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The Role of College Majors on Earnings Premiums

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Abstract

In my research paper, I will be evaluating the role that college majors play in determining wages for adult respondents to the 2009-2017 American Community Survey. I will be analyzing wages for college major categories of STEM, liberal arts, professional, social science, education, and others. The question I am seeking to answer in this paper is, which college major category leads to the highest earnings premium?

I. Introduction

In my research paper, I will be evaluating the role that college majors play in determining wages for adult respondents to the 2009-2017 American Community Survey. I will be analyzing wages for college major categories of STEM, liberal arts, professional, social science, education, and others. The question I am seeking to answer in this paper is, which college major category leads to the highest earnings premium?

It is important for college students to be aware of this research topic. Transparency between college students and the workforce statistics with different areas of study is crucial to undergraduates who are in the process of selecting their major. Picking an area of study in college can be a daunting task. There are many options that cover vastly different skillsets and lead to completely different jobs. With the structure of the workforce changing at a rapid pace, it is critical to be aware of how different skillsets are rewarded post-graduation.

In addition to the importance of awareness, the cost of tuition is rising at a rapid pace and millennial students are struggling to pay off their student loans. The average cost of tuition after adjusting for inflation has risen 213% from 1987 to the 2017-2018 school year (Martin, 2017). Now, it is more important than ever for college students to be aware of their employment outlook in order to make sure that the degree they are pursuing will be worth the monetary cost of attending college. By knowing the wage statistics, college students will be better able to estimate how quickly they will be able to pay off their student loans.

II. Existing Literature

A survey conducted on undergraduates from Duke University (Aracidiacono, 2011) revealed the motives for students' selection of major. The study concluded that college major selection is determined "both on expected earnings and on individual perceptions of their relative abilities to perform the course work in particular majors" (p.25). The paper also concluded, "Adjusting for student differences in expectations about what the average Duke student would earn in different majors would lead to 7.8% of the students in our samples switching their majors. These findings suggest that it may be advantageous to provide college students with information about school-specific average earnings by majors so that they can choose majors that better match their abilities and preferences" (p. 15). Earnings are not the only reason for selecting a field of study. In general, people want to enjoy what they study. In addition, not everyone is capable of completing coursework in specific areas successfully. There are varieties of reasons to pick a certain major regardless of employment outlook. However, earnings are large determinants of education and career path and should be considered in the major selection process.

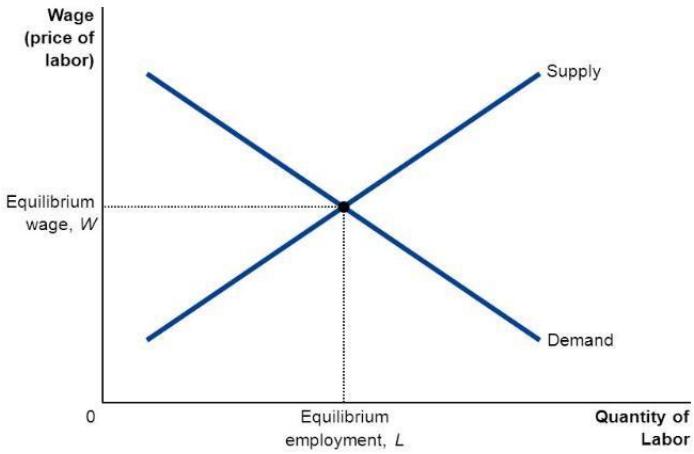
There are also existing economics reports that compute estimated labor force statistics based on field of study. A study in 2006-2010, community college graduates in northern California (Baker, 2018) found that Business, Computer Science, and Tech majors had the highest average earnings of $51,473. Science, Math and Engineering had the second highest average earnings of $46,300. Arts and Language were far behind in last with $28,820. Another study (Webber, 2014) tracked average lifetime

earnings from a cohort of 1979 college graduates. The results showed that STEM majors had the highest lifetime earnings of $3,983,443 with Business related majors closely behind with lifetime earnings of $3,858,248. Arts/Humanities had the lowest lifetime earnings with $3,049,220.

Depending on the empirical research design, economic conditions during the timeframe when the data was collected, and backgrounds of the sample group, conclusions can vary substantially for similar research questions. I will extend previous literature by examining earnings premium on college majors for the most recent cohort available (2009-2017) on the American Community Survey. The sample begins near the tail end of the recession and extends to the modern workforce structure with historically low unemployment rates. My research will reveal the effects of the modernized work environment.

