Why Do College Graduate's Salaries Vary?

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Introduction

The returns to education have long been studied in the fields of both economics and policy. For the most part, economists have long focused on finding the most efficient level of educational attainment for students in order to maximize economic growth, while policy academics often examine the large amounts of government expenditures made in the name of educational attainment with the perceived goal of furthering economic productivity. Both fields have developed a considerable literature wondering if continued government expenditures for education and continued investment in educational by individuals constitutes a prudent and effective way in which to meet societal needs.

While the literature concerning this question—whether or not continued investment in education is appropriate—is myriad, the question of returns among the college educated has not been sufficiently answered. This paper analyzes the salaries of college graduates and attempts to identify which variables explain the variation in the salaries of these graduates. In order to do this, this paper utilizes the Baccalaureate and Beyond study, conducted by the National Center for Education Statistics to regress the explanatory variables of cumulative and major GPA, highest level of education attained, merged SAT and ACT score, age upon earning a bachelor's degree, time between college entry and bachelor's degree, highest degree eventually attained, and undergraduate major. Additionally, the regression controlled for ethnicity, gender, marital status, parent's educational attainment and the number of children under 18 parented by the individual.

The Baccalaureate and Beyond study is a longitudinal study of individuals who graduated in 1993 and were then surveyed three subsequent times between their graduation and 2003. This paper

utilizes the 2003 responses of the survey in order to minimize any post-graduation policy shocks which would skew the data (well connected parents, for example). This analysis uses salary in 2003 as the dependent variable because researchers in both economics and policy have utilized income as a proxy for both utility and efficiency in papers about education. However, income is likely not the ideal measure for outcome—other measurable factors such as time worked, job satisfaction, and job benefits, as well as countless non-quantitative measures also likely factor into an individual's utility function. However, utilization of salary yields interesting results which can be analyzed to provide useful insights about education.

The explanatory variables were selected based on the literature, as has been prescribed by Dr. JS Butler in his handout *Selection of Explanatory Variables.* The variables selected are consistent with the literature and help identify the dependent variable, as well as being consistent with the considerable theory developed by the multitude of researchers on this topic.

Literature Review

The piece which first gave rise to this topic of research is entitled *Rate of Return to Education: A Distributional Analysis Using the Life Paths Model.* This paper was published by the Canadian government and seeks to explain using a new "individual level simulation model developed by the Socio-Economic Modeling Group of Statistics Canada". Using the new simulation tool, they utilize a longitudinal study from the Community College Student Information System and the University Student Information System of Canada to determine that there are indeed positive returns to education. However, they state that their most interesting results are the wide variety within fields of study. They found that for a full fifth of BA graduates, the returns to their degree were negative. Conversely, for the highest fifth of BA graduates, there was a 30% return to their degree, contrasted with a mean of 15%.

The conclusions in this article lead to further research about who one may believe to be at the extremes of the distribution of college graduates. In the *Journal of Cultural Economics*, Randall K. Flier examines returns to income for graduates with Bachelor's degrees who work in artistic professions in his article *Arts and Academe*. He discovered that there exists a wide variation in income for different professions within the arts. He utilizes the Integrated Postsecondary Education Data System provided by the National Center for Education Statistics and regressed people who work in artistic professions on income. He finds initially that the return to education is slightly less for individuals who work in the arts, but after controlling for age, reverses that finding. There are relatively large amounts of young people in artistic professions.

The *Journal of Labor Economics* published a paper in 1993 by Joseph G. Altonji entitled *The Demand for and Return to Education When Education Outcomes are Uncertain.* This paper was the purpose for the author's interest in the explanatory variable about the final education outcomes. Altonji examines the difference between ex post and ex ante returns to starting college. He determines that for women, there are considerable differences. Additionally, ex ante returns are quite higher. He further finds that ex post returns for men are negative. Altonji utilizes NLS72—a US Department of Education longitudinal survey under uncertainty—in order to examine the probability of education outcomes.

From Altonji's citations, an interesting paper was discovered from the journal *Econometrica*. A rather witty author, Zvi Griliches, writes about the foolishness of leaving out "ability" as an explanatory variable in regressions about education in his paper *Estimating the Returns to Schooling: Some Problems*. This is a rather theoretical paper, but he manages to be convincing with his argument that some proxy for "ability" ought to be included, instead of solely assuming such a variable would be positive. While severe qualms still exist about standardized tests being included in measures for school

success, they are designed to be a proxy for ability, and therefore this article provided a compelling rationale to include SAT and ACT scores in the regression.

