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Wage Dispersion Between College Majors

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Introduction

The United States has benefitted from an educated workforce that has been integral to the growth in productivity and innovation in various industries. The education system, which was built to be largely public and egalitarian, allowed individuals of every background to reach their productive potential. Human capital development theorists believe that education is the key to increasing productivity. The skills taught from primary schools, on-the-job training, and institutions of higher education are treated as investments in the individual which lead to higher wages. A degree can also serve as a signaling mechanism to employers, which suggests that an individual may possess specific skills. Higher skills acquired through a college education are compensated with higher wages called the "college wage premium". The college wage premium, calculated by taking the ratio of hourly wages of college educated workers to high school educated workers, is 1.8 (James, 2012). But over the last decade wages for college graduates have been stagnant. Median weekly wages for full-time Bachelor degree holders declined slightly from $1,030 in 2000 to $1,025 in 2009 (Mishel, 2011).

This paper examines college education and its effect on wages by analyzing differences between college majors. Datasets for tens of thousands of individuals were retrieved from the Survey of Income and Program Participation which tracks fields of study in college and income. Two cohorts, each representing three-year-long periods, were compared to track the changes in earnings power based on individual field of study within college degree holding groups, and growth in earnings before and after the Great Recession. The results indicate that there is a divergence between degree types and between college majors. This paper suggests that Medicine & Dentistry, Law, Computer Science, and Engineering majors had higher earnings than other groups. During the post-Great Recession period, average wages for Bachelor degree holders

remained stagnant, but Computer Science and Engineering degrees saw wage growth. Advanced degrees saw earnings increase, particularly for majors in the Natural Sciences. Meanwhile, Advanced and Bachelor's degrees in Education and Advanced degrees in Business & Management saw their respective earnings decline in the post-Great Recession period. Furthermore, there are premiums as well as penalties for certain major-occupation matches. While earnings of Bachelor degree holders have declined, the overall investment may be worthwhile to pursue: it is much better to have a Bachelor's degree than an Associate's degree or no degree.

Section 1 will review some historic background of the relationship between higher education and economic growth. Section 2 is a literature review of prominent economic theories behind higher education and wages, and recent empirical studies of college majors. Section 3 will go over the data and methodology. Section 4 will discuss the results. And Section 5 will conclude the paper with policy recommendations and critical assessments. All figures and tables can be found in the Appendix.

1. Background

Economic Significance of Education in the US

Goldin and Katz (2008) argue in their seminal work, *The Race Between Education and Technology*, that the American education system was crucial for the country's economic development. The 20th century is often dubbed the "American Century" for the country's enormous economic, social and political progress. It was mass secondary education that drove the economic expansion. Unlike European education, which was reserved for the elite few,

American education was open, forgiving, gender neutral, and lacked universal standards. In 1960, only 17.5 percent of 17-year-olds attended high school in Britain. In contrast, in the same year the United States had a 69.5 percent graduation rate (Goldin and Katz, 2008). Mass education enabled much of the American workforce to obtain problem-solving skills, and as a result, many industries, from agriculture to high technology, benefitted from gains in human capital.

Higher education in the United States holds many of the same virtues as the secondary education system: openness, forgiveness, gender neutrality and decentralization. The National Center for Education Statistics (NCES) reports that the US had 2,582 four-year degree institutions in 2005.[1] In comparison, during the same time period, Britain and Germany had one-half and one-third, respectively, the amount of undergraduate institutions on a per capita basis (Goldin and Katz, 2008). The abundance of options allowed for greater educational mobility in the US. The application of science to industry expanded rapidly. Engineers, physicists, chemists, and biologists were demanded by various industries such as manufacturing, energy, biotechnology and agriculture. And social science fields grew in areas of immigration, city planning, and economics.

Over the last decade, wages for those with a Bachelor's degree has been stagnating (See Appendix, Figure 1) (Mishel, 2011). Moreover, since the Great Recession, the economic landscape has drastically changed the outlook for unemployment rates and wages, including those with a college degree. Prominent labor economists, Acemoglu, Autor, Goldin, Katz, and Krueger have pointed to structural changes in the economy and biases towards skilled labor are responsible for this discrepancy.

[1] http://nces.ed.gov/programs/digest/d11/tables/dt11_005.asp

2. Literature Review

Higher education, as it relates to the labor force, is said to serve two main functions: it is a signal to employers and it develops human capital stock. Signaling is a mechanism to address asymmetric information and search costs. A potential employee wishes to signal to employers their level of skill and competency which is otherwise unobservable to the employer at the time of hire. Human capital is the development and the accumulation of productive skills. Greater skills, or perceived skills through signaling, are compensated with an added wage premium above normal wages. Labor economists make extensive use of both theories in examining employment policies, and human resource allocation.

Human Capital

The study of human capital was spearheaded by Schultz (1961), Mincer (1974) and Becker (1993). The investment in human capital encapsulates many factors starting with: family and child preparation, health and nutrition, education, migration, and on-the-job training. Investments in these categories are thought to affect human capabilities and productivity. But education, in particular, has the greatest measurable effect on human capital gains. Goldin and Katz (2008) argue that the mass education movement in the United States is directly related to a century of economic growth and productivity. For example, prior to the 1960s women tended towards professions in teaching, home economics, language, and literature. Becker (1993) points to the economic advancement of women as an example of how education accelerated the growth in wages and the accumulation of human capital. Shifts in the education of women corresponded to changes in their professions. Although not on par with the earnings of men, women are now

engaged in the fields of medicine, accounting, law, and engineering more so than they were 50 years ago.

Investment in education and training increases human capital stock by imparting skills to the worker. Some types of training are more specific to certain industries than others. Becker (1993) argues that general and specific training affects wage negotiations. The costs of general training, skills developed to enhance productivity equally across all firms, are borne by employees in competitive labor markets. Thus general training is usually done at school. The costs of specific training, skills imparted to an employee that increases productivity of a single firm, are borne by both the firm and the employee, through on-the-job training and through lower initial earnings, respectively. Specific training is treated as a capital investment; where the resignation of an employee is treated as a capital loss to the firm, and termination is a capital loss to the employee. Thus, firms have the incentive to keep specifically trained employees; and employees have the incentive to stay with the employer. When demand for a specific skill-set increases, schools may begin to offer training in those areas (Becker, 1993). If specific industries are treated as individual employers, it can be said that schools in law, medicine and fashion have been administering specific training.

Workers can expect wage gains and promotions as a result of higher productivity due to the accumulation of experience and skills. Earnings profiles formulated by Mincer (1974) and Becker (1993) suggests that schooling is responsible for a significant portion of variation in earnings. The Mincer equation describes earnings as a function of the return on schooling and years of work experience, which includes a second order effect to control for declines in wages experienced later in life. Higher education is viewed as an investment, where the student forgoes current wages to enter college in the hopes of earning higher wages in the future. Human capital

accumulates quicker in youth, making the age-earnings profile steeper in the early years of employment. The accumulated skill is also said to be illiquid because an individual's abilities cannot be tangibly sold, thereby requiring a high rate of return for time and uncertainty (Becker, 1993). Also, much like capital assets, human capital depreciates with time. Skills accumulated later in life depreciate faster and has a shorter duration of use. Thus, postponement of higher education reduces the present value of earnings.

Variation in earnings between different age-earnings profiles come from a multitude of factors, many of them immeasurable. Throughout an individual's life, elements of chance, opportunity, innate biological and physiological abilities, may augment or enhance productivity and earnings. Education, a measurable element and usually a proxy for skill accumulation, is shown to increase earnings and steepen individual age-earnings profiles (Becker, 1964 and Mincer, 1974). Empirical work by Tolles (1968) on professional economists, found that, out of seven factors which include: degree type, profession, work activity, years of experience, type of employer, sex, age, and specialty, educational attainment explained 7.6 percent of the variation in earnings, making it the most influential factor of the seven characteristics. However, these results span many economic professions, from financiers to teachers, and significant variation from different job types exist.

Screening and Signaling

Asymmetric information exists in the labor market between employers and job applicants. Arrow (1973), Spence (1973) and Stiglitz (1975) pioneered work on signaling and screening mechanisms to address this information asymmetry. Stiglitz (1975) argues that employers, unaware of a potential employee's abilities, will screen for indicators of skill.

Education is typically a screening device, as professors and teachers hold a great deal of information on an individual's skill level via course work. The educational institution also acts as an impartial third party, issuing screening devices such as grades, exams, graduation, reputation of the institution, and acceptance into the institution itself. On the other hand, Spence (1973) argues that individuals, or potential employees, can signal their qualifications to employers. As long as the costs of signaling, i.e., time, tuition, and mental capacity, are compensated for in wages, an individual will pursue a signal that best maximizes their utility. Thus, highly skilled prospective employees have the incentive to obtain a signal, which would allow them to receive greater than average compensation for the particular job task.