III. Economic Theory

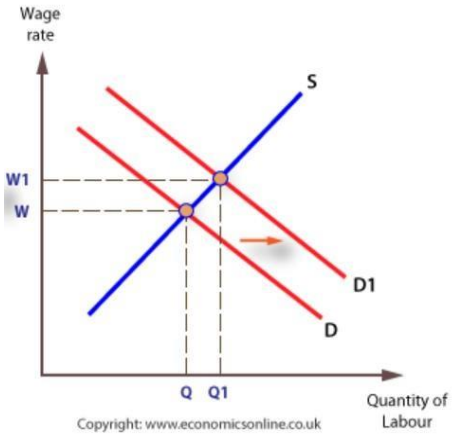
My theoretical framework is based on the microeconomic theory of labor market supply and demand.



This graph depicts the supply and demand lines for a general labor market. The equilibrium quantity of employment and equilibrium wage reside at the intersection of the supply and demand lines. This concept is applicable to individual jobs. If the demand for a certain job increases, the demand line will shift to the right and the new equilibrium point will result in higher wages. Since college majors generally lead to a specific occupation in the workforce, the supply and demand equilibrium of that specific occupation will affect the wages of entrants into that designated field. Therefore, the occupation that has the highest labor market supply/demand equilibrium will have the highest wages.

IV. Hypothesis

Existing literature and current economic trends led me to hypothesize that STEM majors will have higher earnings premiums. As the labor force is becoming more technology-centric, demand for computerized jobs has been climbing. According to the U.S. Department of Labor Bureau of Labor Statistics (BLS), the computer and information technology field is expected to grow by 13 percent from 2016-2026 which is a higher growth rate than the average growth rate of all other occupations. By 2026, for example, another 557,100 jobs are expected to be added to the computer and information technology field.



According to labor market supply and demand theory, the demand for employees in technology related jobs will shift to the right, resulting in higher wages. STEM majors are most likely to pursue jobs in this growing field compared to professional, liberal arts, social science, and education majors. The shift in the demand for STEM-related jobs in the modern workforce will be prevalent in my findings and should lead to even stronger results in the years to come. Therefore, my hypothesis is that STEM majors will have the highest earnings premium relative to the other all other college major categories.

College graduates majoring in STEM will be able to benefit from the growing field of computerized jobs due to signaling and human capital theory. Signaling is an economic theory that states that people convey employable information about themselves through signals. According to Michael Spence, the founder of signaling theory (Spence, 1973), “Primary interest attaches to how the employer perceives the lottery, for it is these perceptions that determine the wages he offers to pay. We have stipulated that the employer cannot directly observe the marginal product prior to hiring. What he does observe is a plethora of personal data in the form of observable characteristics and attributes of the individual, and it is these that must ultimately determine his assessment of the lottery he is buying” (p. 357). This theory is especially

prevalent in a person's education because transcripts and resumes signal important information about the employability of the so-called lottery. One of the signals that a hirer will look for is the major of the applicant. Having a degree in a particular major is a signal to an employer that the student has completed studies in the appropriate field and are capable of performing well enough to obtain a degree in that area of study. Choice of major is an important signal for college students to consider in order to succeed in the job market.

Human Capital theory suggests that people will be monetarily rewarded based on the value they add to a company. In 1994, Gary Becker defined human capital as "activities that influence future monetary and psychic income by increasing resources in people" (Becker, 1994). Higher-quality education leads to improved human capital, which makes workers more valuable to employers. Therefore, workers with high levels of human capital will have a higher salary than those with lower human capital. Human capital theory is often attributed to years of education; however, human capital is also linked to area of study. The courses that students take will prepare them with a specific skillset that other students studying different topics will not have. Some college majors are more difficult to complete than others and some majors are more valuable for certain occupations. The human capital that students acquire through completing their college major will affect their success/earnings in the workforce. STEM majors acquire more human capital relative to other major categories for the modern workforce and should be rewarded with the highest earnings premium.

V. Empirical Model

The data in my research comes from the American Community Survey. The U.S. Census Bureau's American Community Survey provides social, economic, educational, and demographic characteristics of communities in America. The survey contains all the variables that I need for my research and provides trustworthy and accurate data from a large sample.

The findings will be drawn from two OLS linear regression models. In the first regression, natural log of earnings is a function of college major category alone. In the second regression, natural log of earnings is a function of college major category and is adjusted for race, age, and level of attained education, all of which could influence earnings. I have broken down race into dummy variables of Black and Asian. Educational attainment is divided into the highest degree obtained, which includes dummy variable categories of master's degrees, professional degrees, and doctoral degrees. Age is accounted for in the regression under standard age and age^2.

