The Early Impact of Postsecondary Career and Technical Education: Do Workers Earn More in Occupations Related to Their College Major?

A CAPSEE Working Paper

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Appendices A and B are available in a separate document available at capseecenter.org

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Abstract

This study explores the relationship between college major, occupation, and early-career annual earnings for the years 2008 to 2010 using data from the National Longitudinal Survey of Youth of 1997 (NLSY97). I provide estimates of the effect of college major on earnings for those with bachelor's degrees, associate degrees, and some college but no degree. The study also develops a crosswalk between college major and occupation to measure whether education and employment are matched. Results suggest that the early returns to postsecondary credentials vary widely by college major and level of attainment, with large economic benefits accruing to credentials in business, health science, and STEM subjects and much smaller benefits accruing to credentials in education and the humanities. The study also finds that matched employment in the fields of health science, STEM, and education provides a substantial premium to bachelor's degree holders, while matched employment in health science provides a substantial premium to those with an associate degree.

Table of Contents

1. Introduction

In the United States today, postsecondary education is inextricably tied to the world of work. The gap between the earnings of college- and high-school-educated workers has grown dramatically since the 1980s (Goldin & Katz, 2008), strengthening the economic incentives for young people to seek schooling beyond high school. Furthermore, the majority of college students study topics directly linked to potential future occupations. Of the 2.9 million undergraduate credentials awarded in 2006, nearly 70 percent were in career fields such as business, marketing, education, engineering, health sciences, or information technology (NCES, n.d., Table P79). Similarly, out of 19.4 million credential-seeking undergraduate students enrolled during the 2007–08 school year, 12.1 million had declared career majors, while only 5.7 million had declared academic majors (NCES, n.d., Table P41).[1]

This clear focus on career and technical education (CTE) suggests that many students perceive their college studies to be preparation for future employment. A rich literature assesses the labor market returns to postsecondary credentials, but less attention has been paid to whether CTE improves career prospects in occupations related to field of study. Given the large proportion of college students who study career subjects, this analysis has important policy implications for the structure of higher education in the United States.

This study addresses the gap in the literature by exploring the relationship between college major and early-career labor market outcomes. Specifically, the analysis seeks to answer the following questions:

1. How likely are workers to be employed in occupations related to their college major?
2. How do the early returns to postsecondary education differ by college major?
3. Do workers earn more (or less) if their occupation is related to their college major?

The study uses data from the National Longitudinal Survey of Youth of 1997 (NLSY97) for the years 1997 through 2011, and uses data on earnings from 2008, 2009, and 2010. It is important to recognize that the survey respondents were relatively young—between the ages of 26 and 30—at the end of the period for which earnings data are available. Many respondents had only recently finished their formal schooling, and a substantial portion of sample members were still enrolled. Because the impact of education on earnings may not appear immediately after graduation or may increase over time, analysis of these data may underestimate the long-term positive effects of schooling.

[1] The remaining 1.7 million students were undeclared during the 2007–08 academic year.

This analysis contributes to the literature by providing recent, nationally representative estimates of the early-career returns to college major and by offering preliminary estimates of these returns for workers with some college but no degree. In addition, I assess the impact of related employment on earnings by developing a crosswalk between major fields and occupation codes.

I find that that the returns to postsecondary credentials vary widely by college major and level of attainment, with large economic benefits accruing to business; health science; and science, technology, engineering, and mathematics (STEM) subjects; and with much smaller benefits accruing to credentials in education and in the humanities. Specifically, among those with some college but no degree I find modest returns associated with a major in business, STEM, and social science. In addition, I find that matched employment in the fields of health science, STEM, and education provides a substantial premium to bachelor's degree holders, and that matched employment in health science provides a substantial economic benefit to those with an associate degree.

2. Previous Empirical Literature

Theoretical Framework

In his seminal work on the human capital model, Becker (1962) posited that workers invest in education to acquire skills and knowledge that enhance their productivity, raising the wage they command in the labor market. Becker further distinguished between general training, which improves productivity at many different firms, and specific training, which is useful only to a particular employer. CTE can be conceptualized as specific training that provides human capital relevant only in a certain occupation (Robst, 2007). Traditional liberal arts disciplines, by contrast, can be viewed as imparting general skills and abilities that increase productivity and wages in many employment settings. It is possible that academic majors raise wages to a modest extent in many occupations, while CTE increases earnings more substantially in related employment but very little in unrelated jobs. This analysis aims to distinguish between majors that function as specific training and those that offer more general human capital.

Returns to Education by College Major

Several studies offer estimates of the differential labor market returns to college majors within the human capital framework. These analyses all employ some adaption of the classic Mincerian human capital earnings function, according to which individual earnings are determined by schooling and work experience (Mincer, 1974). In a typical formulation, logged earnings are regressed on a measure of schooling, experience, experience squared, and a set of demographic controls.

Using data from the National Longitudinal Study of the Class of 1972 (NLS72) for the period 1972 to 1986, Grubb (1995) found that an associate degree in health had a positive impact on annual earnings when compared with a high school diploma, but that no other field had a significant effect. Based on data from the Survey of Income and Program Participation (SIPP) for 1984 to 1990, however, Grubb (1997) reported a significant effect on logged annual earnings in several fields of study, including business, engineering and computing, public service, vocational/technical fields, and health. Gill and Leigh (2000) analyzed data from the National Longitudinal Survey of Youth of 1979 (NLSY79) for 1985 to 1994 and reported higher returns for engineering and lower, in some cases negative, returns for business, education, and the social sciences at the associate level. A similar pattern obtained for bachelor's degrees, but with substantial gender differences.

Drawing on three data sources—the Beginning Postsecondary Students Longitudinal Study (BPS89), High School and Beyond (HS&B), and the National Education Longitudinal Study of 1988 (NELS), which collectively cover the period 1989 to 2000, Bailey, Kienzl, and Marcotte (2004) found that the return to an associate degree was higher for students who studied occupational subjects than for those who concentrated in academic disciplines. Zhang (2009) relied on data from the Baccalaureate and Beyond Longitudinal Study (B&B) for 1992 to 1997 and found the highest returns for business and management, science and engineering, and public affairs majors, and low returns for humanities majors.

Bailey and Belfield (2013) used data from the 2008 SIPP and reported that higher earnings accrued to students with associate degrees in health and computing, and lower earnings to students with degrees in education and agriculture, compared with degrees in the social sciences. For bachelor's degrees, those who studied engineering, computing, business, health, the sciences, and communications earned more in comparison with social science majors. Finally, Carnevale and Cheah (2013) provided descriptive data on median earnings for college graduates by major, using data from the 2010 and 2011 American Communities Survey (ACS). The authors reported higher wages for workers who majored in engineering, computers and mathematics, health, science, business, and social science, and lower earnings for those with degrees in education, humanities, and the arts.

In addition to this literature that draws on conventional survey data, a number of recent studies on the returns to education have used state-level administrative data that merge public and community college records with earnings information collected from employers by the state unemployment benefits system. Jacobson, Lalonde, and Sullivan (2005) estimated the returns to community college degrees for displaced workers using administrative data from Washington State that included unemployment insurance claims, quarterly wage records, and community college transcripts for the period 1987 to 2000. The authors found that meaningful increases in quarterly earnings accrued to those with quantitative and technical course credits, with much smaller effects from other fields.