Arrow (1973) argues that screening devices (filtering in Arrow's terms) can be independent of skill accumulation. A firm can screen for desirable signals from employees, but they may not have compatible skill-sets to do the job efficiently. Screening does not completely solve the asymmetric information problem. Even with signaling and screening devices, employers still have a poor sense of the prospective employee's ability. Actual ability is not measurable until the employer observes the worker's productivity on the job. But because an employer cannot observe actual work ability before hiring, the employer can only prejudge an applicant using past experiences based on a set of employee characteristics. Moreover, Stiglitz (1975) and Arrow (1973) demonstrate that screening leads to inequality. However, contrary to Stiglitz's assumption that screening leads to higher productivity, Arrow argues that it may lead to inefficiency as employers screen too much, which narrows the criteria for employment and diminishes the wages of non-degree holders, and even some college educated workers. This phenomenon may be already occurring, as Catherine Rampell reports in *The New York Times*, employers are requiring a college degree for occupations that once did not need one. During the

post-Great Recession period, employers ramped up qualifications for job vacancies, requiring prospective employees to acquire multiple skill-sets for less compensation, leading to an arms race between workers (Cappelli, 2012).

Students enrolling in higher education will choose their fields of study based on the association between the major and the wages of a particular industry. But the student's knowledge of industry wages is to be predicted in advance, before graduation, making information between the choice in major and future wages asymmetric. Freeman and Hirsch (2008) demonstrate that students tend to match their fields of study to the knowledge content and earnings potential of desired jobs. The supply of majors in a particular field seems to positively correlate with the return on earnings of those particular skills. To further the point, Business Management and Administration, generally known for high wages and career growth among students, is the most popular field of study (Carnevale, Strohl and Melton, 2011). These findings provide evidence that students generally try to signal their abilities to employers of particular occupations they want to enter. However, there are no college majors that perfectly connect to their respective occupation. Carnevale, Strohl and Melton (2011) report that some majors have high connectivity with their respective occupations, for example, 82 percent of nursing majors are in health practice occupations. But most majors are not linked to one particular occupation. Instead, their skills are applied to other jobs, for example, 18 percent of Liberal Arts majors hold management positions, while 19 percent of Physics majors are in Computer Science fields (Carnevale, Strohl and Melton, 2011).

Wage Premiums

As established from the age-earnings profiles, education plays a large part in explaining variation between groups of educated and non-educated workers. Currently, college degree holders earn approximately two-times the wages of non-college educated workers. However, a college degree does not guarantee higher wages. Goldin and Katz (2008) found that the college wage premium declined in the 1940s and 1970s. They find that the fluctuation in the supply of skilled labor is the most important factor affecting college wage premiums. A 10 percent increase in the supply of college graduate workers decreases the college wage premium from 5.4 to 6.1 percent. The collapse and widening of wage variation coincide with education and technological change. If the supply of educated workers outpaces technological changes, wage variation is compressed. Conversely, if technological change outpaces the supply of skilled workers, there will be greater wage variation between skilled and unskilled labor, this is called Skill-Biased Technological Change (SBTC).

Human capital economists point to SBTC as an explanation for the college wage differentials. As computer technology has advanced in the last few decades, employers demand labor with complementary skills. Autor, Katz and Krueger (1998); Autor (2010); and Wheeler (2005) argue that technological advancements in the labor market favor employment of highly skilled college educated workers, leading to wage dispersion. Autor, Katz and Krueger (1998) found that increasing investments in computers are associated with higher wage-bill share of college educated workers. This indicates that rising technological gains help increase the share of employment of the college educated. Wheeler (2005) suggests that increases in college educated labor and computer usage is associated with increasing wage dispersion. Acemoglu and Autor (2012) find that the increase in technology in conjunction with the stock of college educated

workers raises state per capita income, suggesting that technology together with higher education raise productivity. With increasing specialization of college degrees, having a background in computer science or engineering could increase wage variation within overall college degree cohorts. This may be the cause of the overall stagnant wages of Bachelor's degrees, as wages become concentrated in smaller groups with specific skill-sets.

Mishel, Bernstein and Shierholz (2009) report that roughly 60 percent of wage inequality can be explained by within-group inequality, making the explanation of wage inequality go beyond skill, education and experience. This may point to the immeasurable factors such as ability, upbringing, luck and opportunity. For instance, McCall (2000) finds that region and employment conditions (i.e., unemployment and immigration) explain a significant portion of within-group wage dispersion, while high technology sectors have a weak and ambiguous association with within-group wage dispersion.

A number of recent studies and reports parse out earnings by major fields of study. Altonji, Blom and Meghir (2012) show that engineering majors have the highest returns, and Education majors with the lowest returns. Similarly, Carnevale, Strohl and Melton (2011) report that Petroleum Engineering majors have the highest earnings, while Counseling Psychology majors have the lowest. However, when controlling for occupation, Altonji, Blom and Meghir (2012) report that the effect of college majors on earnings is significantly deflated. Specialized fields of study, such as Engineering, suffer from a high wage penalty when not linked to related occupations, more so than more general fields of study such as Education. The results in this paper also suggest the same.

3. Data and Methodology

Data was retrieved from the Survey of Income and Program Participation (SIPP), part of the US Census Bureau. The SIPP tracks individuals for three years, allowing for longitudinal studies. Cohorts from 2004 (surveyed through years 2004 to 2007), and from 2008 (surveyed from 2008 to 2011), together span from 2004 through 2011 and were used to analyze variations of earnings in the US population for seven years. The indicator for an individual's college major and degree only appear in the SIPP's second wave topical survey and is assumed to be fixed for the duration of the entire survey. The dataset only includes individuals of age 20 and above, and those having at least completed high school. Variables pertaining to race, degree type, major, and occupation are binary variables with omitted groups consolidated as all other races, high school graduates, all other majors, and all other occupations, respectively. Although the SIPP tracks individuals every month, due to technical limitations, each individual has one point of reference per year; that is, individuals in each cohort has a maximum of three points of reference over three years. It is important to note that these datasets are unbalanced.

Data from external sources were merged with the SIPP dataset to better account for occupations. Individual occupation variables were created from O*NET career pathway classifications which were matched with occupation codes in the SIPP dataset. Most O*NET classification codes matched closely with SIPP occupation codes, but some occupations had to be subjectively assessed according to in-text descriptions. The matching allowed for the creation of major-occupation interaction variables. However, due to the large size of the dataset, interactions were limited to a select number of occupations for each cohort.

Detailed descriptions of the 2004 cohort can be viewed in Appendix, Table 1. Average earnings for each category are in columns 2 through 5, and the number of individuals is listed in

the very last column. Variables with prefixes of MA, BA, and OC, denote Advanced degrees, Bachelor's degrees and occupations, respectively. The most popular Advanced degree programs for the 2004 cohort are in Education, Business & Management, Law, Medicine & Dentistry, and Engineering.[2] The least popular Advanced degrees are in Art & Architecture, Math & Statistics, Communications, Foreign Languages, and Agriculture. Referring to Column 2, the highest paying Advanced degrees (monthly earnings in 2005 dollars) are in Medicine & Dentistry ($6,760), Computer Science ($5,772), Business & Management ($5,342), Engineering ($4,935), and Communications ($4,811). The lowest earning Advanced degrees are in Education ($2,559), Psychology ($2,493), Foreign Languages ($2,481), Liberal Arts & Humanities ($2,465), and Philosophy ($2,433). The most popular Bachelor's degrees in the 2004 cohort are in Business & Management, Education, Engineering, Natural Sciences (Physics and Biology), and Liberal Arts & Humanities. The least popular Bachelor's programs are in Philosophy, Pre-professional Studies (Pre-Law and Pre-Med), and Foreign Languages. The most lucrative Bachelor's degrees are in Computer Science ($4,665), Pre-professionals ($4,470), Engineering ($4393), Math & Statistics ($4,128), and Natural Sciences ($3,930). The lowest earning Bachelor's degrees are in Art & Architecture ($2,541), Foreign Languages ($2,530), English & Literature ($2,525), Education ($2,067), and Agriculture ($1,811). The 2008 cohort described in the Appendix, Table 2, is very similar to the 2004 cohort

In order to observe individual effects of college majors on log wages, the random effects model was employed. The alternative fixed effect model will not allow us to isolate the effects of college majors since college majors are assumed to be fixed throughout the duration of the individual's lifetime. The random effects model assumes that individual-specific effects are independently distributed across the regressors. This not an invalid assumption to make. While it

[2] The major "other" is mentioned in the appendix but not in the text.

is possible that individual-specific effects may be correlated with the regressors, the correlation is weak to the extent that students seek to pursue a degree solely as a signal to employers, making individual aptitude independent from college majors within the population. Also as mentioned before, the dataset is unbalanced, but generalized least squares (GLS) methods adjust for heteroskedasticity. The regression equation is described below.

$$lnY_i = lnY_{0i} + \mathrm{bN_{it}} + \mathrm{c}N_{it}{}^2 + \alpha E_{ijt} + \beta \mathrm{M_{ij}} + \gamma O_{ijt} + \delta(M_{ij} * O_{ijt}),$$

Where Y_i represents monthly earnings of individual, i, expressed in natural log. Y_{0i} is the initial earnings capacity of the individual. N is the individual's age at time t. E are external macroeconomic indicators of the individual's state of residence and of level of observed schooling, j, at time t. M is the individual's major which is assumed to be fixed throughout time. O is the occupation of i, j and t. And M*O is the interaction between college major and observation.