Finally, the paper *Education, Earnings, and Productivity: Recent UK Evidence* was examined. This 2003 paper, published by *Labor Market Trends* concluded many of the same things seen in earlier articles—the relationship between educational levels and wage rates suggests a high financial return to education. But it also states that individuals matter and that subject plays a vital role. This has been found earlier, and solidified my decision to include academic major as an explanatory variable. This paper utilized the British Labor Force Survey to find its result.

Methods

Use of the Baccalaureate and Beyond study is restricted, and access to the raw data cannot be obtained easily. However, the National Center for Education Statistics provides a resource which allows for linear and logistic regression called "PowerStats." PowerStats provides regression coefficients, standard errors, t-statistics, p-values, and 95% confidence intervals for each explanatory value, as well as providing summary statistics. This somewhat restricts what an analyst can do with the data in the survey. Given full control of the data, a linear regression could be compared to a selection bias model, which would account for graduates who chose not to participate in the labor market, for instance. Furthermore, several of the variables seem to make more sense as continuous rather than categorical variables (for instance, number of children). Finally, "PowerStats" only provides relative standard errors instead of robust standard errors. While this does not likely have a significant impact on the analysis, it is always beneficial and, given how quickly computers can compute such statistics, the cost to provide robust standard errors is low.

The item which causes the greatest theoretical problem with this model due to the lack of access to the raw data is that the dependent variable is the wage of an individual, and not the logarithm

of the wage. Labor economics has suggested for the past half-century that utilizing the log value of the wage increases the explanatory power of the model as measured by the R-squared term. The analyst is confident that the linear regression used to generate the results of this paper provides enough information to draw interesting and useful conclusions even though a low R-squared is present. This analysis provides important information about where the variance among college graduates stems.

Results

The results of the regression provide some interesting insights. The control variables—gender, ethnicity, marital status, number of dependent children, and parent's highest education—all have signs in the expected direction. A few of these variables have large magnitudes, especially gender, and some of the variables have high levels of significance. However, the results of these variables are not the central concern of this paper—they only exist to control for their effects. The presence of large, expected, and significant values do justify their existence in the model.

The most interesting results in this regression are found in the variables for an undergraduate's major. However, there exist a few others which are significant and have interesting magnitudes—but not age at graduation, time between entry and graduation, or both major GPA and cumulative GPAs. These have effects which do not appear to be very significant or have high magnitudes.