Jepsen, Troske, and Coomes (2009) drew on similar administrative data from Kentucky for 2000 to 2008 and estimated a statistically significant increase in quarterly earnings for vocational certificates and associate degrees in health, vocational fields, and academic subjects other than the humanities. Jacobson and Mokher (2009) used data extending through 2007 on the cohort of Florida students entering high school in 1996 and found higher earnings linked to degrees in health and STEM fields relative to social science or the humanities. Finally, Dadgar and Weiss (2012) analyzed administrative data from Washington state for the period 2001 to 2008 and reported especially high returns to associate degrees in allied health, nursing, and protective services, in comparison with social science, humanities, information science, communication and design, and business and marketing.

In summary, the literature on the labor market returns to postsecondary education has revealed great heterogeneity in earnings by college major, but studies have reported inconsistent findings in terms of which majors provide higher versus lower returns. Degrees in health, computing, engineering, math, and science are generally found to offer a substantial wage premium, credentials in education and the humanities lead to lower earnings, and fields such as business and social science vary in their effects according to degree level and the data used.

A limitation of the existing literature is that no study assesses the effect of individual majors for those with some college but no degree. Jacobson et al. (2005) reported the return to community college credits as distinct from credentials in two broad curriculum categories—quantitative or vocationally oriented, and less quantitative—but not by particular fields of study. Thus while estimates are available for the return to certificates, associate degrees, and bachelor's degrees in specific majors, comparable analyses do not exist for students who began but did not complete college. Approximately 59 percent of full-time students who entered a four-year college for the first time in 2005 earned a bachelor's degree within six years (Snyder & Dillow, 2013, Table 376), while fewer than 30 percent of students who enrolled in a two-year institution in 2007 received a credential within 150 percent of the normal time for program completion (Snyder & Dillow, 2012, Table 345).[2] The effect of postsecondary education on the earnings of this vast pool of non-graduators is therefore an important policy question. Several studies have found that a small but statistically significant earnings premium accrues to some college credits without a degree. For example, Kane and Rouse (1995) estimated that a year's worth of college credits raises earnings by 4–7 percent for men and 7–10 percent for women. However, the impact of college major is an unanswered question.

Another weakness of the literature is the dearth of recent studies that provide nationally representative estimates of the return to college majors. Of the five studies that drew on data collected since 2000 (Bailey & Belfield, 2013; Carnevale & Cheah, 2013; Dadgar & Weiss, 2012; Jacobson & Mokher, 2009; Jepsen et al., 2009), only Bailey and Belfield and Carnevale and Cheah used nationally representative surveys (the SIPP and the ACS, respectively). The other authors relied on administrative data from particular states, which could reflect local labor

[2] The normal time for program completion varies by credential type and program.

market patterns that are not applicable nationwide. Furthermore, Carnevale and Cheah provided only descriptive data and did not control for any demographic factors.

A persistent challenge in the literature on the returns to education is that the decision to obtain postsecondary schooling is not exogenous but rather is vulnerable to selection or omitted variable bias. Individuals who acquire higher levels of schooling are likely to have characteristics—such as greater ability, or parents with higher socioeconomic status—that independently lead to higher earnings. Thus basic ordinary least squares (OLS) regression controlling only for observable demographic characteristics may overestimate the impact of education on wages.

Several decades of intensive research on this topic has yielded consistent evidence that the economic returns to schooling are substantial and robust to a wide variety of econometric methods (Card, 1999). However, research on the effects of college major may be particularly susceptible to selection bias, as decisions about college major may be correlated with individual characteristics and preferences that are especially difficult to measure or control for. Indeed, Arcidiacono, Hotz, and Kang (2012) found that student expectations about earnings in various fields affected college major choice, suggesting that students who value high wages may self-select into majors they believe to be tied to high-paying occupations. Furthermore, Webber (2014) conducted a series of simulations using data from the ACS and the NLS97 and concluded that cognitive ability and unobservable factors were likely to generate substantial selection bias when estimating the returns to college major. It is important to note that in the current analysis, bias may also enter the analysis at the point when young people select into occupations, in addition to when they choose their major.

To address the issue of selection bias, several studies using administrative data have employed a fixed effects specification that compares the wage trajectory of individuals with different college majors, leveraging the availability of earnings for the pre-college period (Dadgar & Weiss, 2012; Jacobson et al., 2005; Jepsen et al., 2009). Other analyses have controlled for measures of individual ability or parental socioeconomic status, which are two of the factors believed to pose the greatest danger of inducing selection when estimating the returns to education (Bailey et al., 2004; Grubb, 1995; Jacobson & Mokher, 2009; Zhang, 2009). The NLSY97 data utilized in the current analysis follow a cohort of young people from adolescence to early adulthood. This renders a fixed effects specification infeasible, as much of the sample is too young to have a well-developed work history that predates their postsecondary education. However, the NLSY97 does include detailed information on cognitive ability, high school achievement, and family background. This analysis will therefore follow the second approach outlined above.

Related Employment and Job Matching

Despite these methodological challenges, the literature on the returns to postsecondary education by field of study is relatively well developed. However, this research provides only suggestive evidence on the mechanism by which various majors lead to differential earnings. High-return majors, such as health and engineering, generally appear to be linked to occupations with relatively high average earnings, while low-return majors either link to low-paying fields—such as education—or to no occupation in particular, as with the humanities. This pattern implies that students are likely to end up working in occupations connected to their field of study, but the correlation is weak and provides no information on how career-oriented education affects earnings once workers are employed.

A separate body of research has explored the relationship between educational concentration and labor outcomes within the framework of job matching. Using B&B data, Horn and Zahn (2001) found that students with applied majors—including both in high-return areas such as engineering and health and in low-return areas such as education and social work—had a high probability of working in an occupation related to their field of study. By contrast, workers with academic majors were scattered among many occupations, with humanities majors similarly likely to work as educators, in business or management, or as editors, writers, or performers. This finding suggests that some career-oriented majors may help former students gain access to employment in a related occupation, even if they do not raise earnings in comparison with other graduates due to low average wages in the relevant field.

Robst (2007) investigated the linkages between college major, related employment, and annual earnings, drawing on data from the 1993 National Survey of College Graduates (NSCG). To measure whether an individual's major was connected to current employment, Robst relied on a survey question that asked whether the respondent's highest degree field of study was "closely related, somewhat related, or not related" to the individual's job at the time of interview. The author used ordered logistic regression to estimate the probability of mismatch, defined as being in a job that is somewhat related or not related to field of study. Robst found that health professions and library science majors had an especially low probability of mismatch, while those who studied English and foreign languages, liberal arts, and social sciences had a high probability of mismatch.

Robst (2007) also estimated the effect of mismatch on wages and reported that working in a job not related to college major was associated with a 10–12 percent decrease in annual earnings. The wage penalty of mismatch was greatest (over 20 percent) for those with applied majors such as business management, computer and information sciences, engineering, health professions, and law, and was insignificant or even positive for education and for many academic majors, including English, liberal arts, psychology, and philosophy, and religion. This finding supports the hypothesis that career-oriented majors constitute specific training that raises wages in related occupations but not in other jobs, while academic majors provide general skills that may offer a lower earnings premium but are more broadly applicable.

Finally, Yuen (2010) conducted a similar analysis using data from the Canadian Survey of Labour and Income Dynamics (SLID), which includes a comparable question on whether the respondent's current job is related to his or her education. The author concluded that at all levels of education, hourly wages are substantially higher—between 25 and 50 percent—for those with closely related jobs, compared with those with unrelated employment. The study also found that workers who majored in education or health were particularly likely to be employed in an occupation tied to their education. In conclusion, the existing literature on job match and college major suggests that working in a job related to one's field of study improves labor outcomes, and that the effect varies in particular between career-oriented and traditional academic subjects.