4. Results

Aggregated STEM Groups

In the Appendix, Tables 3 and 4 show the results of Science, Technology, Engineering and Math (STEM) majors grouped together for the 2004 and 2008 cohorts, respectively. STEM majors include Medicine & Dentistry, Computer Science, Engineering, Math & Statistics, Natural Sciences, Nursing & Pharmacy, and Health Sciences. These fields of study are often portrayed as highly desirable and lucrative, and they are used to support human capital theories, particularly SBTC. Other fields of study, such as Business & Management and Education, were chosen based on popularity. It should be noted that the coefficients for majors are in relation to

the base group of all other omitted majors of their respective degree.[3] The R-squared for each of the four STEM group models range from 0.24 to 0.28.

The results in Table 3 indicate a divergence both between Bachelor's and Advance degrees and between college majors. A Bachelor's degree earns 50 percent and an Advanced degree earns 64.4 percent more than those with only a high school diploma. Column 1 suggests that the highest earning Advanced degrees are in Law, Business & Management and STEM. The highest earning Bachelor's degrees are in STEM and in Business & Management. Bachelor's degrees in Education, and in English & Literature earn 14.5 and 7.5 percentage points less than the base group. Occupation variables are introduced in column 2, which diminishes the explanatory power of several college majors. The most dramatic deflation occurs in Law degrees, which decline by 14.1 percentage points. This deflation could arise from the highly specialized nature of law degree holders. Column 2 could also imply that law degree holders working in unrelated occupations earn 25.4 percentage points over the base group of Advanced degree holders. While all practicing lawyers have a Law degree, not all law degree holders are practicing law, which can create a divergence in earnings potential. A similar effect occurs for Bachelor's in Education, but the effect on earnings actually inflate from -14.5 to -7.6 percentage points. Occupations in teaching earn less than most other occupations, accounting for a decline of 3.0 percentage points.[4] Education majors can be dispersed throughout many different occupations aside from teaching, which can inflate the value of the degree. Major-occupation

[3] Omitted Advanced degrees for Tables 3 and 4 include: Agriculture, Art & Architecture, Communications, Foreign Languages, Liberal Arts & Humanities, Philosophy & Religion, and "Other". Omitted Bachelor's degrees include: Agriculture & Forestry, Art & Architecture, Communications, Foreign Languages, Philosophy & Religion, Pre-professional Studies, and "Other".

[4] Recall, the base group for occupation variables are all other occupation variables not included in the regression. These omitted variables include but are not limited to: Agribusiness, Correctional Services, Counseling, Food Products & Processing, Journalism, Lodging, Logistics & Planning, Maintenance, Performing Arts, and Personal Care Services.

interaction variables are introduced in Table 5 to address skill-to-job matching and will be discussed further below.

Appendix, Table 4 shows similar results to Table 3, where the highest earning majors for the 2008 cohort were advanced degrees in Law, STEM, Business & Management; and Bachelor's degrees in STEM and Business & Management. The lowest, statistically significant, earning major is in Bachelor's in Education, which is associated with 16.2 percentage points less than the base group. Column 2 includes controls for occupation which deflates the effect of college majors on earnings in similar fashion to Table 3. For Law degrees, the deflation is quite drastic with a decline of 21.2 percentage points.

When comparing the 2004 to the 2008 cohort of Tables 3 and 4 (using column 2 unless otherwise stated), Advanced degrees in STEM saw an increase in earnings from 21.8 to 24.7 percentage points, or an increase of 2.9 percentage points; and Bachelor's in STEM also saw an increase of 2.9 percentage points. Law degrees saw earnings increase of 1.0 percentage point. And Bachelor's degrees in Business & Management increased by 3.4 percentage points. Majors that saw declines in earnings were Advanced degrees in Business & Management and in Education, which dropped by 10.6 and 0.5 percentage points, respectively. Overall, total Bachelor's degrees saw earnings increased by 1.8 percentage points, while total Advanced degrees increased by 6.6 percentage points. Tables 3 and 4 show that earnings have tended to gravitate towards Advanced degrees and STEM majors and away from Education and Business & Management majors in the latter half of the decade. The next sub-section will disaggregate the STEM majors and analyze the earnings variation within that group.

Disaggregated STEM Groups

Appendix, Tables 5 and 6 show the results of the 2004 and the 2008 cohorts disaggregated STEM majors and various fields of study which were chosen by popularity. The base group is all omitted college major groups.[5] Columns 3 and 4 control for major-occupation interactions and state-by-state macroeconomic effects, respectively. Major-occupation interaction variables, denoted by prefixes MAOC and BAOC for Advanced and Bachelor's degrees respectively, were selected based on occupations associated with selected majors and on popularity. The omitted reference state variables were selected based on how closely the state's average earnings resemble the national average: it is Louisiana for the 2004 cohort and Nebraska for the 2008 cohort. Although some states contribute highly to earnings, it is likely due to variation within each individual state's economies, and incorporating specific geographic differences within each state would be outside the scope of this paper. The R-squared for all eight of the regressions range from 0.24 to 0.30.

The results from Table 5 show earnings variation within STEM groups, with higher salaries going towards Advanced degrees in Medicine & Dentistry, Computer Science, and Engineering. Advanced degrees in the Natural Sciences, Nursing & Pharmacy, and Math & Statistics have much lower earnings as a STEM group, but these results are statistically insignificant. The same deflation in earnings occur when controlling for occupations, affecting Law degree holders the most, and inflating the earnings of Bachelor's and of Advanced degrees in Education as before. When major-occupation interactions are introduced, earnings for

[5] Omitted Advanced degrees for Tables 5 and 6 include: Agriculture, Art & Architecture, Communications, Foreign Languages, Liberal Arts & Humanities, Philosophy & Religion, Psychology, Social Science & Humanities and "Other". Omitted Bachelor's degrees include: Agriculture & Forestry, Art & Architecture, Communications, Foreign Languages, Philosophy & Religion, Pre-professional Studies, English & Literature, Psychology, Social Science & Humanities and "Other".

Medicine & Dentistry drastically deflate. The interaction term for Advanced degrees in Medicine & Dentistry and occupations in Health Services, account for an additional 44.4 percentage points in earnings to those with a degree in Medicine & Dentistry. A similar effect can be seen in major-occupation interactions in Bachelor's in Engineering and Computer Science with occupations in Information Support Services, accounting for an additional 46.8 and 37.2 percentage points, respectively. Some college majors that enter unrelated occupations receive a positive gain in earnings: Bachelor's in Engineering receive an additional 18.7 percentage points when matched with Business & Financial Management. Other matches saw a negative effect on earnings, such as Business & Financial Management with Advanced degrees in Engineering and with Bachelor's in Education, which decline by 21.3 and 11.3 percentage points, respectively. These results suggest that proper matching of occupations to appropriate skill-sets have a significant and positive sway on earnings, while non-optimal matching may lead to lower than expected earnings.

Appendix, Table 6 shows disaggregated STEM groups for the 2008 cohort. Table 6 follows closely with Table 5: column 1 shows that Advanced degree earnings tend to gravitate towards Medicine & Dentistry, Law, Computer Science, and Engineering. However, unlike the 2004 cohort, Nursing & Pharmacy, and Natural Sciences saw earnings dramatically increase to 19.4 and 19.9 percentage points greater than the base group, respectively. Column 2 shows the same pattern of earnings deflation in Advanced degrees in Law, and of earnings inflation in Bachelor's in Education. Column 3 shows that the most highly compensated job-skill match is in Bachelor's in Engineering with Information Support Services, which accounts for an additional 45.7 percentage points to earnings for those with a Bachelor's degree in Engineering. Information Support Services is also highly compensated in matches with Advanced degrees and

with Bachelor's in Computer Science, accounting for an additional 38.1 and 35.9 percentage points, respectively. Also notable is the match between Law degrees and Legal Services, which increases earnings by an additional 20.1 percentage points. The mismatch between Bachelor's in Education with occupations in Business & Financial Management, declined more severely from -11.3 percentage points (Table 5, Column 3) to -26.4 percentage points. There is a peculiar "mismatch" between Bachelor's in Business & Management with Business Analysis occupations, which are low and statistically insignificant in Table 5, now reduce earnings by 11.4 percentage points in the 2008 cohort. This effect also occurs in the interaction between Bachelor's in Natural Science with Biotechnology occupations, reducing earnings by 25.4 percentage points. These matches should be favorable to high earnings, but column 3 suggests that the reverse is true.

To compare the two cohorts, Column 3 was examined, unless otherwise specified. However note that, for most cases, there is little substantial difference between columns 2 and 3. Associate's and Bachelor's degrees saw stagnant earnings growth, by 0.3 and 2.7 percentage points, respectively. However, Advanced degrees saw earnings increase by an additional 7.6 percentage points. The most dramatic growth in earnings are in Advanced degrees in Natural Science which was statistically insignificant at 3.0 percentage points in Table 5 increasing to 17.6 percentage points in Table 6. Relatively modest growth are found in Advanced degrees in Medicine & Dentistry, and Engineering, which increase by an additional 3.7 and 2.6 (column 2) percentage points, respectively. Advanced degrees in Computer Science and Education saw slight declines in growth, by 2.9 (column 2) and by .01 percentage point, respectively. The most notable declines in Advanced degrees are in Law and in Business & Management, which saw declines of 7.5 and 10.83 (column 2) percentage points, respectively. Interestingly, Advanced

degrees in Business & Management became more sensitive to occupation controls and showed much greater deflation in earnings relative to the 2004 cohort. This could be evidence towards demands for greater job-specialization in business. Meanwhile, some Bachelor's degree majors exhibit more modest growth in earnings than some Advanced degrees. The highest earnings growth for Bachelor's degrees is in Health Sciences, which increased by 9.8 (column 1) percentage points. Bachelor's degrees in Computer Science exhibit relatively high growth, increasing by 8.5 percentage points. While Bachelor's in Engineering increased modestly by 4.4 percentage points. Bachelor's in Business & Management saw relatively low growth at 2.2 percentage points. And Math & Statistics saw negative growth, declining by 5.4 percentage points.