I sorted out a listing of many college majors into six dummy variable categories: STEM, liberal arts, professional, social science, education, and other. STEM includes all majors relating to sciences, technology, math, and engineering. Education groups all majors that involve learning the practice of teaching. Social science includes classes relating to anthropology, economics, psychology, political science, and history. The Professional group includes majors that prepare students for professional careers such as business, accounting, finance, and classes relating to law. The Liberal Arts category groups humanities and creative arts majors. Refer to Table 3 on page 16 for a complete

representation of the six major categories. The two regression equations are stated as follows:

1: LnWagei = $\boldsymbol{\beta 0}$ + $\boldsymbol{\beta 1}$STEM+ $\boldsymbol{\beta 2}$Liberal Arts + $\boldsymbol{\beta 3}$Social Science + $\boldsymbol{\beta 4}$Prof + $\boldsymbol{\beta}$5Other + $\boldsymbol{ui}$

2: LnWagei = $\boldsymbol{\beta 0}$ + $\boldsymbol{\beta 1}$STEM+ $\boldsymbol{\beta 2}$Liberal Arts + $\boldsymbol{\beta 3}$Social Science + $\boldsymbol{\beta 4}$Prof + $\boldsymbol{\beta}$5Other + $\boldsymbol{\beta}$6Black + $\boldsymbol{\beta}$7Asain+ $\boldsymbol{\beta}$8 Age + $\boldsymbol{\beta}$9 age^2 + $\boldsymbol{\beta}$10Master's + $\boldsymbol{\beta}$11Professional + $\boldsymbol{\beta}$12doctoral + $\boldsymbol{ui}$

VI. Results

First, I will cover descriptive statistics to gain insight into the data before going into the regression results. The data consists of a pooled sample of 3,036202 individuals from the years 2009-2017. The data has been restricted to only include college graduates with at least a bachelor's degree who are between the ages of 23 and 65. The data has also been restricted to only include individuals who are working full time (50-52 weeks per year and 36+ hours per week). Although left in the sample for comparison, I will not be evaluating the major category of "Other" to draw results and conclusions because it only contains majors that did not fit into the categories of interest.

Table 1.a provides mean statistics for the age and earnings of the data sample for each major grouping. Education has the highest average age (45.49) while Social Science had the lowest (42.60). The range for the mean ages in the sample is very low, only 2.89 years separates the highest and lowest mean age per major. The standard deviation across the age groupings is between 11.06 (Professional) and 11.67 (Education). Once again, the range is small and there are no standouts in the results.

The small range of mean and standard deviation of age shows that age is not a significant factor in determining major groups.

Unlike age, there are vastly different results for mean earnings across major groups. STEM had strong results with average earnings of $100,161.27, significantly above the rest of the majors. Education yielded the lowest average earnings of $58,446.13. The difference between STEM and Education earnings is a resounding $41,715.15. STEM major earnings are $7,855.92 higher than Professional majors, which were second highest ($92,305.35). The standard deviations for earnings reveal important information as well. Education has a significantly lower standard deviation (40,534.62) than the rest of the major while Professional, Social Science, and STEM majors had standard deviations above 83,000. I attribute the wide difference between the standard deviation of Education and the other majors to the low ceiling and consistency of teaching salaries. The results for mean wages across the data sample show a significant earnings premium for STEM majors.

Table 1b is a cross-sectional table, comparing gender, race, and highest obtained degree across the different major groups. There are significant differences in gender across majors, predominately in Education, STEM, and Professional majors. 72.1% of education majors in the sample are female, while 62.1% of STEM majors and 58.3% of Professional majors are male. For race, Black accounts for 6.7% of the total sample and are most underrepresented in STEM (5.5%) and most overrepresented in Social Science (8.5%). Asian accounts for 9.1% of the sample and are most prevalent in STEM (15.5%), and barely found in Education (2.7%). The Education major group was most likely to obtain a master's degree (42.9%) while Professional majors were least

likely (20%). Social Science majors were most likely to get a professional degree such as an M.D or J.D (10.6%) while Professional majors were least likely (3.3%). For Doctoral degrees, STEM majors were most likely (7.7%) and Professional majors were least likely (0.9%). The cross-section table provides meaningful information that may provide insight to the differences in earnings across majors.

Table 2.a displays the results from the first regression. The regression is a function of the natural log of earnings and the major groups are the only independent variables. Since Education had the lowest mean earnings, I left out the Education major category to use as a reference group. STEM had a very high beta, accounting for a 50.9% earnings premium over Education. Professional majors were second highest with a 42.2% earnings premium. Liberal Arts majors had a small positive premium of only 4.6%.