The current study contributes to the literature on the returns to college major and education–job match in three ways. First, I provide estimates of the return to college major using data that are both recent and nationally representative, while nearly all of the data used in the existing literature either date from before the year 2000 or are state-specific. Second, I exploit the richness of the education data available in the NLSY97 to construct a measure of college major for all postsecondary students who declared a field of concentration at some point, not just for those who graduated. Therefore, I am able to provide the first estimates of the returns to different majors for students with some college but no degree.

Third, I develop a mapping between reported college major and reported occupation, drawing on classification systems from the National Center of Education Statistics (NCES) and the Bureau of Labor Statistics (BLS). Whereas previous studies have relied on subjective interpretations of related employment, leading to noisy and imprecise measurements, I offer an innovative attempt to measure major–occupation match based on an objective framework. Researchers at the Georgetown Center for Education and the Workforce have developed a comparable crosswalk to project labor demand within the 16 CTE career clusters, which this study also uses to build its major–occupation mapping (e.g., Carnevale et al., 2011). However, to my knowledge, no existing study relies on a crosswalk of this type to measure the earnings premium associated with related employment.

3. Data

This study uses data from the NLSY97, which examines the transition from school to work and entry into adulthood. The NLSY97 sample, first interviewed in 1997, consists of 8,983 young people who were between 12 and 16 years of age at the end of 1996. The cohort is composed of a cross-sectional sample that is representative of children born in the United States between 1980 and 1984, drawn from 75,291 households in 147 non-overlapping primary sampling units, and a supplemental sample of Black and Hispanic youths. Following the 1997 baseline interview, the NLSY97 study has conducted annual follow-up interviews, collected high school transcript data, and administered the Armed Services Vocational Aptitude Battery (ASVAB) test, which assesses cognitive functioning. This analysis uses data from the first 15 waves of the NLSY97, collected between 1997 and 2011, which are publicly available from the BLS.

Like its predecessor the NLSY79, the NLSY97 contains rich data on education, labor market outcomes, ability, family socioeconomic status, and how these factors change through time. A particular advantage of the NLSY97 is that the data are recently collected and have been analyzed by relatively few studies, compared with the older, much-cited NLSY79 and other longitudinal surveys such as NLS72, HS&B, and NELS. As the analysis examines earnings from 2008 through 2010, this study provides some of the first estimates of the returns to postsecondary education during the Great Recession. As stated in the introduction, a disadvantage of the survey is that the sample members are relatively young at the end of the period for which earnings data are available. Therefore, this analysis only accounts for the returns to education that appear in the years immediately following the completion of formal schooling.

Earnings and Employment

The analysis uses data on earnings from 2008, 2009, and 2010, the last three years for which income data are available. Earnings from 2008 and 2009 are inflated to 2010 dollars,[3] and total earnings including self-employment and business income are pooled across the three years and averaged to create a measure of annual earnings.[4] Respondents who reported categorical income are assigned the value at the midpoint of the category. Sample members who reported no income from wages or salary in a particular year are assigned a value of zero for that year. If respondents are missing data on earnings in one or two of these three years, I calculate annual earnings using the two or one years with valid data, respectively. Nearly all sample members with missing data on earnings in a given year were not interviewed in that year. I include indicators for missing earnings data by year in the analysis.

In addition to the primary models that focus on earnings, I estimate a specification that uses weeks worked per year as the outcome. As with earnings, I calculate an average value for weeks worked using data from 2008, 2009, and 2010, or the subset of these years with valid employment data, and include indicators for missing data on weeks worked by year in the analysis.

All models control for the respondent's labor market experience, which is measured as cumulative hours of work from the year the individual turned 18 through 2007.[5] As many respondents have missing values for hours worked in some years, I create a series of dummies indicating a missing value for this variable by year, and assign values of zero for those years with no data.

[3] All dollar figures throughout the paper are in 2010 U.S. dollars unless otherwise indicated.
[4] Earnings are top-coded at $125,000.
[5] Experience is often quantified as years since the completion of formal education, but this definition is not easily adapted to those with some college but no degree, for whom the end to schooling may be gradual. In addition, many students work part-time or full-time while attending school.

Educational Attainment

The model incorporates measures of the respondent's highest level of educational attainment as of 2007, the year prior to the first year of earnings examined. The categories considered are no educational credential, GED, high school diploma, some college but no degree, associate degree, bachelor's degree, and graduate degree. The *some college* category consists of all sample members who reported completing at least one year of college but had no degree beyond a high school diploma or GED. The model includes indicators for those with no educational credential, a GED, or a graduate degree, with the comparison category being those with a high school diploma. The some college, associate degree, and bachelor's degree categories are further disaggregated into fields of study, as discussed in more detail below. For respondents missing data on educational attainment in 2007, I use data on attainment from 2006 or 2008 if I can ascertain that these individuals were not enrolled in school after 2007.

The analysis excludes those who reported continuing their formal schooling after 2007, either by stating that they were enrolled in school or by obtaining an additional credential. Workers generally have lower earnings while enrolled in school, if they are employed at all. Therefore, including these individuals might lead to a downward bias in estimates of the returns to schooling.

Major Field of Study

In each survey round, the NLSY97 collects data on each college the respondent has attended since the last interview. Specifically, sample members are asked to report a first and second major, if applicable, for each term in every college they attended over the preceding year. For those whose highest credential is an associate or bachelor's degree, I code major field of study as the most recently reported first major in the college and year that the respondent received this credential.[6] For associate and bachelor's degree holders with no information on the college at which their credential was obtained, I use the last-reported first major from the year in which their degree was earned. Finally, for the small number of respondents with no information on college or year of degree receipt, I code major field of study as the last-reported first major in any college or year through 2007. I create an indicator for associate and bachelor's degree holders who reported a second major in the college or year in which they received their degree.[7] For those with some college but no degree, I code field of study as the last-reported first major in any college and year through 2007.

Majors as reported in the NLSY97 data are then grouped into categories, using the NCES Classification of Instructional Programs (CIP) and the National Association of State Directors of Career and Technical Education Consortium's (NASDCTEc) system of 16 career clusters as

[6] For the small number of respondents who have obtained more than one associate degree or more than one bachelor's degree, I use the major from the most recently acquired degree.
[7] Only 5 percent of associate degree holders and 17 percent of bachelor's degree holders included in the primary analysis of the returns to major are coded as having a second major.

points of reference.[8] At the bachelor's degree and some college levels, majors reported in the NLSY97 with a vocational focus are assigned to one of four categories: (1) business and communications, (2) health science, (3) STEM fields, and (4) education. Traditional liberal arts majors are assigned to one of two broad categories: (1) social science, and (2) humanities and other academic majors. All remaining majors are grouped into an "other major" category.

At the associate degree level, education majors are included in the other major group and social science and humanities are combined into a single category for academic majors, due to small sample sizes. The small number of respondents at the bachelor's and associate degree level with no reported major are also placed in the "other major" category. For those with some college, respondents with no reported major are placed in a separate category.

Occupation and Related Employment

Similar to college majors, the NLSY97 asks respondents at each round about all jobs held since the last interview. The survey data include an occupation code for each job using the 2002 version of the Census Bureau's Standard Occupation Classification (SOC). To measure related employment, I create a crosswalk between the college major categories and the SOC codes, using a CIP–SOC crosswalk developed by NCES as a guide.[9] I match occupation codes to the four vocational major groups and define categories for other professional and managerial occupations; administrative, clerical and sales occupations; and non-professional and low-skill occupations. Appendix A[10] displays the detailed crosswalk with all SOC and NLSY97 major codes.