Overall, the results from Tables 3 through 6 suggest that earnings are diverging between Bachelor's and Advanced degrees and also in between college majors. Earnings tend to gravitate towards Advanced degrees in Medicine & Dentistry, Law, Computer Science, Engineering, and Business & Management; and in Bachelor's degrees in Computer Science, Engineering and Math & Statistics. The major-occupation variables suggest high compensation for matches between Bachelor's degrees in Computer Science and in Engineering with Information Support Services; and for degrees in Medicine & Dentistry with Health Informatics. Changes in the earnings of certain skill-sets may correspond to changes found in the economy. Earnings growth in Biotechnology in the 2008 cohort coincide with earnings growth for Bachelor's and Advanced degrees in the Natural Sciences and for Bachelor's in Health Sciences.[6] These occurrences provide evidence for human capital theory, particularly Skill-Biased Technological Change.

[6] Note that the major-occupation interaction variables for Biotechnology occupations and aforementioned degrees (with the exception for Bachelor's in the Natural Sciences), show negative, but statistically insignificant, earnings.

Majors that are dispersed throughout many occupations may see little change, or even inflation in earnings, after controlling for occupation and major-occupation matches. For instance, both Advanced degrees and Bachelor's degrees in Education see considerable inflation in earnings after the addition of these controls. And Bachelor's degrees in Math & Statistics saw relatively little change when controlling for various occupations and a major-occupation interaction terms—although this could also mean the most relevant occupation variable was unintentionally left out. Moreover, neither occupation nor the major-occupation interaction variables completely explain away the earnings of college majors, which suggest that there is still a premium for these majors even as they enter unrelated occupations. These occurrences could provide evidence for signaling theory, where just the qualification would serve as a vehicle for job entry.

Earnings have been stagnant, particularly for Bachelor's degrees, and not many majors—with the exception of Computer Science and Engineering—offer high enough premiums in earnings to make up for such low growth. Majors, such as Education, and more drastically in Advanced degrees in Business & Management, saw declines in earnings in cohort-to-cohort comparisons. This could be evidence for diminishing demand for general skill-sets. This could be an indicator of the inequality mentioned by Stiglitz and Arrow regarding signaling theory, where over-filtering, in this case for more specialized skills, lead to declining wages of some college degrees. The overall effect of these two divergences can lead to stagnant wage growth observed for Bachelor's degree holders.

The interaction term for Bachelor's in Natural Sciences show a decline of 25.4 percentage points at the 90 percent confidence interval.

5. Conclusion

Uncertainty in future wages is a significant cause for concern among college students. Stagnant incomes of many Bachelor's degree holders have forced students to rethink the role of higher education as it relates to the labor force. While Bachelor's degrees are still valuable in the labor market, the choice in major adds significant wage premiums. This paper suggests that there has been greater demand for specific skill-sets, and demand for those skills has only increased in the post-recession period.

There is evidence for both prevailing theories in human capital and signaling in this paper. Human capital theory is evidenced in the preference for degrees in Medicine & Dentistry, Law, Engineering, and Computer Science; the high premium for matches between majors and occupations; and also in the deflation in earnings of specific majors after controlling for occupation. This suggests that such majors, i.e., Medicine & Dentistry and Law, guide the individual towards specific occupations. But there still exists a relatively significant premium for these majors after controlling for occupation and major-occupation interactions. This residual could not be completely explained away by occupation variables and hence it provides evidence for signaling theory. Many students will be dispersed to occupations outside their fields of study, but there still exists a premium for those degrees. This is most readily seen in Advanced degrees in Law which has declined considerably with each subsequent control but maintains relatively high incomes. Furthermore, the inflation in earnings of Education degrees, after controlling for occupation, points to signaling as an explanation for the college wage premium. Not surprisingly, considering the lower than average wages in teaching occupations, Education majors would seek employment in other fields which inflates the value of their degree.

Critical Assessment

There is plenty of room for improvement and expansion of the research in this paper. The model was not able to explain most of the earnings variation between individuals. Roughly a quarter to a third of the variation can be explained by schooling, occupation and job-to-skill matches. This suggests that there is much more to earnings than just schooling and college majors. The model contained no individual measures of aptitude outside of the college major. If data on family wealth, college ranking, and other measures of skill were available, future research should employ them. The SIPP provides very detailed surveys, but the variables for college majors are sometimes too broad. Business & Management, for instance, could cover many sub-fields of business. The SIPP also provides over 400 variables for occupation, which required the use of O*NET to condense them into a manageable size. Consequently, this made interpretation of the occupation coefficients opaque and best understood when compared relative to other occupations. Also major-occupation interaction variables had to adhere to O*NET and SIPP limitations. Moreover, major-occupation interactions do not catch all relevant matches, due to the enormity of the dataset and to computational limitations.

Policy Recommendation

It is difficult to assess a policy recommendation to the subject matter. College majors are an individual's choice, and may not be related to future incomes for many students. Thus, it is important not to penalize against "unproductive" majors, which would further incentivize students to forego studies that best makes use of their innate skills and interests. This would cause a great deal of mismatching, for which there is a financial penalty. However evidence points to inequality that is fueled by demand for specific skill-sets in the labor market. While it is

difficult to assess what skill-sets will be in demand several years into the future, this paper supports the view that technological skill-biases, considerably favoring computer skills, are involved, and this trend may continue into the foreseeable future. Perhaps it would be best to prepare students for computer science skills before they enter college, or offer basic courses as part of the core curriculum.

Goldin and Katz (2008) suggest that historically education and the economy are intertwined, with one benefiting from the other. This paper supports this notion. But over the last decade, many groups of the highly educated have seen declines in incomes. While this paper indicates that the value of many Bachelor's degrees are diminishing, the earnings potential is far greater when compared with Associate's degrees and with high school diplomas. Furthermore, many majors are dispersed across many occupations, and workers may apply some portion of unrelated education at their jobs, adding unrealized productive value. Attrition, or the foregone development of human capital results in lost potential. A policy to reduce student debt is crucial for the development of human capital. This would encourage the accumulation of both specialized and generalized human capital stock, and would discourage attrition. While this may still result in wage inequality, it is important that the workforce has a diverse pool of skill-sets in order to seize unforeseen opportunities in the future economy.

The high unemployment rate in the post-Great Recession period enables employers to increase the qualifications for employment by demanding more specific and technical skill-sets. This also encourages wage dispersion between groups of highly educated people. To correct this imbalance, it is necessary to increase the overall demand for labor. And to achieve this, policies that increase aggregate demand are necessary. This may help increase income growth for all workers; which has been long overdue after a decade of stagnant wages.

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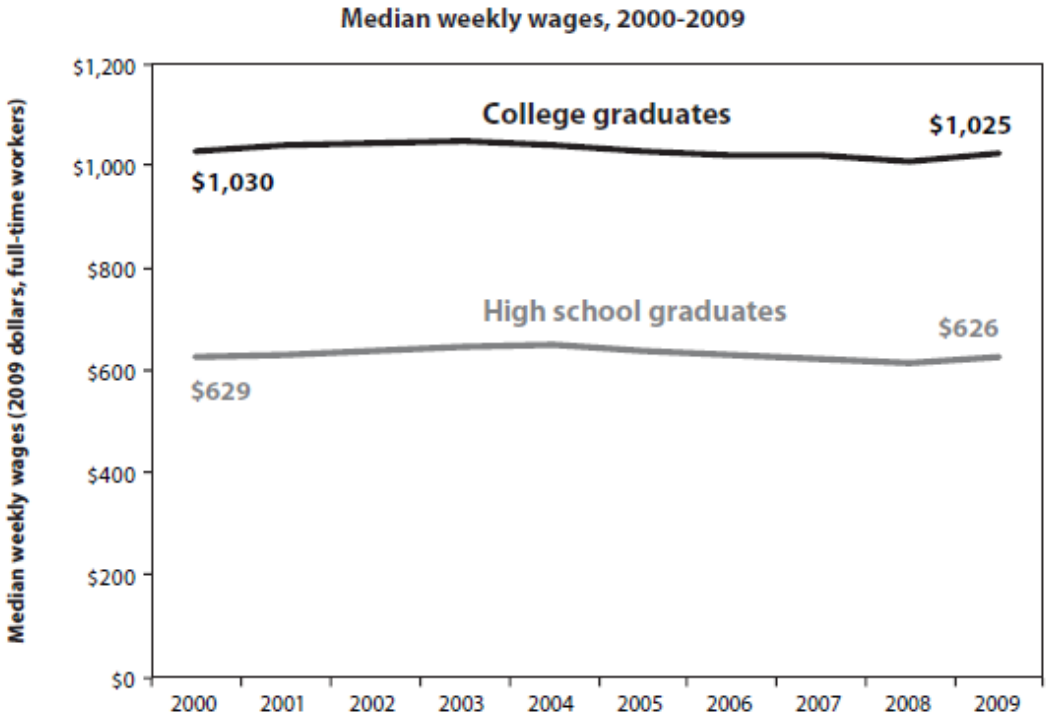
Appendix

Figure 1



Source: Mishel, Lawrence. "Education is Not the Cure for High Unemployment or for Income Inequality." *Economic Policy Institute*.

Table 1. Description of 2004 cohort.

	Average earnings 2004-07	2004	2005	2006	2007	N_2004
White	1842.21	1713.63	1851.47	1991.86	2035.45	59424
Black	1325.23	1257.08	1352.01	1356.17	1449.88	8556
Asian	2311.49	2042.35	2242.80	3003.04	2586.19	2484
Other Race	1514.16	1380.81	1504.27	1713.94	1713.15	2507
Male	2337.52	2165.45	2338.12	2572.14	2580.82	34115
Female	1295.99	1215.94	1293.13	1389.45	1437.77	38856
MA_Medicine/Dentistry	6760.54	6474.30	6615.61	7487.22	7093.48	386
MA_Computer and Information Sciences	5772.37	4989.30	5726.22	7114.06	6570.23	187
MA_Business/Management	5342.80	5082.40	5254.76	5841.96	5599.02	862
MA_Engineering	4935.59	4438.82	4955.92	5396.75	5773.67	325
MA_Communications	4811.49	3889.50	5148.81	5972.03	5077.51	64
MA_Law	4646.76	4171.14	4856.54	4720.06	5449.15	436
MA_Math/Statistics	4057.01	3360.20	4289.66	4597.57	4789.71	65
MA_Nature Sciences(Biological and Physical)	3870.53	3784.10	3728.24	3906.58	4436.43	255
MA_other	3642.39	3352.76	3863.06	3723.90	3953.64	967
MA_Social Sciences/History	3010.81	2688.44	3109.59	3273.38	3296.43	178
MA_Nursing/Pharmacy/Public Health	2917.87	2669.20	3141.22	2851.84	3321.85	205
MA_Agriculture	2657.33	3453.48	2794.96	1211.04	1690.58	42
MA_Art/Architecture	2593.73	2376.47	2706.18	2991.24	2431.29	95
MA_English/Literature	2562.77	2255.49	2490.17	3193.44	3024.79	97
MA_Education	2559.46	2424.04	2483.99	2834.02	2739.40	1354
MA_Psychology	2493.53	2860.50	2405.54	2115.10	2085.71	252
MA_Foreign Languages	2481.71	2537.45	3355.81	1887.31	1736.15	44
MA_Liberal Arts/Humanities	2465.85	2239.69	2574.94	3009.11	2156.16	105
MA_Philosophy/Religion/Theology	2433.77	2372.19	2567.08	2393.91	2404.28	122
BA_Agriculture/Forestry	1811.20	1661.62	1730.39	2219.07	1838.63	231
BA_Art/Architecture	2541.41	2360.15	2602.55	2913.47	2469.73	471
BA_Business/Management	3495.67	3308.35	3491.93	3748.58	3738.67	3185
BA_Communications	3323.44	2803.51	3477.43	3951.54	3719.39	458
BA_Computer and Information Sciences	4665.46	4344.49	4583.38	5340.41	4854.22	531
BA_Education	2067.82	1922.15	2078.41	2272.99	2209.97	2461
BA_Engineering	4393.32	4057.57	4477.54	4679.54	4806.29	1331
BA_English/Literature	2525.64	2280.52	2599.76	2835.47	2678.28	560

BA_Foreign Languages	2530.18	2042.93	2792.16	2760.15	3219.33	139
BA_Health Sciences	3011.52	2765.55	2973.14	3361.95	3467.42	960
BA_Liberal Arts/Humanities	3016.76	2873.74	2912.52	3255.61	3346.44	960
BA_Math/Statistics	4128.84	3605.06	3934.30	5002.56	5172.43	367
BA_Nature Sciences(Biological and Physical)	3930.24	3589.04	3935.32	4236.71	4592.29	1117
BA_Philosophy/Religion/Theology	2840.18	2412.14	2999.58	2736.26	4046.34	202
BA_Pre-Professional	4470.13	4683.57	4219.75	4343.57	4493.95	159
BA_Psychology	2664.12	2562.11	2703.65	2758.27	2758.74	787
BA_Social Sciences/History	3002.73	2646.99	3119.34	3305.30	3420.27	779
BA_Other	3419.00	3196.68	3489.58	3634.41	3663.90	2938
OC_Administrative and Information Support	2704.79	2336.36	2804.13	3056.32	3355.87	4622
OC_Agribusiness Systems	1846.85	1404.99	1940.64	2559.92	2620.72	877
OC_Animal Systems	3048.99	2777.41	3249.87	3172.16	3398.83	910
OC_Audio and Video Technology and Film	4356.53	3892.66	4641.85	4638.11	4908.06	523
OC_Banking and Related Services	2172.82	1996.48	2333.71	2369.74	2202.14	327
OC_Biotechnology Research and Development	5374.68	4172.22	5528.74	6535.03	8172.19	119
OC_Business Analysis	6139.87	5646.02	6012.80	6517.43	7424.72	669
OC_Business Financial Management and Accounting	4311.68	3769.09	4546.11	4899.64	4869.88	4988
OC_Business, Management and Administration	5347.13	4665.68	5423.50	6638.68	5399.99	311
OC_Buying and Merchandising	2005.32	1601.53	2413.60	2384.08	2712.28	2296
OC_Construction	3046.35	2683.69	3130.10	3445.23	3655.82	3509
OC_Consumer Services	3931.35	3463.61	3910.92	4614.00	4447.87	177
OC_Correction Services	4463.86	4149.75	4272.26	5242.74	5091.69	45
OC_Counseling and Mental Health Services	3121.76	2722.58	3380.64	3454.29	3485.43	305
OC_Diagnostic Services	4322.46	3657.24	4382.85	5144.73	5460.44	231
OC_Emergency and Fire Management Services	2630.96	2306.89	2752.13	2911.64	3179.02	819
OC_Engineering and Technology	5606.16	5077.10	5729.14	6010.82	6366.47	969
OC_Environmental Service Systems	2364.75	2127.30	2438.10	2615.35	2729.92	509
OC_Facility and Mobile Equipment Maintenance	2751.29	2465.03	2938.77	3031.73	3018.60	620
OC_Family and Community Services	2564.81	2120.70	2676.38	3237.38	3229.09	1297

OC_Financial and Investment Planning	5658.01	4904.11	5625.43	6272.76	7278.78	307
OC_Food Products and Processing Systems	2539.52	2142.78	2812.02	2751.90	3304.18	90
OC_Health Informatics	3626.37	3147.92	3863.46	4124.88	4287.52	2759
OC_Information Support and Services	5239.11	4666.66	5260.20	5937.00	5858.28	828
OC_Insurance Services	4023.94	3559.65	4034.79	4895.16	4334.01	178
OC_Journalism and Broadcasting	3695.92	3224.78	3808.29	3585.05	5067.11	83
OC_Law Enforcement Services	3874.99	3558.47	3992.74	4313.58	4032.49	292
OC_Legal Services	6458.89	5739.84	6424.80	7285.56	7951.03	326
OC_Lodging	1678.42	1386.22	1820.39	2053.87	2254.38	2606
OC_Logistics Planning and Management Services	2920.85	2587.47	3030.88	3417.53	3333.40	1451
OC_Maintenance, Installation and Repair	3127.07	2816.06	3146.75	3341.91	3836.74	771
OC_Manufacturing Production Process Development	1606.87	1593.11	1354.89	1395.36	2271.41	13
OC_Natural Resources Systems	2157.22	1937.26	2206.49	2400.16	2549.36	240
OC_Performing Arts	2076.77	1769.26	2164.50	2403.59	2613.26	631
OC_Personal Care Services	1367.48	1179.81	1459.79	1747.70	1635.99	593
OC_Printing Technology	3213.39	2911.94	2996.50	4643.55	2727.90	5
OC_Production	2503.96	2274.23	2524.97	2762.05	2979.14	2248
OC_Professional Sales and Marketing	4329.31	3851.82	4517.39	4736.40	5152.11	1339
OC_Professional Support Services	2921.49	2321.86	3059.08	4222.96	3282.53	108
OC_Recreation, Amusements and Attractions	2743.60	2478.35	2340.00	3213.41	3593.73	17
OC_Regulation	3445.31	3469.94	3396.77	3260.65	3672.74	46
OC_Restaurants and Food/Beverage Services	1397.26	1123.13	1636.82	1953.98	1877.27	1610
OC_Science and Math	5153.40	4553.98	5436.06	5803.38	5720.17	98
OC_Security and Protective Services	3390.90	2165.38	4293.31	4330.35	5834.98	82
OC_Teaching/Training	2924.88	2357.72	3156.94	3522.77	3698.32	2732
OC_Telecommunications	2271.40	1939.68	2314.50	3180.36	#DIV/0!	3
OC_Therapeutic Services	2811.27	2569.65	3008.65	2972.03	3179.68	359
OC_Transportation Operations	2791.15	2625.07	2896.28	3043.90	2959.95	177