Table 2.b shows the results from the second regression equation. For this regression, the results are adjusted for race, age, and obtained degree. For race, White is used as the reference group. The premiums for degree obtained are in reference to having a bachelor's degree. Once again, Education will be used as the reference group for the major groups. The results show that STEM remains the earnings victor, with a smaller but still substantial premium of 44.6% over Education. Professional majors were second highest again with a premium of 39.9%. Liberal Arts were much higher than the previous regression and still had the lowest premium of 17.2%. The results for race show a significant negative premium for Black (-23.4%) and a small negative premium for Asian (-2.3%). Standard age had a 9.8% premium and age^2 proved to be insignificant (-0.1%). Obtaining a professional degree proved to be the most valuable for

earnings with a 54.7% over having just a bachelor's degree. Doctoral was second highest (32.9%) and master's was lowest but still beneficial for higher earnings (18.5%).

VII. Conclusion

The transparency of labor force statistics is critical for college students' major selection. The structure of the labor market is constantly changing, and students must be aware about the value of the skillsets they will gain through schooling. College students must be aware of expected earnings in their field of study as a reference for the duration of paying off student loans. This paper sought to examine the earnings premiums for standard major categories. As hypothesized, the STEM major category led to the highest earnings premium. The result was supported through mean earnings and both regression models. The human capital acquired through completion of STEM programs prepares graduates for high-income jobs.

The conclusions drawn from this research are in line with the existing literature covering lifetime earnings of college graduates with STEM majors as earnings leaders and professional/business majors close behind. The increasing demand for computer/technology related occupations should push the STEM earnings premium even higher relative to all other majors going forward. I would be interested to see a similar study conducted at various timeframes in the future to compare how the premiums change over time with new workforce structures. I would also like to see a study on earnings premiums for college majors at different periods in the economic cycle. It would be insightful for graduates to be aware of how earnings premiums change depending on whether the economy is in a period of high growth or recession.

Table 1.A- Average Age and Wage Across Major Groups

Major Group	N	Age Mean	Age Std. Deviation	Wage Mean	Wage Std. Deviation
STEM	1,017,989	43.34	11.25	$100,161.27	83,364.32
Education	303,743	45.49	11.67	$58,446.13	40,534.62
Liberal Arts	442,566	42.15	11.58	$73,486.43	69,496.06
Social Science	527,878	42.60	11.50	$86,845.77	86,136.76
Professional	688,582	43.35	11.06	$92,305.35	84,584.72
Other	55,444	40.05	11.20	$72,570.14	61,852.17
Total	3,036202	43.20	11.38	$87,499.32	79,731.24

Table 1.B- Gender, Race, and Highest Degree Obtained Cross Tabulation

	STEM	Education	Liberal Arts	Social Science	Professional	Other	Total
%Male	62.1%	27.9%	45.0%	51.3%	58.3%	71.1%	53.6%
%Female	37.9%	72.1%	55.0%	48.7%	41.7%	28.3%	46.4%
%Black	5.5%	6.5%	6.0%	8.5%	7.7%	5.3%	6.7%
%Asian	15.5%	2.7%	5.7%	5.7%	7.8%	4.2%	9.1%
%Master's Degree	26.6%	42.9%	24.3%	28.9%	20.0%	17.8%	26.6%
%Professional Degree	8.7%	3.5%	6.2%	10.6%	3.3%	3.7%	6.8%
%Doctoral Degree	7.7%	2.7%	3.8%	4.9%	0.9%	3.0%	4.5%

Table 2.A- Natural Log Earnings of College Majors

	β	Std. Error	t	sig
STEM	.509	.002	282.480	.000
Liberal Arts	.046	.002	22.796	.000
Social Science	.231	.002	116.438	.000
Professional	.422	.002	219.119	.000
Other	.154	.004	36.716	.000
(Constant)	10.450	.002	6764.223	.000

Model Summary	**R**	**R Squared**	**Adjusted R Squared**	**Standard Error**	**N**
	.181	.033	.033	1.07215	3,036202

Table 2.B- Natural Log Earnings of College Majors Adjusted for Race, Age, Age^2 and Highest Degree Obtained

	β	Std. Error	t	sig
STEM	.446	.001	328.374	.000
Liberal Arts	.172	.002	112.339	.000
Social Science	.267	.001	180.366	.000
Professional	.399	.001	279.971	.000
Other	.247	.003	82.427	.000

Black	-.234	.001	-156.886	.000
Asian	-.026	.001	-19.515	.000
Age	.098	.001	368.514	.000
Age^2	-.001	.000	-317.550	.000
Master's Degree	.185	.001	211.493	.000
Professional Degree	.547	.002	362.678	.000
Doctoral Degree	.329	.002	179.827	.000
(Constant)	8.404	.006	1496.545	.000

Model Summary	**R**	**R Squared**	**Adjusted R Squared**	**Standard Error**	**N**
	.433	.188	.188	.64513	3,036202

Table 3- Major Groups					
STEM	Education	Liberal Arts	Social Science	Professional	Other

. General Agriculture . Agriculture Production and Management . Animal Sciences . Food Sciences . Plant Science and Agronomy . Soil Science . Miscellaneous Agriculture . Environmental Science . Forestry . Natural Resource Management . Architecture . Computer and Information Systems . Information Sciences . Computer Information Management and Security . Computer Networking and Telecommunications . General Engineering . Aerospace Engineering . Biological Engineering . Architectural Engineering . Biomedical Engineering . Chemical Engineering . Civil Engineering . Computer Engineering . Electrical Engineering . Engineering Mechanics, Physics and Science . Environmental Engineering . Geological and Geophysical Engineering . Industrial and Manufacturing Engineering . Materials Engineering and Materials Sciences . Mechanical Engineering . Metallurgical Engineering . Mining and Mineral Engineering . Naval Architecture and Marine Engineering . Nuclear Engineering . Petroleum Engineering . Miscellaneous Engineering . Engineering Technologies . Biology . Botany . Ecology . Genetics . Microbiology . Physiology . Neuroscience . Mathematics .Statistics and Decision Science . Military Technologies . Nutrition . Cognitive Science . Astronomy	. General Education . Educational Administration and Supervision . School Student Counseling . Elementary Education . Mathematics Teacher Education . Physical and Health Education Teaching . Special Needs Education . Social Science or History Teacher Education . Teacher Education (Multiple Levels) . Language and Drama Education . Arts and Music Education . Miscellaneous Education	. Area, Ethnic, and Civilization Studies . Communications . Journalism . Mass Media . Advertising and Public Relations . Communication . Linguistics and Foreign languages . Linguistics and Comparative Language and Literature . English Language, Literature . Composition and Speech . Liberal arts and Humanities . Library Science . Fine Arts . Drama and Theatre Arts . Music . Visual and Performing Arts . Commercial Art and Graphic Design . Film, Video, and Photographic Arts . Studio Arts . Miscellaneous Fine Arts	. Interdisciplinary Social Sciences . Physical Fitness, Parks, Recreation, and Leisure . Philosophy and Religious Studies . Theology and Religious Studies . Psychology . Educational Psychology . Clinical Psychology . Counseling Psychology . Industrial and Organizational Psychology . Social Psychology . Miscellaneous Psychology . Criminal Justice and Fire Protection . Public Affairs, Policy, and Social Work . General Social Sciences . Economics . Anthropology and Archeology . Criminology . International Relations . Political Science and Government . Sociology . Miscellaneous Social Sciences . History . United States History	. Law . Court Reporting . Pre-law and Legal Studies . General Business . Accounting . Actuarial Sciences . Business Management and Administration . Operations, Logistics, and E-Commerce . Business Economics . Marketing and Market Research . Finance . Human Resources and Personnel Management . International Business . Management Information Systems and Statics . Miscellaneous Business and Medical Administration	. Cosmetology Services and Culinary Arts . Construction Services . Electrical and Mechanical Repairs . Transportation Sciences . Precision Production and Industrial Arts

References

Ruggles, S. IPUMS USA: Version 9.0 [dataset]. Minneapolis, MN: IPUMS, 2019 *https://doi.org*

Martin, E. (2017) Here's how much more expensive it is for you to go to college than it was for your parents. CNBC. https://www.cnbc.com

Baker, R. (2018) The Effect of Labor Market Information on Community College Students' Major Choice. EconLit, 65, 1-13. https://www.sciencedirect.com

Webber, D. A. (2014) The lifetime earnings premia of different majors: Correcting for selection based on cognitive, noncognitive, and unobserved factors. EconLit, 28, 14-23. https://reader.elsevier.com

Fuchs, V. (1994) Gary Becker: ideas about facts. JEP, 8(2), 183-192, http://www.jstor.org

Arcidiacono, P. (2011) Modeling college major choices using elicited measures of expectations and counterfactuals. EconLit, 166(1), 3-16. https.sciencedirect.com

Spence, M. (1973) Job Market Signaling. EconLit, 87(3), 355-375. https://www.jstor.org