Using these occupation categories, I create measures for occupation in the respondent's main job in 2008, 2009, and 2010. Next, I construct a series of indicators that code a respondent as having a particular occupation if he or she reported that occupation as his or her main job in 2008, 2009, or 2010.[11] I create separate sets of occupation indicators for bachelor's degree holders, associate degree holders, and those with some college. Finally, I construct a series of dummies that indicate a match between a respondent's major and occupation in each of the four related employment categories, separately for each attainment level.

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[8] The career clusters were largely developed in response to the Carl D. Perkins Career and Technical Education Act of 2006 (Perkins IV), which provides federal funding for CTE, organized into comprehensive "programs of study" that prepare students to work in a particular career field.

[9] The NCES crosswalk matches each SOC code to multiple CIP codes, and vice versa. To create a one-to-one mapping for my analysis, I assign each SOC code to one major category.

[10] Appendices A and B are available in a separate document available at capseecenter.org.

[11] The analysis also includes indicators by attainment level for reporting more than one main occupation over the 2008–2010 period, as these occupation dummies are not mutually exclusive. Twenty-seven percent of bachelor's degree holders, 20 percent of associate degree holders, and 22 percent of those with some college in the workers-only sample used for the related employment analysis reported more than one main occupation.

Ability, Family Socioeconomic Status, and Demographics

Ability is incorporated into the model using a measure of respondent's performance on the ASVAB, a military enlistment exam from which the Armed Forces Qualifying Test (AFQT) score is computed. Overall, 79 percent of the NLSY97 sample completed the ASVAB between 1997 and 1998. This study uses a variable constructed by the NLSY97 research team that provides the respondent's percentile ranking on the four math and verbal subtests, adjusted to take into consideration the youth's age. The score is rescaled so that values fall between 0 and 100. The analysis also includes a measure of high school grade point average (GPA) derived from the NLSY97's supplemental survey of respondents' high school transcripts. Transcript data were obtained for 69 percent of the overall NLSY97 sample.

To control for family socioeconomic status, the analysis includes gross income for the respondent's household at baseline, when sample members were between 12 and 17, and years of education for the respondent's biological father. For ASVAB score, high school GPA, household income, and father's education, I create dummies indicating if a respondent is missing data for this variable, and assign an arbitrary value to those with missing data in order to include them in the analysis. Finally, the model incorporates indicators of gender, race and ethnicity, and geographic region at baseline.[12]

Sample Restrictions

The final sample for the primary analysis including both workers and non-workers is comprised of 5,074 respondents.[13] Of the 8,983 original sample members, 2,680 are excluded because they were enrolled in formal schooling after 2007. Among those who were enrolled, 5 percent obtained a GED after 2007, less than 1 percent obtained a high school diploma, 9 percent acquired an associate degree, 15 percent gained a bachelor's degree, and 12 percent earned a graduate degree. Of the 1,621 individuals who attended formal education but did not acquire an additional credential, 4 percent reported being enrolled in high school, 51 percent in a two-year college, 40 percent in a four-year college, and 17 percent in graduate school.[14] An additional 925 sample members are excluded from the analysis because they are missing data on educational attainment, while a further 304 are excluded because of missing data on earnings.

[12] The racial and ethnic categories included in the analysis are White non-Hispanic, Black non-Hispanic, Hispanic, and other or mixed race. The region categories are Northeast, North Central, South, and West.
[13] The specification that examines weeks worked annually instead of earnings has a sample size of 5,211, as there are 143 respondents with valid data for weeks worked but not for earnings, and six respondents with valid data for earnings but not for weeks worked.
[14] Some sample members reported being enrolled in more than one type of formal education program.

4. Empirical Strategy

Following the approach of prior studies, the current analysis adopts Mincer's human capital earnings function as its primary identification strategy. I use ordinary least squares (OLS) regression to estimate the returns to college major and the effect of related employment on annual earnings, disaggregating by degree level and holding constant occupation. To address selection bias, the model incorporates measures of ability, family socioeconomic status, and a vector of demographic variables.

Incidence of Related Employment

Before estimating the Mincerian earnings equation, I present a descriptive statistics on the relationship between college major and subsequent occupation (Question 1). Specifically, I examine a series of cross-tabulations of major and occupation, disaggregated by degree level, to assess rates of related employment by field.

Returns to College Major

The first regression model assesses the return to postsecondary education, disaggregated by college major (Question 2). I estimate the following equation using OLS regression:

$$(1) \qquad Earn_i = \alpha + \eta * NC_i + \gamma * GED_i + \pi_j * SC_i * Maj_{ij} + \lambda_j * AS_i * Maj_{ij} + \beta_j * BA_i * Maj_{ij} + \delta * Abil_i + \omega * SES_i + \theta * Exp_i + \rho * Exp_i^2 + \psi_r * Dem_{ir} + \varepsilon_i$$

The outcome variable, *Earn*, indicates average annual earnings in the period under study for individual *i*. The focus of the traditional Mincerian framework is to estimate the increase in marginal productivity associated with a given quantity of schooling by measuring the proportional rise in the wage rate. Therefore, many studies condition on employment and use logged earnings as the outcome. Such an approach may not capture the full return to an educational investment, however, if the probability of employment varies by schooling type and level. To avoid this potential bias, I include non-workers in the model by assigning a value of zero to those who did not work and using unlogged earnings.

NC and *GED* are indicators for having no educational credential or holding a GED (and no further qualifications), in comparison with the reference category of those whose highest educational credential is a high school diploma. At the level of associate degree (*AS*) and bachelor's degree (*BA*), as well as for those who have obtained some college education but no degree (*SC*), I disaggregate further by *j* major fields of study (*Maj*). In other words, the major categories are incorporated into the model in the form of an interaction between field of study and degree level. Thus β_j can be interpreted as the increase in annual earnings associated with holding a bachelor's degree in field *j*, in comparison with having a high school diploma and no postsecondary education.

The model also includes measures of ability (*Abil*), family socioeconomic status (*SES*), work experience and the square of experience (*Exp*), and a vector of demographic variables (*Dem*), as discussed above. Finally, α is a constant term, η, γ, π, λ, β, δ, ω, θ, ρ, and ψ are model parameters, and ε is an error term.

Several studies have found that the returns to college major vary substantially by gender (see Bailey & Belfield, 2013; Dadgar & Weiss, 2012; Gill & Leigh, 2000). Therefore, I present results separately for men and women, in addition to providing estimates for the overall sample. I also conduct a series of regressions conditional on employment, one with unlogged earnings and one with the natural log of earnings, in order to compare my analysis with the existing literature. Finally, I estimate a specification in which the outcome is weeks worked annually, to capture the effect of college major on the quantity of labor supplied by workers.

Related Employment and Earnings

Next, I examine whether workers earn more if their jobs are related to college major (Question 3). I augment Equation 1 by including measures of occupation and related employment, as follows:

$$(2) \quad Earn_i = \alpha + \eta * NC_i + \gamma * GED_i + \pi_j * SC_i * Maj_{ij} + \chi_k * SC_i * Occ_{ik} + \upsilon_q * SC_i * Match_{iq}$$
$$+ \lambda_j * AS_i * Maj_{ij} + \sigma_k * AS_i * Occ_{ik} + \tau_q * AS_i * Match_{iq}$$
$$+ \beta_j * BA_i * Maj_{ij} + \kappa_k * BA_i * Occ_{ik} + \phi_q * BA_i * Match_{iq}$$
$$+ \delta * Abil_i + \omega * SES_i + \theta * Exp_i + \rho * Exp_i^2 + \psi_r * Dem_{ir} + \varepsilon_i$$

In this specification, *Occ* represents a series of *k* indicators for the respondent's occupation, with administrative, clerical, and sales occupations omitted as the reference category, and *Match* denotes a vector of *q* dummies marking major–occupation matches. The *Match* variables can be interpreted as an interaction between major and occupation for a particular field. Furthermore, as with the major indicators, the occupation and match categories are attainment level–specific. Thus ϕ_q captures the earnings premium or penalty associated with obtaining a bachelor's degree in field *q* and working in field *q*, holding constant the main effects of major and occupation. However, it is important to note that because this model controls for occupation, it does not incorporate the effect of college major on the probability of working in various occupations. In addition, this analysis is restricted to workers, (i.e., those with a positive value for annual earnings), as it does not make sense to examine occupation for those who are not employed.

5. Results

Summary Statistics

Table 1 displays summary statistics for the educational attainment, labor market, and control variables, first for the sample including both workers and non-workers used to estimate the returns to college major (Equation 1) and next for the workers-only sample utilized in the related employment analysis (Equation 2).[15] Focusing on the first panel of the table, those with only a high school diploma comprise 32 percent of the sample, forming the largest attainment category, followed by bachelor's degree holders (21 percent) and those with some college but no degree (16 percent). Associate degree recipients constitute only 6 percent of the sample.[16]

Among those with some college but no postsecondary credential, 47 percent reported being enrolled in a four-year institution at some point. Overall, 64 percent of sample members with at least one year of college obtained some type of degree. This percentage is moderately higher than the 59 percent graduation rate for all U.S. students entering four-year colleges in 2005 and dramatically higher than the 32 percent graduation rate for students entering two-year colleges in 2007 (Snyder & Dillow, 2013, Table 376; Snyder & Dillow, 2012, Table 345). This high implied graduation rate may be a result of the fact that the sample only includes those young people who completed their formal schooling at a relatively young age. Sample members who continued their education after 2007 but who may eventually have dropped out without completing a degree are excluded.

A comparison of the sample sizes in the first and second panel indicates that 4,567 of the 5,074 sample members included in the workers and non-workers sample had earnings greater than zero in 2008, 2009, or 2010, translating into an employment rate of 90 percent. Average earnings in 2010 were approximately $29,000 for the overall sample, and $32,000 among workers only. Of the 5,211 respondents included in supplemental analysis of weeks worked per year,[17] 4,776 worked at least one week during 2008, 2009, or 2010, which implies a comparable employment rate of 92 percent. worked an average of 40 weeks per year in the period under study, while those with positive earnings worked 43 weeks.

[15] Unless otherwise noted, all descriptive and regression results are weighted using the 1997 cross-sectional sample weight.
[16] The NLSY97 data do not identify those whose highest educational credential is an occupational certificate. Data from the 2008 Current Population Survey Annual Social and Economic Supplement (CPS ASEC) indicate that among those aged 25-29 years, 29 percent held a high school diploma, 20 percent had some college but no degree, 9 percent held an associate degree, and 24 percent were bachelor's degree recipients (U.S. Census Bureau, 2009).
[17] Statistics on the weeks worked variable displayed in Table 1 are for the samples included in the earnings analyses, not the slightly different universe of 5,211 respondents included in the weeks worked specification.

Table 1: Summary Statistics for Highest Educational Credential, Labor Market Outcomes, and Control Variables

	Workers and Non-Workers				Workers Only			
Variable	**N**	**Mean**	**Med.**	**SD**	**N**	**Mean**	**Med.**	**SD**
Highest educational credential as of 2007								
No educational credential	5,074	0.11	0	0.32	4,567	0.10	0	0.29
GED	5,074	0.11	0	0.31	4,567	0.10	0	0.30
High school diploma	5,074	0.32	0	0.47	4,567	0.32	0	0.47
Some college, no degree	5,074	0.16	0	0.37	4,567	0.17	0	0.38
Associate degree	5,074	0.06	0	0.23	4,567	0.06	0	0.24
Bachelor's degree	5,074	0.21	0	0.40	4,567	0.22	0	0.42
Graduate degree	5,074	0.03	0	0.16	4,567	0.03	0	0.17
Labor market outcomes								
Average annual earnings ($)	5,074	29,028	25,230	25,541	4,567	31,824	27,597	25,023
2008 earnings ($)	4,846	28,567	25,320	24,953	4,388	31,164	28,358	24,461
2009 earnings ($)	4,765	28,349	24,394	26,637	4,303	31,010	27,443	26,337
2010 earnings ($)	4,723	29,360	25,000	27,179	4,268	32,071	28,000	26,832
Average weeks worked annually	5,068	39.5	49.3	17.2	4,562	42.9	50.3	13.6
Total hours worked age 18 through 2007	5,074	10,764	10,474	5,825	4,567	11,285	11,047	5,617
Ability and socioeconomic status								
ASVAB percentile score	4,019	47.2	45.5	29.3	3,659	48.9	47.6	29.1
High school GPA	3,417	2.8	2.9	0.6	3,151	2.9	2.9	0.6
Gross household income in 1997 (1997 $)	3,786	49,092	41,000	39,989	3,411	50,501	42,000	40,637
Father's education in years	3,974	12.7	12	3.0	3,638	12.7	12	3.0
Demographics								
Age (in 2010)	5,074	28.1	28	1.4	4,567	28.1	28	1.4
Male	5,074	0.54	1	0.50	4,567	0.55	1	0.50
White non-Hispanic	5,074	0.67	1	0.47	4,567	0.68	1	0.47
Black non-Hispanic	5,074	0.15	0	0.36	4,567	0.14	0	0.35
Hispanic	5,074	0.13	0	0.34	4,567	0.14	0	0.34
Other or mixed race	5,074	0.04	0	0.20	4,567	0.04	0	0.20
Region of residence in 1997								
Northeast	5,074	0.18	0	0.38	4,567	0.18	0	0.38
North Central	5,074	0.27	0	0.44	4,567	0.27	0	0.44
South	5,074	0.36	0	0.48	4,567	0.35	0	0.48
West	5,074	0.20	0	0.40	4,567	0.20	0	0.40

Note. Data are from the NLSY97 1997–2011 and are weighted using the 1997 cross-sectional weight. The second panel presents summary statistics for those with earnings in 2008, 2009, or 2010, while the first panel also includes those without earnings. Note that the variable for average earnings uses data from the subset of years with valid earnings data, and the analysis includes indicators for missing earnings data by year. Similarly, other variables with missing data are assigned an arbitrary value to indicate missing information, and indicators for missing data on these variables are included in the analysis. The specification that examines weeks worked annually has a sample size of 5,211, as the subset of respondents with valid data on employment is not identical to the subset with valid data on earnings. Both panels restrict the sample to individuals with non-missing data on educational attainment who were not enrolled in formal education after 2007.

Statistics for educational attainment, measures of ability and socioeconomic status, and other control variables are similar for the overall and the workers-only samples. As noted above, the ability and socioeconomic status variables have substantial amounts of missing data. In particular, 21 percent of the overall earnings sample is missing data on ASVAB score, 33 percent is missing data on high school GPA, 25 percent is missing data on household income in 1997, and 22 percent is missing data on father's education. I assign arbitrary values to sample members who lack data on these variables and include indicators for missing data in the analysis.

Cross Tabulation of Major and Occupation

Tables 2, 3, and 4 show weighted cross-tabulations between college major and main occupation in 2008 for workers whose highest credential is a bachelor's degree, an associate degree, and some college, respectively. The samples in these tables are restricted to those with positive earnings for 2008, 2009, or 2010. It is important to note that the occupation variables used in estimating Equation 2 above are non-mutually exclusive indicators for reporting a main occupation in a given category in 2008, 2009, or 2010, and thus are not identical to the mutually exclusive 2008 occupation measures displayed in Tables 2 through 4. Unweighted frequencies for the number of sample members in each major and in the non-mutually exclusive occupation and match categories are presented in Appendix B, disaggregated by level of highest educational credential.

In Tables 2, 3, and 4, the first (top) number in each cell is the row percentage, which indicates the portion of sample members with a particular major employed in a given occupation, while the second (bottom) number is the column percentage, which denotes the portion of individuals in a given occupation with a degree in a particular major. Row and column percentages from 20 through 40 are highlighted in light gray, while percentages above 40 are highlighted in dark gray.

The marginal column percentages in Table 2 reveal that the most common major among bachelor's degree holders was business and communications (33 percent of degree recipients), followed by social science (16 percent) and STEM (14 percent). Relatively few sample members had degrees in health science (5 percent), education (8 percent), and humanities and other academic majors (9 percent). The marginal row percentages indicate that the largest number of bachelor's degree recipients worked in administrative, clerical, and sales occupations (24 percent), followed by business (19 percent), other professional and managerial occupations (14 percent), non-professional occupations (13 percent), and education (12 percent). On the other end of the spectrum, only 5 percent of graduates were employed in health sciences.

Table 2: Cross Tabulation of Major Field of Study and Main Occupation in 2008 With Row and Column Percentages for Bachelor's Degree Holders

	Main Occupation in 2008								
Major Field of Study in Bachelor's Degree	**Business**	**Health**	**STEM**	**Education**	**Other Prof**	**Admin**	**Non-Prof.**	**No Occ.**	**Total**
Business and communications	32 57	2 11	3 11	3 9	11 25	37 52	7 19	5 37	100 33
Health science	5 1	57 60	5 3	8 4	7 3	15 3	3 1	0 0	100 5
STEM	17 13	5 15	43 68	4 5	5 5	13 8	10 12	2 6	100 14
Education	5 2	0 0	1 1	60 44	8 5	6 2	13 9	6 11	100 8
Social science	18 15	4 12	2 4	12 16	28 31	20 13	11 15	6 19	100 16
Humanities and other academic majors	11 5	0 1	5 5	23 18	13 8	21 8	23 17	3 6	100 9
Other major and no major reported	8 6	0 1	5 8	4 5	26 24	23 13	26 27	7 21	100 13
Total	19 100	5 100	9 100	12 100	14 100	24 100	13 100	5 100	100 100

Note. Data are from the NLSY97 1997–2011, and are weighted using the 1997 cross-sectional weight. The sample is restricted to those with earnings in 2008, 2009, or 2010 whose highest educational credential is a bachelor's degree. The first number in each cell is the row percentage; the second is the column percentage. Major-occupation match cells are outlined.. Percentages from 20 through 40 are highlighted in light gray; percentages above 40 are highlighted in dark gray.

Cells that represent a match between major and occupation are outlined. Among bachelor's degree holders, rates of related employment for the four match categories varied from roughly 30 to 70 percent. In addition, the percentage of students entering a related occupation was often quite different from the percentage of workers with a related degree. Specifically, relatively low percentages of students with majors in business and communications (32 percent) and STEM subjects (43 percent) were in matched employment, but much higher percentages of workers held a related credential (57 percent of business and communications workers and 68 percent STEM workers). Conversely, 60 percent of those who majored in education work in that field, but only 44 percent of those with jobs in education had a related major. Match rates for health science were high both for students (57 percent) and workers (60 percent).

It is interesting to note that fully 37 percent of business and communications majors were employed in administrative, clerical, and sales occupations—more than those who worked in business occupations. In addition, 52 percent of administrative workers held a business or communications degree, suggesting that these occupations may be interpreted as a second match category for business and communications majors. Also of interest are the non-negligible proportions of STEM majors (17 percent) and social science majors (18 percent) who worked in business and communications, and the large numbers of social science majors who were employed in other professional occupations (28 percent) and administrative, clerical, and sales jobs (20 percent). Finally, those with degrees in humanities and other academic subjects were concentrated in education jobs (23 percent); administrative, clerical, and sales positions (21 percent); and non-professional and low-skill occupations (23 percent).

In summary, the relationship between major and occupation at the bachelor's degree level is strongest in the health sciences, although there is a clear correlation between field of study and area of employment for all four vocationally oriented majors. The occupational categories of business and education, in particular, appear to have attracted workers with a range of college majors, specifically STEM subjects and social science for business, and humanities and social science for education.

The cross-tabulation of major and occupation for associate degree holders in Table 3 indicates that nearly a third of the sample falls into the other major category, which includes education (31 percent). Large numbers of those with associate degrees also studied health science (21 percent) and the STEM subjects (20 percent). Fully 26 percent of associate degree holders were working in non-professional occupations, compared with 13 percent of those with bachelor's degrees. In addition, 24 percent of those with associate degrees were in administrative positions, and 16 percent were in health-related occupations. Rates of matched employment in the health sciences were even higher at the associate than at the bachelor's level, with 68 percent of students and 91 percent of workers in a related job. The other match categories should be interpreted with caution, due to small sample sizes in these fields.

Table 3: Cross Tabulation of Major Field of Study and Main Occupation in 2008 With Row and Column Percentages for Associate Degree Holders

	Main Occupation in 2008							
Major Field of Study in Associate Degree	Business	Health	STEM	Other Prof	Admin	Non-Prof.	No Occ.	Total
Business and communications	15 37	3 3	9 18	8 9	39 26	15 10	11 31	100 16
Health science	0 0	68 91	0 0	7 10	10 9	8 6	7 25	100 21
STEM	12 37	1 2	28 69	13 19	15 13	29 23	1 3	100 20
Academic majors, including social science and humanities	8 13	0 0	0 0	33 26	36 17	16 7	8 16	100 12
Other major including education and no major reported	3 13	2 4	3 12	17 37	27 35	44 53	5 25	100 31
Total	7 100	16 100	8 100	14 100	24 100	26 100	6 100	100 100

Note. Data are from the NLSY97 1997–2011, and are weighted using the 1997 cross-sectional weight. The sample is restricted to those with earnings in 2008, 2009, or 2010 whose highest educational credential is an associate degree. The first number in each cell is the row percentage; the second is the column percentage. Major-occupation match cells are outlined. Percentages from 20 through 40 are highlighted in light gray; percentages above 40 are highlighted in dark gray.

Finally, the cross tabulation in Table 4 for those with some college but no degree shows that these individuals were concentrated in the major fields of business and communications (21 percent), the other major category (17 percent), and the STEM subjects (16 percent). In addition, 12 percent of those with some college but no degree did not report a major. It is likely that many of these respondents did not progress far enough in their degree course to select a concentration, although it is important to note that all those coded as having some college reported completing at least one year of postsecondary education. Overall, only a quarter of the some college sample was employed in "professional" occupations (business and communications, health science, STEM fields, and other professional or managerial occupations); the remainder worked in administrative positions (30 percent) or non-professional jobs (36 percent). The incidence of related employment was generally low for those with some college but no degree, although the STEM and education categories should be interpreted with caution because of small cell sizes. Once again, the highest rates of matched employment occurred in the health sciences, where 24 percent of students and 41 percent of employees held related jobs. In the field of business and communications, only 11 percent of students and 33 percent of workers were in matched occupations.

Table 4: Cross Tabulation of Major Field of Study and Main Occupation in 2008 With Row and Column Percentages for Those With Some College but No Degree

Major Field of Study at Some College Level	Main Occupation in 2008: Business	Health	STEM	Education	Other Prof.	Admin	Non-Prof.	No Occ.	Total
Business and communications	11	2	2	2	9	36	29	8	100
	33	8	16	35	25	25	17	19	21
Health science	2	24	1	1	7	27	29	9	100
	3	41	5	10	9	9	8	10	10
STEM	2	4	6	0	7	24	47	11	100
	5	11	28	0	15	13	21	20	16
Education	7	8	5	4	7	24	39	5	100
	8	9	12	22	6	6	8	4	7
Social science	10	3	0	0	9	33	37	7	100
	17	6	2	0	14	13	12	9	12
Humanities and other academic majors	14	1	3	0	3	49	16	13	100
	11	1	5	0	2	9	2	8	5
Other major	5	3	3	2	9	25	45	8	100
	11	7	16	29	20	14	21	14	17
No major reported	7	9	4	1	5	32	31	12	100
	11	17	16	5	7	12	10	16	12
Total	7	6	3	1	7	30	36	9	100
	100	100	100	100	100	100	100	100	100

Note. Data are from the NLSY97 1997–2011, and are weighted using the 1997 cross-sectional weight. The sample is restricted to those with earnings in 2008, 2009, or 2010 whose highest educational credential is some college but no degree. The first number in each cell is the row percentage; the second is the column percentage. Major-occupation match cells are outlined. Percentages from 20 through 40 are highlighted in light gray; percentages above 40 are highlighted in dark gray.

Annual Earnings by College Major

Figures 1, 2, and 3 display average gross annual earnings by college major for bachelor's degree holders, associate degree holders, and those with some college but no degree, respectively. Unlike Tables 2, 3, and 4, the samples in these figures include both workers and non-workers, with a value of zero assigned to those with no earnings in 2008, 2009, or 2010. At the bachelor's degree level, those with degrees in STEM subjects earned the most (nearly $55,800 annually), followed by those with majors in health (just over $50,600) and business (close to $48,700). At the bottom end of the earnings distribution are those with majors in education (just over $32,600) and humanities (just over $33,000), in comparison to an average of approximately $44,500 for all bachelor's degree recipients.

Figure 1: Weekly Earnings by Bachelor's Degree Major

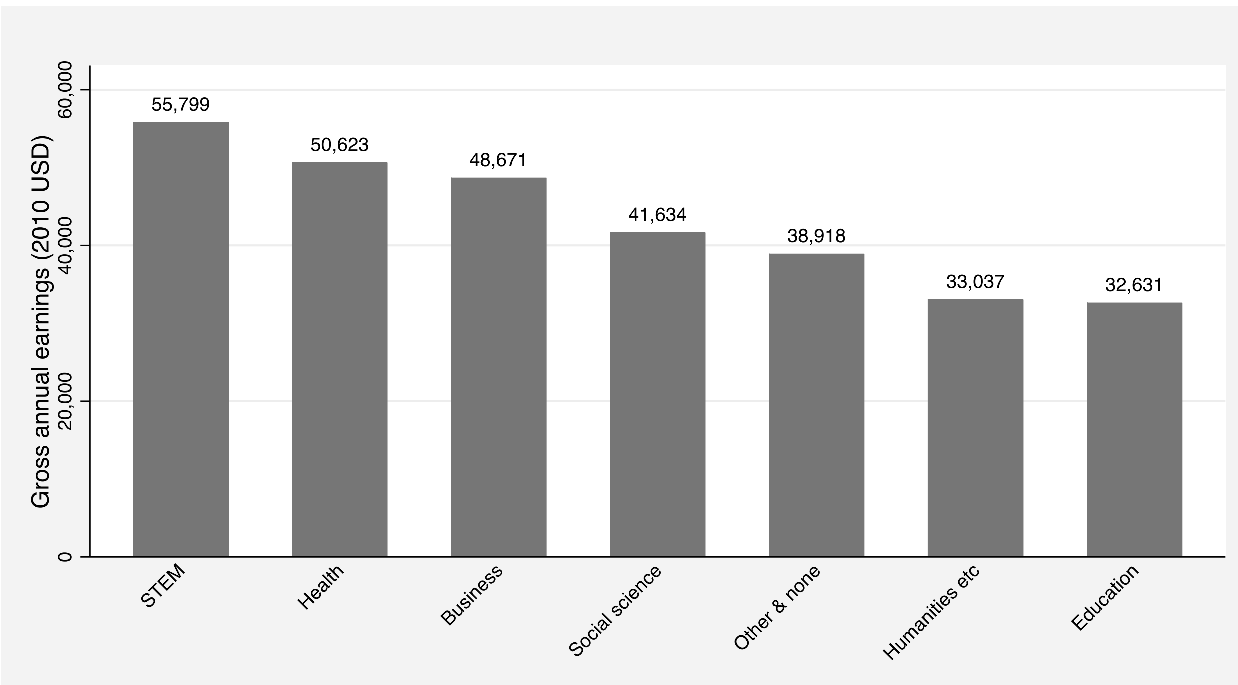


Figure 2: Weekly Earnings by Associate Degree Major

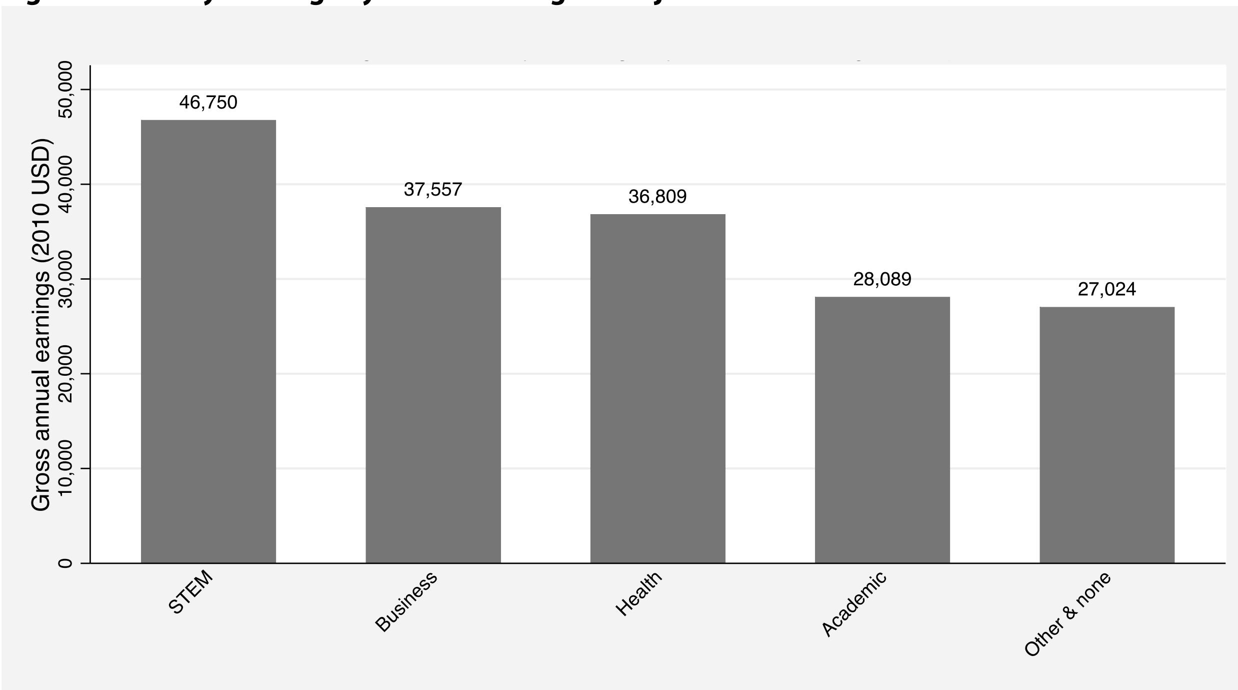
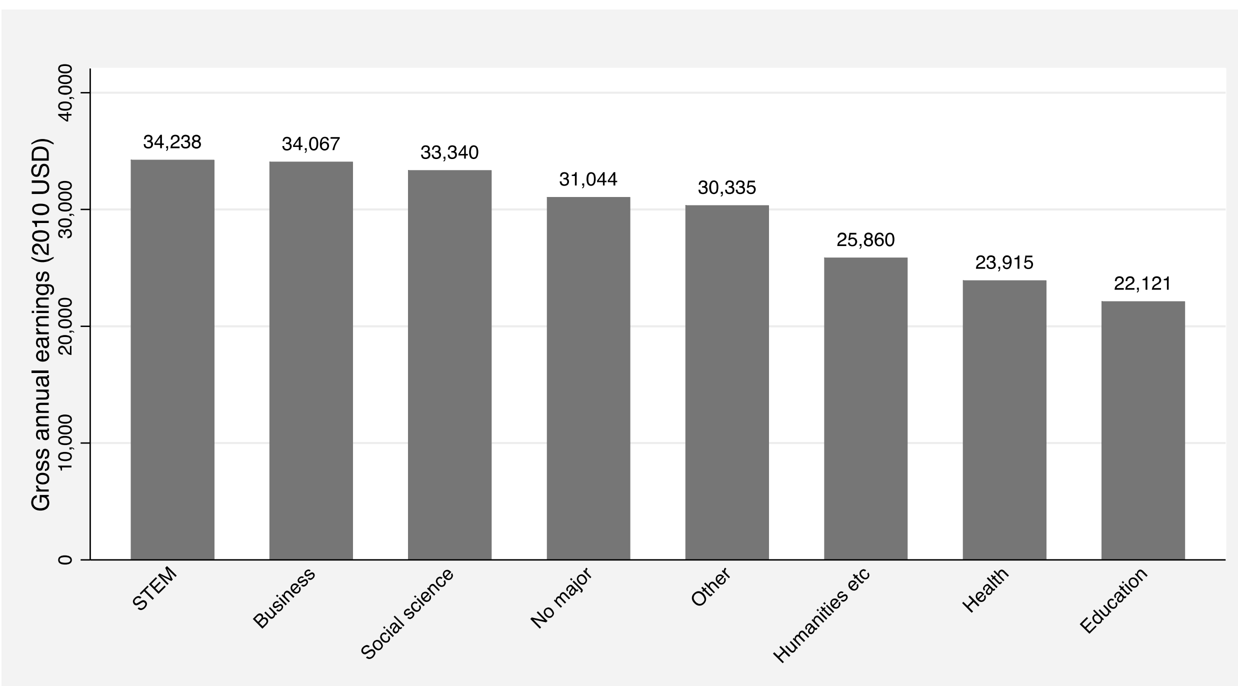


Figure 3: Weekly Earnings by Major for Respondents With Some College



Note. Data in Figures 1, 2 and 3 are from the NLSY97 1997–2011, and are weighted using the 1997 cross-sectional weight. Figure 1 shows average earnings for bachelor's degree holders, Figure 2 shows average earnings for associate degree holders, and Figure 3 shows average earnings for those with some college but no degree. The samples include workers and non-workers.

At the associate degree level, the graduates who earned the most were those with degrees in the STEM subjects ($46,750), business (more than $37,500) and health (just over $36,800), while those with academic majors earned substantially less (just under $28,100). Average annual earnings for associate degree holders overall were just under $35,000. It is likely that many of those with associate degrees in academic subjects had planned to transfer to four-year institutions and complete bachelor's degrees. It is interesting to note that early in their careers, those with associate degrees in STEM, business, and health subjects actually earned more on average than bachelor's degree recipients who majored in education or the humanities.

Among those with some college but no degree, those who reported majors in STEM subjects and business once again had the highest earnings (approximately $34,200 and $34,000, respectively), while those with education majors earned the least (just over $22,100). In contrast to bachelor's and associate degree holders, however, those with some college who majored in health had relatively low earnings (just over $23,900), while social science majors earned $33,340, more than the overall average of about $30,600. There was substantial overlap in earnings between the associate degree and some college categories, with respondents in five of the seven some college major categories earning more than the two least lucrative majors among those with associate degrees.

Returns to Education by Attainment Level

Table 5 displays OLS results for annual earnings regressed on the educational attainment categories, without disaggregating by college major.[18] Model 1 includes only the degree indicators, with high school diploma as the reference category. Model 2 adds work experience and the demographic control variables (age, gender, race and ethnicity, work experience, and region at baseline), and Model 3 also incorporates measures of ability and family socioeconomic status (ASVAB score, high school GPA, household income at baseline, and father's education).

The preferred specification in Model 3 indicates that in comparison with having a high school diploma, those with no educational credential experienced an earnings penalty of approximately $5,000 per year, while those with a GED earned nearly $3,000 less. By contrast, having some college but no degree is associated with a small but statistically significant premium of nearly $3,700 annually, associate degree holders enjoyed a benefit of approximately $7,800, bachelor's degree recipients earned nearly $18,000 more per year, and those with graduate degrees experienced a premium of over $35,000.

[18] These specifications include both workers and non-workers.

Table 5: Earnings Regressed on Highest Educational Credential

Highest Educational Credential	(1) No Controls	(2) Demog-raphics	(3) Ability & SES	(4) Males	(5) Females
No educational credential	–12,410*** (1,105)	–7,494*** (996)	–5,031*** (1,015)	–6,760*** (1,462)	–2,483* (1,364)
GED	–6,341*** (1,123)	–4,060*** (996)	–2,877*** (997)	–4,155*** (1,414)	–47 (1,358)
Some college, no degree	6,147*** (971)	6,206*** (858)	3,677*** (873)	3,955*** (1,276)	3,202*** (1,141)
Associate degree	10,467*** (1,470)	10,394*** (1,302)	7,804*** (1,309)	7,674*** (2,040)	8,764*** (1,599)
Bachelor's degree	20,041*** (904)	23,944*** (823)	17,863*** (978)	17,608*** (1,513)	18,529*** (1,204)
Graduate degree	36,053*** (2,060)	42,839*** (1,851)	35,237*** (1,959)	31,235*** (3,703)	38,636*** (2,129)
Observations	5,074	5,074	5,074	2,726	2,348
R-squared	0.200	0.384	0.402	0.367	0.439

Note. Data are from the NLSY97 1997–2011, and are weighted using the 1997 cross-sectional weight. All models show OLS regressions results. The sample includes both workers and non-workers. The outcome is (unlogged) gross annual earnings averaged over 2008, 2009, and 2010, with a value of zero assigned to those with no earnings. The reference category for highest educational credential is a high school diploma. Model 1 does not include any control variables. Model 2 includes age, gender, race, region of residence at baseline, work experience in hours, the square of work experience, and indicators for missing data on earnings and work experience by year. Model 3 adds ASVAB percentile score, high school GPA, household income in 1997, father's education in years, and indicators for missing data on these variables. Model 4 presents results with all control variables for men only, and Model 5 presents results for women only.

Standard errors in parentheses. *** $p < .01$, ** $p < .05$, * $p < 0.1$.

These results are roughly consistent with data from the 2012 Current Population Survey (CPS) on median 2011 earnings by educational attainment level, as reported by the College Board's *Education Pays 2013* report (Baum, