 0.37 percent less per year than public school attendees. This leads to the conclusion that private schools are not the source of wage increases but are instead attracting students who would have succeeded regardless of the type of college they chose.

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I. Introduction

According to Forbes' Camilo Maldonado the price of a college education in the United States has continued to rise since the 1980s when a college education would set back perspective attendees around \$26,902 (\$52,892 adjusted for inflation) to the modern day where they report the same four-year degree would cost a student \$104,480 on average as of 2018. College prices have no sign of slowing down either so without a massive change to the way the system is financed, it will become less and less affordable. The price increases have been most obvious for private institutions. According to the Digest of Education Statistics (2017) the average price of tuition, fees, room and board for an academic year at a nonprofit private college institution is now \$44,551 more than twice the amount one would expect to pay at a public four-year institution which they quote at \$17,237. This begs the question of whether the quality provided by these elite institutions is being shown to have any significant economic effect on the wages of the graduates who incur such higher cost.

Colleges in the United States generally fall into two categories: public colleges and private colleges. With private colleges having non-profit and for-profit variations. Public colleges are generally operated on a state by state basis with funding being received by the state government as well as tuitions from attending students. Private nonprofit colleges are not funded by the state in which they reside and instead are funded by private donors in addition to the tuitions they charge students, thus it would be expected that in order to survive they must continue to provide an education that pay higher dividends in the workforce. For-profit private colleges are operated as a business with tuition and financial aid often being treated simply as profit with no requirement for these colleges to put their money back into the school.

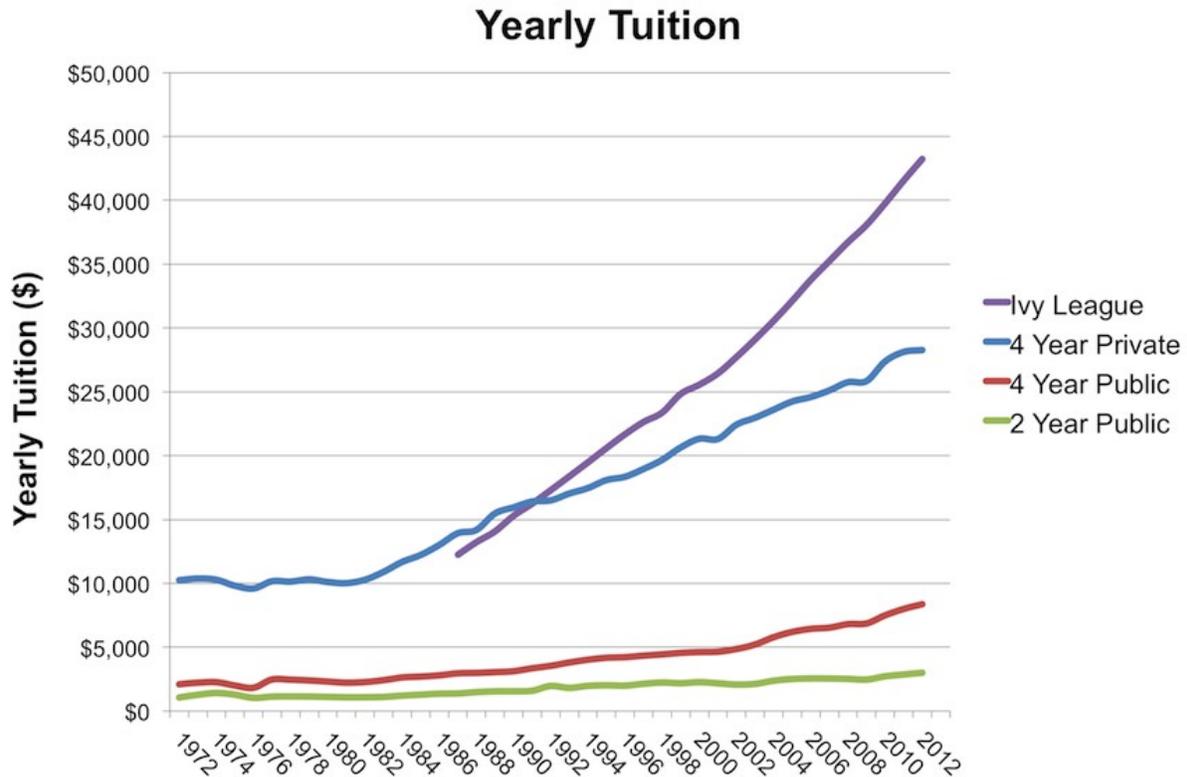


Figure 1: Yearly tuition cost Source: graph from Mayyasi (2013)

This gap between the price of a public and private education is likely to continue to rise into the future without some intervention by either the arrival of an alternative or government intervention. With the advancement of the job force away from manufacturing, the requirement of a college education is likely the only viable alternative to access a rewarding career. Therefore, research on what is the most cost-effective way to achieve a successful career is important for those that will be attending in the future.

If it were to be shown that a private school education was no longer causing enough of an increase in wages to offset the higher cost, then it may be showing that private colleges are succeeding off their prestige and that in actuality their preserved quality is being overvalued. In the event where private colleges are still responsible for a significant cause of the higher wages received by graduates then it shows that the difference in tuition prices may be worth it. In either

case due to the inconsistency of past results, new research should be performed to add to the argument for either side.

A. The Research Question

What is the effect that attending a private college has on wages received by college graduates when compare to public college attendees? My hypothesis is that there will be a significant difference in the annual wages that graduates of private and public colleges receive in the workforce.

II. Literature Review

A large amount of research has looked at the effect (or return on investment) from attending a college of higher quality. The studies use various econometrics strategies and data sources in order to reach their conclusion. In “Is it a Good Investment to Attend an Elite Private College?” by Marc Fox (1993), Fox attempts to calculate the rate of return for investments associated to the quality of a college education. Marc Fox’s paper was written in response to the observation that private college tuition prices were rising faster than the consumer price index (CPI). This is one of many studies to draw from the High School and Beyond survey which identifies individuals who attend the most selective colleges (as determined by Barron’s Profiles of American Colleges) and those who did not. He concluded that at the time the return on investment of an elite selective private school was worth the prices paid by graduates but posited that as private schools got more expensive this value would decrease until it was no longer worth the costs. This could be a portion of the reason why research since has been less conclusive on the topic.

“The returns to individual and college characteristics Evidence from the National Longitudinal Survey of Youth,” by James Monk (1999) found using multiple OLS regressions that college quality led to significant returns in terms of log hourly wages. His analysis used the AFQT score to determine academic ability and found positive and significant returns in terms of that as well. Most interestingly they found a 14 percent increase in wages for graduates from graduate degree granting colleges then those did not grant graduate degrees. “College Choice and Wages: Estimates Using Data on Female Twins,” by Jere R. Behrman, Mark Z. Rosenzweig, and Paul Taubman (1996) found that, using a sample of twins from the Minnesota Twin Registry, college quality has a significant positive effect on the wages of graduates. They found that Ph.D. granting private institutions with small class sizes allowed graduates to earn significantly higher wages after endowment effects were controlled for. The study of twins is interesting due to the sample offering them the unique opportunity to directly compare individuals who will presumably have very similar backgrounds and family-based endowments.

Some papers have found much smaller differential in terms of public vs private colleges wage gap, e.g. “The Returns to College Education – An Analysis with College-Level Data” by Philip R. P. Coelho and Tung Liu (2017). This paper uses college-level data and estimates a between-groups model in order to assess if what institution you attend matters more or less than the field of study you were in. The researchers concluded that major selection had a much larger effect on graduate wage than the type of college in which the graduate studied (public vs private.)

Finally, other papers indicate that recently college quality does not lead to a premium. In “College quality and early adult outcomes,” Mark C. Long (2008) used an OLS, an instrumental variable and a test that compared students who were accepted and declined by similar colleges to

account for opportunity and concluded that college quality did not have a significant effect on wages outside of the OLS.

This shows that through the current day a great deal of research has shown to various degrees that a private education leads to significantly larger wages for those college graduates.

III. Theory and Design

Private colleges are known to be a more expensive alternative to the public college system. The choice to attend one is made with the assumption that such choice will come to lead to a better paying career after graduation. It is an investment one is making in their own future to pick a college of higher quality. However, this choice cannot be made in a vacuum, as the differences in college attendees in terms of demographics, background or ability will often influence the type of college they attend, if not due to affordability then by perceived ability to succeed. This brings up the argument that the college you attend is more of a signal of your already existing ability than a source of said ability.

Our research will be using a model like the one used in “Does it Pay to Attend an Elite Private College?” by Brewer et al. (1999), who based their analysis on the models of Willis and Rosen (1979). Their model uses a great deal more quality variables than we have available using a public dataset so we will be using a formula closer to a Mincer equation.

Our methodology follows theirs; it is expected that students select the colleges they will attend based on a great deal of qualities including their race and gender. In addition, we will be looking at the education achieved by the parents of the student. This variable is expected to serve as an indicator of the wealth of the family of the student as well as the value that a family has on higher education. The thought is that a student from a family with experience in higher education

will have both the desire and funding to attend the best school that they believe they can succeed at instead of perhaps what is most accessible which may be the case for students from less educated and wealthy families.

$$\ln(\text{Salary}) = \ln(\text{SalaryIntercept}) + \text{YearsSchooling} + \text{PotentialExp} - \text{PotentialExpSq} - \text{FEMALE} - \text{BLACK2} - \text{HISPANIC2} + \text{DGRDG}_2 + \text{DGRDG}_3 + \text{DGRDG}_4$$

We will be running an OLS regression as a sort of baseline for what we should expect to see when the various qualities of an individual are used to explain their wage. However, due to the non-random nature of our data being non-random, we will use a Heckman correction to allow us to account for the selection bias presumed to be present in our data. In this research the OLS should not be stated as having the ability to prove that attending a private college has on wages but instead serves as a general explanation of the data.

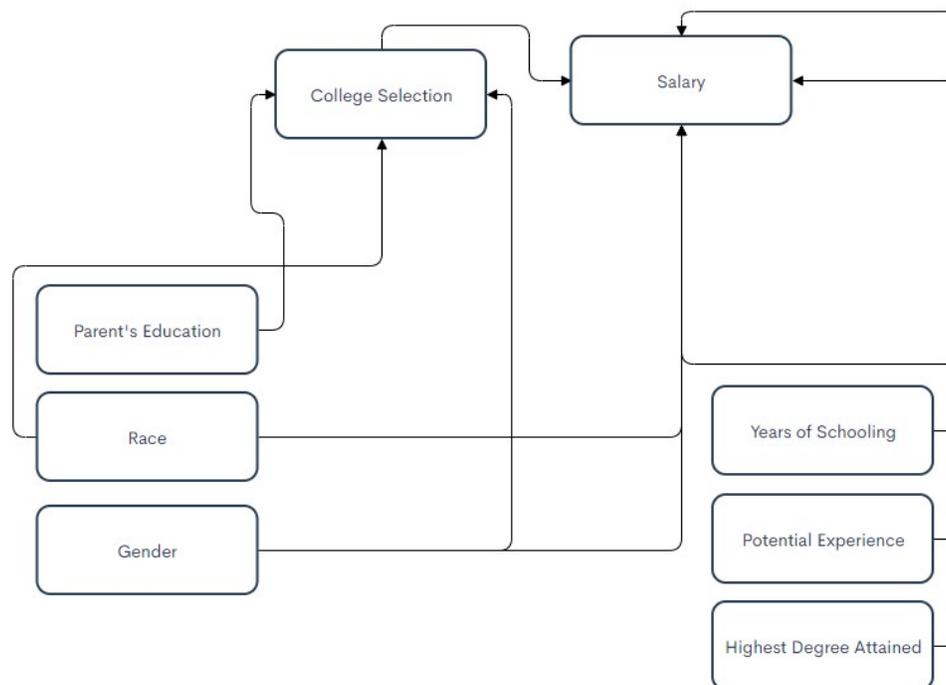


Figure 2: Flowchart of the expected source of college selection and wages

Our true analysis will be a Heckman correlation and the variables we will look at for our Heckman correlation will include the above variables to find the chance a student attends a private college. This will be followed up by the Heckman itself which will introduce a set of dummy variables denoting the highest level of degree achieved by the graduate as this is an important predictor of wages but not of the college the individual will attend.

$$PRIVATE = PRIVATEIntercept - FEMALE - BLACK2 - HISPANIC2 + EDPARENT$$

$$Ln(Salary) = Ln(SalaryIntercept) + YearsSchooling + PotentialExp + PotentialExpSq -$$

$$FEMALE - BLACK2 - HISPANIC2 + DGRDG_2 + DGRDG_3 + DGRDG_4$$

$$select(PRIVATE=1)$$

IV. Data Discussion

The data I am using for my project is from the National Survey of College Graduates 2017 conducted by the National Center for Science and Engineering Statistics (NCSES) and release on November 7th, 2019. The survey contains over a variety of questions ranging from the type of college attended to the career that was entered upon graduation. The survey had three requirements in order to be considered part of the population sample. Individuals must have completed a bachelor's degree or higher before 2016, the individual had to not be in jail as of the beginning of 2017 and the individual had to be younger than seventy-six years of age.

The respondents of this study were not asked if they attended a for-profit or a non-profit private university, so we are unable to examine the difference in terms of value between them. Due to the requirement to have completed a bachelor's degree in order to be included in the

survey, it can be assumed that a great majority of participants attended non-profit universities since the graduation rates for these schools are much higher.

Although the survey sample consists of 83,672 individuals, we are only able to use only 52,753. This difference is due to our research criteria. In order to qualify for this project, the respondent had to have answered the questions regarding their salary and/or whether they attended a private or public college for their first bachelor's degree. Our respondents also had to be under 65 which is considered the typical age where retirement begins, and they had to respond to the demographic criteria. Figure 1 reports the average salary, year of birth and hours worked per week by institution type in the sample.

Labels	Salary	Birth Year	Hours Worked in a Week	N
Public Mean	85257	1974	42	35849
Public Std. Dev	77909	12	11	
Private Mean	93445	1974	42	16904
Private Std. Dev.	95952	12	12	

Figure 3: Results of proc means on the data. Data Source: National Survey of College Graduates 2017

After running proc means the mean annual salary of public college graduates is \$85,257 per year and the mean annual salary of private college graduates is \$93,445. This is a difference of around \$8,188 yearly or around a 9.5 percent increase in average annual wage for the graduates of private institutions over the wages of public college graduates. This value indicates a significant difference in wages between the two groups at the .001 significance level from the t-test.

T-Test Method	Variances	DF	t-Value	Pr > t
Pooled	Equal	52751	-10.43	<.0001
Satterthwaite	Unequal	27780	-9.69	<.0001

Figure 4: Results of the T-Test between private and public salary. Data Source: National Survey of College Graduates 2017

On average, the respondents in the survey are 43 years old. Interestingly, this age is also around halfway through the span of work life of Americans, which is when workers' earnings

typically peak. Hours worked is also being presented to show that neither private nor public college graduates work a great deal more weekly hours which could have explained the wage difference.

This dataset includes indicators for things such as the education level of the parents of the graduate which can serve as a personal indicator of the value of education, making the assumption that if the parents are well educated the student will likely have a higher personal value for education. They also may have a higher chance of attending a private college if their parent was well educated as they likely grew up in a decent financial situation, though this could be offset by their associations with their parents' alma maters which could be favored by the graduate.

V. Results

The results of our OLS show that the choice of a private college over a public college amounts to yearly wage increase of 3.77 percent this serves to support the hypothesis that a college of higher quality leads to an increased wage after graduation. This value is also significant in our analysis at the 0.001 significance-level meaning the null hypothesis that college quality has no effect on wages should be rejected.

Many of the demographic variables that were tested were significant at the .001 confidence level. Years of potential experience had a return of 4.56 percent higher wages per year of additional experience likely due to the increase in experience that a worker acquires as they spend time in the workplace and as a return on the knowledge they have acquired while working there. The variable relating to the respondent being female returning a loss of 3.84 percent per

year while a respondent being Black, or Hispanic returned loses of 12.97 percent and 6.51 percent respectively. These were all significant at the .0001 confidence level.

The results of the Heckman correlation for the values associated with attending a private or public college are that a private college attendee earns 0.37 percent lower wages per year than their public-school attendee counterparts once selection bias is accounted for with a sigma of 0.793372 and a rho of -0.004692. This negative value for the returns to a private education contradict both the OLS and mean comparison that was run in our analysis however neither of those were accounting for selection bias. The Heckman correlation shows that the difference in wages between public and private school attendees is almost entirely determined by other variables such as race, gender, experience and the level of degree that the individual attained.

VI. Conclusion

As shown by the results of our analysis, attending a private college is not on its own a determiner of higher wages for graduates. Our findings suggest that the increased wages seen by private college graduates are more likely a result of the level of degree that they complete as well as the amount of years it has been since they began working. It is likely that the positive wage increases we saw in our other analyses were the result of students who attend private schools having higher confidence that they will succeed there and likely that they will succeed in the work force. A student that believes that they are capable to succeed at any school and want the best returns for their effort according to this analysis would be slightly better served by attending a public college instead of a private college.

Limitations of my research include the lack of ability to use data that includes private variables. In order to maintain the ability to do research like this identifying information must be

kept confidential such as the exact school where an individual attended school along with other variables that would have been included well in the calculation of whether a student would go to private or public school. The lack of a variable that gave us insight into the aptitude of the student when entering college is a weakness of our analysis. Another limitation would be that we could not identify whether a student went to an excellent college or a below average college as no variables were present to distinguish them beyond being private or public.

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[Rosen\(1979\)_JPE_Education and Self-Selection.pdf](http://unionstats.gsu.edu/9220/Willis-Rosen(1979)_JPE_Education%20and%20Self-Selection.pdf)

Appendix

Table 1: Variable Definitions

Variable	Definition
PRIVATE	Whether the survey taker attended a public or private college.
YearsSchooling	Years of schooling.
PotentialExp	Years after the completion of their most recent college degree.
FEMALE	Whether the survey taker was female.
BLACK2	Whether the survey taker identified as black.
HISPANIC2	Whether the survey taker identified as hispanic.
DGRDG_2	Masters's degree completion.
DGRDG_3	Doctorate degree completion.
DGRDG_4	Professional degree completion.

Table 2: OLS Output

Variable Name	Value	Significance	Std. Error
Intercept	10.87705	***	0.01456
PRIVATE	0.03769	***	0.00714
YearsSchooling	-0.00388	***	0.00056899
PotentialExp	0.04561	***	0.00116
PotentialExpSq	-0.00093	***	0.00002905
FEMALE	-0.3836	***	0.00674
BLACK2	-0.1297	***	0.01156
HISPANIC2	-0.06511	***	0.01101
DGRDG_2	0.23564	***	0.00792
DGRDG_3	0.40129	***	0.01489
DGRDG_4	0.59384	***	0.0167
N	52753		
R-Squared	0.1281		
F-Value	774.78		

Note: *** denotes significance at the .001 level.

Table 3: Heckman Output

Variable Name	Value	Significance	Std. Error
Insalary.Intercept	10.8889 4	***	0.100457
Insalary.YearsSchoolin g	-0.00355	***	0.001008
Insalary.PotentialExp	0.04603 7	***	0.002138
Insalary.PotentialExpS q	-0.00092	***	0.0000541 6
Insalary.FEMALE	-0.38408	***	0.014182
Insalary.BLACK2	-0.09585	***	0.021161
Insalary.HISPANIC2	-0.07932	***	0.021114
Insalary.DGRDG_2	0.25103 8	***	0.014596
Insalary.DGRDG_3	0.42555 6	***	0.025256
Insalary.DGRDG_4	0.68861 4	***	0.027155
_Sigma.Insalary	0.79337 2	***	0.004325
PRIVATE.Intercept	-0.87323	***	0.017315
PRIVATE.FEMALE	0.11599 5	***	0.011469
PRIVATE.BLACK2	0.13402 8	***	0.019556
PRIVATE.HISPANIC2	-0.00434	0.8206	0.019132
PRIVATE.EDPARENT	0.08798 7	***	0.003825
_Rho	-0.00469	0.9669	0.11299
N	16904		

Note: *** denotes significance at the .001 level.

SAS CODE

```

data senior.formatted;
set work.projectthree;
if BAPBPR = "L" then delete;
if BAPBPR = "M" then delete;
if SALARY = 9999998 then delete;
if AGE > 65 then delete;
if LFSTAT = 2 then delete;
if LFSTAT = 3 then delete;
if BLACK = "X" then delete;
if HISPANIC = "X" then delete;
PRIVATE=.;
if BAPBPR=1 then PRIVATE=0;
if BAPBPR=2 then PRIVATE=1;
BLACK2=.;
if BLACK = "N" then BLACK2=0;
if BLACK = "Y" then BLACK2=1;
HISPANIC2=.;
if HISPANIC = "N" then HISPANIC2=0;
if HISPANIC = "Y" then HISPANIC2=1;
FEMALE=.;
if GENDER = "M" then FEMALE=0;
if GENDER = "F" then FEMALE=1;
if SALARY = 0 then delete;
lnsalary = log(salary);
PotentialExp = 2017-MRYR;
PotentialExpSq = PotentialExp**2;
YearsSchooling = Age-PotentialExp-6;
if EDDAD = 8 then delete;
if EDMOM = 8 then delete;
EDPARENT = MAX(EDDAD,EDMOM);

ARRAY dummies4 {*} 3. DGRDG_1 - DGRDG_4;

DO i=1 TO 4;
  dummies4(i) = 0;
END;
dummies4( DGRDG ) = 1;

run;

proc sort data=senior.formatted;
by PRIVATE;
run;

```

```
proc freq data=senior.formatted;
  tables EDDAD EDMOM;
  by PRIVATE;
run;

proc means data=senior.formatted maxdec=0 mean stddev;
var SALARY BIRYR HRSWK;
class PRIVATE;
run;

proc ttest data=senior.formatted;
title "Public vs Private Salary";
class PRIVATE;
var SALARY;
run;

proc reg data=senior.formatted;
model lnsalary = PRIVATE YearsSchooling PotentialExp PotentialExpSq FEMALE
BLACK2 HISPANIC2 DGRDG_2 DGRDG_3 DGRDG_4;
run;

proc qlim data=senior.formatted;
model PRIVATE = FEMALE BLACK2 HISPANIC2 EDPARENT /discrete;
model lnsalary = YearsSchooling PotentialExp PotentialExpSq FEMALE BLACK2
HISPANIC2 DGRDG_2 DGRDG_3 DGRDG_4 /select(PRIVATE=1);
run;
```