Summary Statistics				
	Current or most recent salary 2003			
	(Avg>0)	Relative Standard Errors	(Median>0)	Relative Standard Errors
Total	$ 55,193.40	1.09	$ 48,300.00	1.14
Age when received bachelor's degree				
22 or younger	$ 57,609.40	1.44	$ 49,920.00	0.91
23-24	$ 55,293.40	2.15	$ 47,900.00	2.55
25-29	$ 55,201.40	3.15	$ 48,880.00	1.97
30 or older	$ 51,846.20	2.24	$ 47,840.00	3.67
Gender of student				
Male	$ 65,829.80	1.43	$ 59,964.00	2.19
Female	$ 46,275.70	1.08	$ 41,000.00	1.59
Marital status, 2003				
Single, never married	$ 54,702.40	2.86	$ 49,000.00	2.68
Married	$ 56,065.00	1.06	$ 49,000.00	1.42
Cohabiting/living with a partner	$ 55,150.70	2.93	$ 50,000.00	3.65
Separated	$ 46,498.30	6.27	$ 41,375.00	5.73
Divorced	$ 50,067.80	4.14	$ 41,000.00	4.31
Number of dependent children under 18 in 2003				
0	$ 54,834.20	1.58	$ 48,630.00	1.56
1	$ 57,006.70	1.86	$ 49,920.00	1.4
2	$ 54,969.60	2.23	$ 47,840.00	2.93
3	$ 52,921.30	3.67	$ 45,760.00	4.52
4+	$ 54,329.00	6.68	$ 46,500.00	7.34
Parent's highest education				
Not HS graduate or equivalent	$ 48,432.20	5.39	$ 41,000.00	5.01
HS graduate or equivalent	$ 52,533.00	1.61	$ 47,250.00	2.47
Some PSE, lt 2 years	$ 51,876.30	2.54	$ 45,000.00	3.19
2 years or more PSE, AA lt BA	$ 54,374.60	2.61	$ 48,651.00	3.39
Bachelor's degree	$ 58,064.50	2.36	$ 49,300.00	1.93
Advanced degree	$ 58,203.60	1.79	$ 50,000.00	0.89
Cumulative undergraduate grade point average 1994				
Less than 2.75	$ 53,558.70	2.28	$ 45,718.00	4.21
2.75-3.74	$ 56,607.00	1.36	$ 49,920.00	0.84
3.75 or higher	$ 57,146.70	2.11	$ 49,392.00	2.01
Grade point average in undergraduate major 1994				
Less than 2.75	$ 50,775.10	3.15	$ 45,760.00	4.65
2.75-3.74	$ 57,139.30	1.47	$ 49,920.00	0.41
3.75 or higher	$ 56,115.60	2.09	$ 47,850.00	2.26
Merged SAT and ACT score quartile				
Did not take SAT or ACT	$ 50,798.80	2.45	$ 45,000.00	3.72
Bottom quartile SAT (or ACT if no SAT)	$ 49,223.10	1.58	$ 42,500.00	1.68
Second quartile SAT (or ACT if no SAT)	$ 54,070.90	1.88	$ 47,840.00	2.48
Third quartile SAT (or ACT if no SAT)	$ 58,308.80	1.74	$ 51,864.00	1.7
Top quartile SAT (or ACT if no SAT)	$ 64,342.50	2.61	$ 55,000.00	2.75
Time between college entry and bachelor's degree				
4 years or less	$ 58,446.70	1.92	$ 49,920.00	1.11
5-6 years	$ 55,609.00	1.65	$ 48,900.00	1.72
More than 6 years	$ 52,781.90	1.99	$ 47,000.00	2.49
Undergraduate major				
Business and management	$ 62,666.80	2.62	$ 54,965.00	1.84
Education	$ 39,745.60	1.7	$ 36,800.00	1.76
Engineering	$ 73,215.70	2.19	$ 70,000.00	1.92
Health professions	$ 58,057.20	2.35	$ 52,000.00	2.53
Public affairs/social services	$ 47,154.50	3.6	$ 41,000.00	3.93
Biological sciences	$ 59,770.90	4.01	$ 47,000.00	4.11
Mathematics & science	$ 61,430.30	2.47	$ 56,600.00	2.9
Social science	$ 61,010.00	3.27	$ 49,500.00	3.38
History	$ 54,956.40	5.21	$ 45,000.00	9.72
Humanities	$ 49,508.90	3.51	$ 40,860.00	2.91
Psychology	$ 44,734.80	3.97	$ 40,000.00	2.66
Other	$ 53,435.70	2.36	$ 45,800.00	2.69
Highest degree attained by 2003				
Bachelor's degree	$ 53,406.50	1.18	$ 47,840.00	1.98
Post-baccalaureate certificate	$ 42,944.50	8.64	$ 40,000.00	10.4
Master's degree	$ 56,353.10	1.71	$ 49,392.00	1.7
First-professional degree	$ 83,940.90	5.14	$ 68,000.00	8.04

The highest degree attained by 2003, on the other hand, does yield interesting results. Interestingly, if an individual receives a post-baccalaureate certificate after receiving a bachelor's degree, their salary actually decreases. The p-value of this result is 0.1133, which means it may not pass tests for significance, but the result does not act as one would expect, and therefore ought to be studied more in depth. Furthermore, if an individual pursues a professional degree, this has a very significant, large effect on their income. Professional degrees, such as a Pharm.D for pharmacists, a JD for a lawyer, or a degree in Physical Therapy, then, have a very large impact on the salaries of college graduates.

The ability measures included in this regression—SAT and ACT scores—do yield some interesting results. All the coefficients react in the expected direction, and the top quartile has a statistically significant and large magnitude. If the story of ACT and SAT scores being proxies for ability can be believed, that would show that the top quartile of college graduates would make a significantly larger amount of money than the bottom quartile.

The most interesting results in this regression come from the information about the undergraduate majors of the graduates. Each of these variables has a p-value of less than 0.02 (implying statistical significance), and many have very large magnitudes. Education was made the base case for this regression, as it has the lowest mean value. The most lucrative major a graduate could have in this regression is engineering—this makes sense because the skills required to become an engineer are difficult to obtain and have a very distinct field. However, the premium earned for that degree is substantially larger than the author's expectation. Additionally, business & management and health professions, like engineering, have very distinct fields and high paying jobs. It follows then that they would earn substantially more than other fields. Furthermore, biological sciences, mathematics & science, social science, and other all had relatively large magnitude impacts. The data does not give

evidence as to why this is the case, but a hypothesis may be that these degrees lead directly towards graduate studies, which yield higher salaries.

ESTIMATED FULL SAMPLE REGRESSION COEFFICIENTS						
	b	S.E.	t	p-value	Lower 95%	Upper 95%
Intercept	$ 35,078.98	5116.84	6.8556	0.0000	$ 24,768.55	$ 45,389.42
Age when received bachelor's degree	$ (87.30)	201.16	-0.4340	0.6664	$ (492.64)	$ 318.05
Gender of student						
Female	$ (17,232.17)	1180.26	-14.6003	0.0000	$ (19,610.39)	$ (14,853.95)
Graduate ethnicity (ref: White)						
American Indian/Alaska Native	$ 11,904.52	15620.61	0.7621	0.4501	$ (19,571.01)	$ 43,380.05
Asian or Pacific Islander	$ (871.57)	3064.53	-0.2844	0.7774	$ (7,046.61)	$ 5,303.46
Black, non-Hispanic	$ (1,906.21)	1960.84	-0.9721	0.3363	$ (5,857.29)	$ 2,044.88
Hispanic	$ 69.81	1755.01	0.0398	0.9685	$ (3,466.53)	$ 3,606.15
Marital status, 2003 (ref: Single)						
Married	$ 4,150.66	2127.44	1.9510	0.0574	$ (136.13)	$ 8,437.45
Cohabitating/living with a partner	$ 466.70	2539.39	0.1838	0.8550	$ (4,650.18)	$ 5,583.57
Separated	$ (2,778.66)	5023.02	-0.5532	0.5829	$ (12,900.03)	$ 7,342.72
Divorced	$ 3,664.68	2447.55	1.4973	0.1415	$ (1,267.13)	$ 8,596.49
Number of dependent children under 18 in 2003 (ref: 0)						
1	$ 591.92	1660.84	0.3564	0.7232	$ (2,754.67)	$ 3,938.51
2	$ (1,071.48)	1679.91	-0.6378	0.5269	$ (4,456.50)	$ 2,313.55
3	$ (4,820.35)	1959.34	-2.4602	0.0179	$ (8,768.42)	$ (872.27)
4+	$ (3,606.55)	3905.28	-0.9235	0.3608	$ (11,475.69)	$ 4,262.59
Parent's highest education (ref: HS Diploma)						
Not HS graduate or equivalent	$ 2,522.17	2538.56	0.9935	0.3259	$ (2,593.03)	$ 7,637.36
Some PSE, < 2 years	$ (361.70)	1638.71	-0.2207	0.8263	$ (3,663.70)	$ 2,940.31
2 years or more PSE, AA < BA	$ (735.42)	1551.96	-0.4739	0.6379	$ (3,862.63)	$ 2,391.79
Bachelor's degree	$ 3,497.04	1863.03	1.8771	0.0671	$ (256.96)	$ 7,251.04
Advanced degree	$ 2,347.50	1347.55	1.7421	0.0885	$ (367.81)	$ 5,062.81
Cumulative undergraduate grade point average 1994	$ 25.04	15.26	1.6411	0.1079	$ (5.70)	$ 55.78
Grade point average in undergraduate major 1994	$ 19.89	16.67	1.1928	0.2393	$ (13.71)	$ 53.48
Merged SAT and ACT score quartile (ref: 1st quartile)						
Did not take SAT or ACT	$ 1,455.34	1899.75	0.7661	0.4477	$ (2,372.66)	$ 5,283.34
Second quartile SAT (or ACT if no SAT)	$ 1,912.65	1543.75	1.2390	0.2219	$ (1,198.01)	$ 5,023.31
Third quartile SAT (or ACT if no SAT)	$ 2,093.62	1396.94	1.4987	0.1411	$ (721.22)	$ 4,908.45
Top quartile SAT (or ACT if no SAT)	$ 4,464.83	2000.81	2.2315	0.0308	$ 433.19	$ 8,496.46
Time between college entry and bachelor's degree	$ (18.89)	21.16	-0.8929	0.3768	$ (61.53)	$ 23.74
Undergraduate major recoded (ref: Education)						
Business and management	$ 19,465.07	1822.84	10.6784	0.0000	$ 15,792.05	$ 23,138.10
Engineering	$ 22,412.76	2178.25	10.2893	0.0000	$ 18,023.59	$ 26,801.94
Health professions	$ 17,421.78	1607.91	10.8351	0.0000	$ 14,181.84	$ 20,661.72
Public affairs/social services	$ 6,185.50	2266.69	2.7289	0.0091	$ 1,618.13	$ 10,752.88
Biological sciences	$ 10,148.70	2965.72	3.4220	0.0014	$ 4,172.78	$ 16,124.63
Mathematics & science	$ 15,284.81	1979.97	7.7197	0.0000	$ 11,295.17	$ 19,274.45
Social science	$ 15,036.37	2076.55	7.2410	0.0000	$ 10,852.12	$ 19,220.61
History	$ 9,201.85	3551.55	2.5909	0.0129	$ 2,045.47	$ 16,358.23
Humanities	$ 6,196.98	1803.64	3.4358	0.0013	$ 2,562.64	$ 9,831.32
Psychology	$ 4,123.93	2003.72	2.0581	0.0455	$ 86.44	$ 8,161.43
Other	$ 11,016.01	1395.18	7.8957	0.0000	$ 8,204.72	$ 13,827.31
Highest degree attained by 2003 (ref: BA)						
Post-baccalaureate certificate	$ (8,430.70)	5218.58	-1.6155	0.1133	$ (18,946.15)	$ 2,084.74
Master's Degree	$ 2,141.78	1349.11	1.5876	0.1195	$ (576.67)	$ 4,860.23
1st Professional degree	$ 25,612.01	5359.71	4.7786	0.0000	$ 14,812.19	$ 36,411.83
Doctoral Degree	$ 3,889.52	3294.38	1.1807	0.2441	$ (2,748.66)	$ 10,527.70

History and the humanities have lower salaries than the fields already described. This could be because these degrees are not attached to a particular field, and even if a graduate were to pursue a graduate degree in these fields, the likely jobs would be relatively lower paying than jobs other graduate degree holders may work. Psychology, public affairs/social services, and education bring up the rear in terms of salary. This is interesting because these fields have jobs attached to them. However, many of these jobs are not high paying (social worker, teacher, etc), and that likely explains why these majors yield relatively low salaries.

The R-squared value for this model is 0.13, which means that all of the explanatory variables explain 13% of the variance associated with different graduates. However, if the logarithm of the salary had been able to be used, this number would likely have been higher. At any rate, even if these explanatory variables do not completely describe the variance between graduates, the results still provide interesting and useful insights.

Conclusions

In order for a college graduate to maximize their salary ten years after graduation, the most effective thing that the graduate could do would be to major in engineering and to earn a professional degree. Even if that individual were to not have the highest ability—a low SAT/ACT score—and even if it takes longer for that individual to earn the degree, earning a degree in engineering and earning a professional degree would more than make up for those issues.

As far as policy implications, this regression showcases that college graduates who have degrees attached to careers as public servants—education and social services—make considerably less salary relative to other college graduates. This could lead to the best students migrating to high paying degrees. However, it may also have the effect that only graduates passionate about doing the jobs which education and social service majors do would enroll in such programs.

Caveats

This paper is based on the Baccalaureate and Beyond study, which studied graduates from 1993 and surveyed them in 2003. The world has changed substantially since 1993, but this study remains the most complete and useful data set of college graduates. Furthermore, the fact that the data set is restricted limits its usefulness, especially because the regression cannot utilize the logarithm of the wage. Even so, the results do yield significant and useful information. Finally, the R-square term for this model is relatively low. However, R-squared terms are easily manipulated and fixating on this point only serves to lessen the results of any research—while this model only states confidently that 13% of the variation between college graduates is explained, it likely has significant impact on the other 87%.

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