Table 2. Description of 2008 cohort

	average earnings 2008-11	2008	2009	2010	2011	N_2008
Male	2661.55	2635.28	2564.68	2681.64	2797.97	33139
Female	1623.66	1612.18	1580.03	1620.38	1696.97	37413
White	2160.85	2155.72	2097.74	2157.51	2248.90	56861
Black	1592.85	1588.25	1521.46	1612.20	1667.87	8180
Asian	2816.11	2609.65	2708.27	2913.36	3152.02	3046
Other Race	1665.54	1675.52	1556.47	1684.22	1766.79	2465
MA_Agriculture	2512.33	2215.43	2566.30	2866.81	2479.41	36
MA_Art/Architecture	3475.66	3461.66	3260.96	3544.49	3672.93	89
MA_Business/Management	6107.49	6032.77	5803.50	6399.13	6260.98	934
MA_Communications	3325.52	3388.72	3425.04	2930.69	3537.74	74
MA_Computer and Information Sciences	6593.16	6595.36	6361.39	6869.54	6564.19	208
MA_Education	3133.81	3251.78	3135.55	3048.06	3067.69	1431
MA_Engineering	5765.01	5862.63	5444.89	5765.20	6009.01	395
MA_English/Literature	2764.50	2810.52	2866.72	2722.42	2627.38	116
MA_Foreign Languages	2979.76	3544.56	2338.63	2413.35	3533.85	37
MA_Law	6048.72	6323.88	5993.27	5719.81	6091.46	492
MA_Liberal Arts/Humanities	3310.78	3460.97	3302.16	3445.30	2997.90	115
MA_Math/Statistics	4897.34	4567.72	4952.02	5025.44	5146.97	104
MA_Medicine/Dentistry	7682.71	6974.60	7766.76	8021.49	8233.59	449
MA_Nature Sciences(Biological and Physical)	4940.91	4823.04	4924.07	5035.49	5017.63	255
MA_Nursing/Pharmacy/Public Health	4888.35	4574.51	4911.41	4921.44	5233.32	234
MA_Philosophy/Religion/Theology	2737.31	2790.62	2735.82	2601.20	2816.65	109
MA_Psychology	3219.14	3514.10	3119.29	2888.08	3282.45	274
MA_Social Sciences/History	3437.12	3537.73	3079.00	3630.77	3517.49	224
MA_other	4239.36	4133.97	4293.79	4179.53	4383.97	1104
BA_Agriculture/Forestry	3054.33	2921.60	2975.14	3153.44	3218.66	236
BA_Art/Architecture	2704.82	2759.82	2666.22	2509.46	2884.89	491
BA_Business/Management	4309.31	4307.18	4152.88	4386.99	4416.33	3367
BA_Communications	3794.13	3505.58	3630.39	3938.87	4256.37	497

BA_Computer and Information Sciences	5818.29	5627.09	5685.50	5891.03	6167.32	588
BA_Education	2387.72	2481.51	2340.66	2297.31	2416.36	2583
BA_Engineering	5410.52	5318.21	5221.42	5467.36	5708.45	1454
BA_English/Literature	3081.74	3147.11	2977.92	2973.53	3233.23	570
BA_Foreign Languages	3591.05	3576.84	3479.70	3725.33	3597.82	142
BA_Health Sciences	3917.40	3790.07	3931.04	3955.56	4044.33	963
BA_Liberal Arts/Humanities	3522.68	3495.46	3374.73	3596.25	3653.17	1019
BA_Math/Statistics	4063.48	4133.04	3930.37	3995.59	4196.70	399
BA_Nature Sciences(Biological and Physical)	4604.93	4309.20	4471.74	4870.32	4890.08	1145
BA_Philosophy/Religion/Theology	3387.90	3222.24	3229.98	3542.23	3632.76	215
BA_Pre-Professional	5750.70	5715.80	6460.06	5275.12	5444.89	149
BA_Psychology	3206.14	3166.05	3198.38	3248.51	3226.14	838
BA_Social Sciences/History	3590.55	3699.85	3521.41	3535.16	3582.85	996
BA_Other	3962.63	3923.75	3794.38	3966.09	4213.51	3257
OC_Administrative and Information Support	2999.95	2899.91	2915.94	3040.34	3219.53	4215
OC_Agribusiness Systems	1829.67	1701.30	1820.39	1956.73	1911.92	837
OC_Animal Systems	3526.20	3235.53	3345.46	3780.59	4010.41	816
OC_Audio and Video Technology and Film	4715.54	4523.72	4350.86	4653.21	5461.58	430
OC_Banking and Related Services	2684.48	2366.90	2775.59	2724.71	3033.61	261
OC_Biotechnology Research and Development	7563.59	7152.30	7119.82	7901.58	8359.47	118
OC_Business Analysis	7320.52	6974.31	7036.22	7552.16	7943.10	718
OC_Business Financial Management and Accounting	5315.02	5087.51	5138.00	5560.80	5629.40	4634
OC_Business, Management and Administration	6768.34	6725.34	6123.22	6870.13	7512.05	319
OC_Buying and Merchandising	2147.31	1948.11	2034.42	2308.98	2438.90	2050
OC_Construction	3438.10	3256.20	3425.58	3457.11	3768.10	3103
OC_Consumer Services	4316.43	4257.28	4181.90	4422.58	4465.62	189

OC_Correction Services	5778.30	5879.97	6143.13	5409.30	5406.52	53
OC_Counseling and Mental Health Services	4216.73	4129.08	4156.96	4063.55	4562.90	258
OC_Diagnostic Services	5281.85	4911.90	5146.98	5340.77	6009.47	254
OC_Emergency and Fire Management Services	3361.84	3206.86	3286.99	3369.86	3692.92	781
OC_Engineering and Technology	6873.93	6746.35	6799.33	6811.72	7203.58	927
OC_Environmental Service Systems	2711.74	2571.29	2692.49	2792.75	2869.42	404
OC_Facility and Mobile Equipment Maintenance	3263.65	3170.80	3220.56	3292.55	3429.26	503
OC_Family and Community Services	3055.16	2889.41	2942.60	3112.69	3387.59	1287
OC_Financial and Investment Planning	7305.34	7041.30	6798.45	7734.43	7828.99	262
OC_Food Products and Processing Systems	3116.86	3246.06	2847.72	3085.18	3362.10	81
OC_Health Informatics	4428.21	4169.46	4342.98	4557.55	4769.64	2777
OC_Information Support and Services	6793.00	6356.54	6656.32	7064.34	7329.61	934
OC_Insurance Services	4896.30	4777.14	5406.38	4751.18	4581.91	189
OC_Journalism and Broadcasting	4398.51	4653.57	4546.73	3945.55	4472.65	66
OC_Law Enforcement Services	5214.49	5215.73	5205.05	5107.95	5345.23	261
OC_Legal Services	9031.75	8959.48	9032.46	8767.77	9435.72	338
OC_Lodging	1778.14	1647.99	1723.39	1867.48	1965.11	2427
OC_Logistics Planning and Management Services	3060.44	2944.08	3024.44	3094.44	3252.78	1311
OC_Maintenance, Installation and Repair	3958.94	3761.45	3958.90	4076.55	4149.01	697
OC_Manufacturing Production Process Development	3722.97	2560.00	3931.45	4309.02	5821.22	8
OC_Natural Resources Systems	2547.57	2327.18	2686.66	2509.76	2807.44	210
OC_Performing Arts	2060.21	1851.06	1991.99	2206.60	2326.09	550
OC_Personal Care Services	1544.43	1468.68	1480.32	1578.12	1684.47	585
OC_Printing Technology	4712.43	3821.95	4983.84	5352.42	6907.26	8

OC_Production	2815.46	2599.05	2768.95	2886.81	3145.87	1667
OC_Professional Sales and Marketing	4741.74	4546.67	4547.51	4829.93	5181.44	1207
OC_Professional Support Services	3455.54	3138.07	3102.92	3562.55	4256.30	91
OC_Recreation, Amusements and Attractions	3422.41	3414.12	2270.23	4593.85	4951.40	9
OC_Regulation	4107.35	4326.67	3856.76	4111.19	4039.41	52
OC_Restaurants and Food/Beverage Services	1440.57	1305.53	1395.27	1535.00	1659.02	1637
OC_Science and Math	5922.70	5627.34	5646.23	5912.44	6530.13	98
OC_Security and Protective Services	3530.27	3775.50	3517.54	3494.57	3239.35	66
OC_Teaching/Training	3626.55	3439.64	3558.66	3680.60	3924.62	2893
OC_Telecommunications	3570.63	3698.06	3672.48	3091.79	3789.59	7
OC_Therapeutic Services	3455.63	3323.93	3345.11	3503.31	3747.67	330
OC_Transportation Operations	3058.88	3257.59	3048.54	2923.34	2906.46	182

Table 3. Effects of Various College Majors on Earnings: Aggregated STEM majors for the 2004 cohort.

VARIABLES	(1) lnearnings	(2) lnearnings
age	0.113***	0.109***
	(0.00168)	(0.00165)
age sq	-0.00121***	-0.00117***
	(1.92e-05)	(1.89e-05)
male	0.363***	0.376***
	(0.00727)	(0.00744)
white	0.100***	0.0868***
	(0.00909)	(0.00891)
AS	0.127***	0.112***
	(0.00826)	(0.00814)
BA	0.500***	0.466***
	(0.0122)	(0.0121)
MA_plus	0.643***	0.618***
	(0.0193)	(0.0191)
ma_stem	0.240***	0.218***
	(0.0298)	(0.0294)
ma_businessmanagement	0.273***	0.211***
	(0.0338)	(0.0331)
ma_education	0.0483	0.0858***
	(0.0315)	(0.0310)
ma_psychology	-0.0228	-0.00278
	(0.0617)	(0.0603)
ma_socialscienceshistory	-0.0285	-0.0206
	(0.0679)	(0.0663)
ma_law	0.398***	0.254***
	(0.0468)	(0.0506)
ba_stem	0.145***	0.121***
	(0.0184)	(0.0182)
ba_businessmanagement	0.0889***	0.0571***
	(0.0185)	(0.0182)
ba_education	-0.145***	-0.0762***
	(0.0227)	(0.0228)
ba_liberalartshumanities	-0.0221	-0.0120
	(0.0309)	(0.0303)
ba_psychology	-0.0379	-0.0249
	(0.0339)	(0.0331)
ba_socialscienceshistory	-0.0498	-0.0326
	(0.0328)	(0.0321)
ba_englishliterature	-0.0753*	-0.0387
	(0.0388)	(0.0380)

oc_businessfinancialmanagementan		0.226***
		(0.00823)
oc_businessanalysis		0.375***
		(0.0175)
oc_administrativeandinformations		0.0748***
		(0.00812)
oc_construction		0.138***
		(0.0105)
oc_healthinformatics		0.150***
		(0.0116)
oc_teachingtraining		-0.0305**
		(0.0130)
oc_audioandvideotechnologyandfil		0.156***
		(0.0216)
oc_biotechnologyresearchanddevel		0.147***
		(0.0518)
oc_businessmanagementandadminist		0.321***
		(0.0262)
oc_diagnosticservices		0.312***
		(0.0297)
oc_emergencyandfiremanagementser		0.0162
		(0.0182)
oc_engineeringandtechnology		0.252***
		(0.0169)
oc_financialandinvestmentplannin		0.310***
		(0.0266)
oc_legalservices		0.297***
		(0.0348)
Constant	4.839***	4.875***
	(0.0360)	(0.0353)
Observations	84,905	84,905
Number of fullpersonid	40,064	40,064

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Column 1 controls for select majors and demographic factors, with all selected variables shown. The base group is all omitted majors. Omitted Advanced degrees include: Agriculture, Art & Architecture, Communications, Foreign Languages, Liberal Arts & Humanities, Philosophy & Religion, and "Other". Omitted Bachelor's degrees include: Agriculture & Forestry, Art & Architecture, Communications, Foreign Languages, Philosophy & Religion, Pre-professional Studies, and "Other". Column 2 controls for occupation with all selected variables shown.

Table 4. Effects of Various College Majors on Earnings for the 2008 cohort (STEM majors aggregated)

VARIABLES	(1) lnearnings	(2) lnearnings
tage	0.109***	0.105***
	(0.00170)	(0.00165)
tagesq	-0.00114***	-0.00110***
	(1.88e-05)	(1.84e-05)
male	0.355***	0.374***
	(0.00771)	(0.00782)
white	0.0893***	0.0740***
	(0.00950)	(0.00923)
AS	0.138***	0.115***
	(0.00883)	(0.00864)
BA	0.524***	0.484***
	(0.0128)	(0.0126)
MA_plus	0.707***	0.684***
	(0.0190)	(0.0188)
ma_stem	0.290***	0.247***
	(0.0294)	(0.0287)
ma_businessmanagement	0.194***	0.105***
	(0.0340)	(0.0331)
ma_education	0.000819	0.0807***
	(0.0316)	(0.0308)
ma_psychology	-0.0152	0.00706
	(0.0623)	(0.0603)
ma_socialscienceshistory	0.0374	0.0590
	(0.0653)	(0.0632)
ma_law	0.476***	0.264***
	(0.0464)	(0.0493)
ba_stem	0.195***	0.150***
	(0.0178)	(0.0174)
ba_businessmanagement	0.147***	0.0912***
	(0.0191)	(0.0186)
ba_education	-0.162***	-0.0549**
	(0.0234)	(0.0231)
ba_liberalartshumanities	-0.0358	-0.0188
	(0.0314)	(0.0305)
ba_psychology	-0.0458	-0.0354
	(0.0341)	(0.0331)
ba_socialscienceshistory	-0.0467	-0.0366
	(0.0313)	(0.0304)
ba_englishliterature	-0.0339	0.0228
	(0.0410)	(0.0398)

oc_businessfinancialmanagementan		0.345***
		(0.00924)
oc_businessanalysis		0.457***
		(0.0192)
oc_administrativeandinformations		0.115***
		(0.00896)
oc_construction		0.176***
		(0.0121)
oc_healthinformatics		0.250***
		(0.0118)
oc_teachingtraining		-0.106***
		(0.0125)
oc_audioandvideotechnologyandfil		0.0945***
		(0.0249)
oc_biotechnologyresearchanddevel		0.375***
		(0.0527)
oc_businessmanagementandadminist		0.434***
		(0.0280)
oc_diagnosticservices		0.340***
		(0.0306)
oc_emergencyandfiremanagementser		0.0624***
		(0.0198)
oc_engineeringandtechnology		0.376***
		(0.0186)
oc_financialandinvestmentplannin		0.508***
		(0.0318)
oc_legalservices		0.453***
		(0.0355)
Constant	5.003***	5.027***
	(0.0375)	(0.0366)
Observations	111,413	111,413
Number of fullpersonid	40,589	40,589

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Column 1 controls for select majors and demographic factors, with all selected variables shown. The base group is all omitted majors. Omitted Advanced degrees include: Agriculture, Art & Architecture, Communications, Foreign Languages, Liberal Arts & Humanities, Philosophy & Religion, and "Other". Omitted Bachelor's degrees include: Agriculture & Forestry, Art & Architecture, Communications, Foreign Languages, Philosophy & Religion, Pre-professional Studies, and "Other". Column 2 controls for occupation with all selected variables shown.

Table 5. Effects of Various College Majors on Earnings for the 2004 cohort (STEM Majorsdisaggregated)

VARIABLES	(1) lnearnings	(2) lnearnings	(3) lnearnings	(4) lnearnings
age	0.113***	0.109***	0.109***	0.109***
	(0.00168)	(0.00165)	(0.00164)	(0.00164)
age sq	-0.00121***	-0.00117***	-0.00116***	-0.00116***
	(1.92e-05)	(1.89e-05)	(1.88e-05)	(1.88e-05)
male	0.360***	0.373***	0.372***	0.372***
	(0.00729)	(0.00746)	(0.00746)	(0.00742)
white	0.102***	0.0880***	0.0882***	0.102***
	(0.00908)	(0.00890)	(0.00889)	(0.00909)
AS	0.127***	0.111***	0.111***	0.106***
	(0.00825)	(0.00812)	(0.00811)	(0.00810)
BA	0.478***	0.450***	0.448***	0.433***
	(0.0119)	(0.0118)	(0.0118)	(0.0118)
MA_plus	0.623***	0.604***	0.603***	0.580***
	(0.0176)	(0.0175)	(0.0175)	(0.0175)
ma_computer&informationscience	0.212***	0.213***	0.160**	0.146**
	(0.0612)	(0.0599)	(0.0678)	(0.0675)
ma_engineering	0.132**	0.0881*	0.102	0.0988
	(0.0541)	(0.0530)	(0.0670)	(0.0668)
ma_mathstatistics	0.00126	0.00386	0.0149	0.0292
	(0.110)	(0.108)	(0.109)	(0.108)
ma_medicine&dentistry	0.650***	0.609***	0.303***	0.305***
	(0.0506)	(0.0499)	(0.0735)	(0.0732)
ma_natural sciences	0.0698	0.0538	0.0303	0.0358
	(0.0578)	(0.0567)	(0.0585)	(0.0582)
ma_nursing& pharmacy	0.0961	0.0712	0.0722	0.0602
	(0.0655)	(0.0643)	(0.0644)	(0.0640)
ma_business&management	0.263***	0.204***	0.195***	0.188***
	(0.0332)	(0.0326)	(0.0379)	(0.0377)
ma_education	0.0490	0.0842***	0.0833***	0.0931***
	(0.0308)	(0.0303)	(0.0307)	(0.0306)
ma_law	0.403***	0.260***	0.256***	0.248***
	(0.0462)	(0.0501)	(0.0608)	(0.0605)
ba_computer&informationscience	0.254***	0.239***	0.112***	0.101***
	(0.0358)	(0.0351)	(0.0390)	(0.0389)
ba_engineering	0.273***	0.207***	0.135***	0.134***
	(0.0278)	(0.0278)	(0.0299)	(0.0298)
ba_healthsciences	0.0489*	0.0221	0.0280	0.0330
	(0.0289)	(0.0287)	(0.0296)	(0.0295)
ba_natural sciences	0.0355	0.0249	0.0185	0.0163
	(0.0289)	(0.0283)	(0.0293)	(0.0292)
ba_math&statistics	0.153***	0.140***	0.145***	0.127***
	(0.0472)	(0.0462)	(0.0462)	(0.0460)
ba_business&management	0.112***	0.0729***	0.0600***	0.0632***
	(0.0182)	(0.0179)	(0.0198)	(0.0197)

ba_education	-0.124***	-0.0656***	-0.0581**	-0.0329
	(0.0222)	(0.0222)	(0.0228)	(0.0227)
oc_bus&financial mgmt		0.229***	0.229***	0.224***
		(0.00824)	(0.00920)	(0.00918)
oc_businessanalysis		0.379***	0.389***	0.383***
		(0.0175)	(0.0197)	(0.0197)
oc_healthinformatics		0.144***	0.138***	0.142***
		(0.0119)	(0.0120)	(0.0120)
oc_teaching&training		-0.0219*	-0.0152	-0.0189
		(0.0130)	(0.0131)	(0.0131)
oc_biotechnology		0.184***	0.266***	0.270***
		(0.0520)	(0.0707)	(0.0705)
oc_bus mgmt & admin		0.324***	0.333***	0.329***
		(0.0262)	(0.0262)	(0.0261)
oc_diagnosticservices		0.313***	0.322***	0.325***
		(0.0297)	(0.0297)	(0.0296)
oc_engineering&technology		0.253***	0.284***	0.280***
		(0.0172)	(0.0185)	(0.0184)
oc_financial& investment planning		0.314***	0.325***	0.316***
		(0.0266)	(0.0267)	(0.0266)
oc_legalservices		0.298***	0.306***	0.296***
		(0.0347)	(0.0410)	(0.0409)
maoc_legalservices_ma_law			0.00209	0.0156
			(0.0763)	(0.0760)
baoc_engineering_ba_business			-0.135*	-0.128
			(0.0785)	(0.0783)
baoc_infosupportsrvce_ba_comp			0.372***	0.364***
			(0.0495)	(0.0494)
baoc_infosupportsrvce_ba_engineer			0.468***	0.444***
			(0.0659)	(0.0657)
maoc_busfinclmgmt_ma_engineer			-0.213**	-0.220**
			(0.108)	(0.108)
baoc_busfinclmgmt_ba_educ			-0.113**	-0.112**
			(0.0520)	(0.0518)
baoc_busfincl mgmt_ba_engi			0.187***	0.188***
			(0.0531)	(0.0529)
maoc_healthinfo_ma_medicine			0.444***	0.450***
			(0.0781)	(0.0779)
Constant	4.842***	4.877***	4.880***	4.869***
	(0.0359)	(0.0353)	(0.0352)	(0.0556)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Each model includes 84,905 observations and 40,064 individuals. The base group for college major variables is all other majors that were omitted from the model (see footnote 5 on page 17 for details). Column 2 includes controls for occupation, with only select variables shown. Column 3 shows major-occupation interactions, with only select variables shown. Column 4 controls for 50 US States with none of the variables shown.

Table 6. Effects of Various College Majors on Earnings for the 2008 cohort (STEM Majors disaggregated)

VARIABLES	(1) lnearnings	(2) lnearnings	(3) lnearnings	(4) lnearnings
age	0.109***	0.104***	0.104***	0.105***
	(0.00170)	(0.00165)	(0.00165)	(0.00164)
age sq	-0.00114***	-0.00110***	-0.00110***	-0.00110***
	(1.88e-05)	(1.83e-05)	(1.83e-05)	(1.82e-05)
Male	0.349***	0.366***	0.363***	0.362***
	(0.00778)	(0.00789)	(0.00788)	(0.00784)
White	0.0918***	0.0761***	0.0770***	0.1000***
	(0.00950)	(0.00923)	(0.00921)	(0.00942)
AS	0.138***	0.114***	0.114***	0.110***
	(0.00882)	(0.00862)	(0.00861)	(0.00858)
BA	0.512***	0.476***	0.475***	0.460***
	(0.0120)	(0.0118)	(0.0118)	(0.0118)
MA_plus	0.697***	0.682***	0.679***	0.661***
	(0.0173)	(0.0171)	(0.0171)	(0.0171)
ma_computer & information science	0.202***	0.184***	0.0242	0.00893
	(0.0623)	(0.0604)	(0.0673)	(0.0670)
ma_engineering	0.176***	0.114**	0.107*	0.0977
	(0.0532)	(0.0516)	(0.0646)	(0.0644)
ma_math & statistics	0.0666	0.118	0.108	0.114
	(0.0973)	(0.0942)	(0.0943)	(0.0938)
ma_medicine & dentistry	0.640***	0.555***	0.340***	0.346***
	(0.0494)	(0.0483)	(0.0688)	(0.0686)
ma_natural sciences	0.199***	0.181***	0.176***	0.162**
	(0.0647)	(0.0629)	(0.0656)	(0.0653)
ma_nursing & pharmacy	0.194***	0.116**	0.120**	0.119**
	(0.0589)	(0.0574)	(0.0574)	(0.0571)
ma_business & management	0.185***	0.0957***	0.0578	0.0616*
	(0.0335)	(0.0326)	(0.0365)	(0.0363)
ma_education	-0.00179	0.0753**	0.0832***	0.0772**
	(0.0309)	(0.0302)	(0.0305)	(0.0303)
ma_law	0.472***	0.259***	0.181***	0.159***
	(0.0459)	(0.0488)	(0.0578)	(0.0576)
ba_computer & information science	0.340***	0.334***	0.197***	0.189***
	(0.0367)	(0.0356)	(0.0400)	(0.0399)
ba_engineering	0.320***	0.219***	0.179***	0.171***
	(0.0283)	(0.0280)	(0.0348)	(0.0347)
ba_healthsciences	0.147***	0.0853***	0.0995***	0.113***
	(0.0303)	(0.0298)	(0.0305)	(0.0304)
ba_natural sciences	0.0910***	0.0677**	0.0645**	0.0528*
	(0.0308)	(0.0299)	(0.0313)	(0.0312)
ba_math&statistics	0.106**	0.0960**	0.0910*	0.0786
	(0.0506)	(0.0490)	(0.0490)	(0.0488)
ba_business&management	0.161***	0.101***	0.0822***	0.0836***
	(0.0185)	(0.0180)	(0.0200)	(0.0200)

ba_education	-0.152***	-0.0515**	-0.0306	-0.0158
	(0.0227)	(0.0223)	(0.0228)	(0.0227)
oc_bus&financial mgmt		0.350***	0.352***	0.348***
		(0.00925)	(0.0104)	(0.0104)
oc_businessanalysis		0.460***	0.509***	0.500***
		(0.0192)	(0.0215)	(0.0214)
oc_health informatics		0.252***	0.247***	0.249***
		(0.0121)	(0.0122)	(0.0122)
oc_teaching&training		-0.0987***	-0.0967***	-0.0981***
		(0.0126)	(0.0126)	(0.0126)
oc_biotechnology		0.407***	0.516***	0.520***
		(0.0530)	(0.0676)	(0.0674)
oc_business mgmt & admin		0.439***	0.445***	0.445***
		(0.0280)	(0.0287)	(0.0286)
oc_diagnosticservices		0.350***	0.360***	0.361***
		(0.0307)	(0.0307)	(0.0306)
oc_engineering&technology		0.381***	0.414***	0.410***
		(0.0190)	(0.0224)	(0.0223)
oc_financial&investment planning		0.512***	0.530***	0.526***
		(0.0318)	(0.0319)	(0.0318)
oc_legalservices		0.457***	0.401***	0.383***
		(0.0355)	(0.0425)	(0.0424)
oc_science&math		0.223***	0.247***	0.245***
		(0.0480)	(0.0582)	(0.0581)
maoc_oc_legalservices_ma_law			0.201***	0.219***
			(0.0765)	(0.0763)
baoc_oc_biotechrd_ba_naturescien			-0.254*	-0.260*
			(0.140)	(0.140)
baoc_oc_businessanalysis_ba_busi			-0.114**	-0.109**
			(0.0477)	(0.0476)
maoc_oc_infosupportsrvcs_ma_comp			0.381***	0.385***
			(0.0931)	(0.0929)
baoc_oc_infosupportsrvcs_ba_comp			0.359***	0.350***
			(0.0552)	(0.0551)
baoc_oc_infosupportsrvcs_ba_engi			0.457***	0.450***
			(0.0673)	(0.0671)
maoc_oc_busfinclmgmtacct_ma_busi			0.114***	0.116***
			(0.0442)	(0.0441)
maoc_oc_busfinclmgmtacct_ma_educ			-0.237***	-0.229***
			(0.0891)	(0.0888)
maoc_oc_busfinclmgmtacct_ma_engi			0.0700	0.0779
			(0.111)	(0.111)
baoc_oc_busfinclmgmtacct_ba_busi			0.0790***	0.0797***
			(0.0279)	(0.0278)
baoc_oc_busfinclmgmtacct_ba_educ			-0.264***	-0.264***
			(0.0551)	(0.0550)
baoc_oc_busfinclmgmtacct_ba_heal			-0.149*	-0.151*
			(0.0884)	(0.0882)
maoc_healthinfo_ma_medicineden			0.322***	0.317***
			(0.0727)	(0.0725)

Constant	5.007***	5.031***	5.028***	4.946***
	(0.0375)	(0.0365)	(0.0365)	(0.0568)

Each model includes 111,413 observations and 40,589 individuals. The base group for college major variables is all other majors that were omitted from the model (see footnote 5 on page 17 for details). Column 2 includes controls for occupation, with only select variables shown. Column 3 shows major-occupation interactions, with only select variables shown. Column 4 controls for 50 US States with none of the variables shown.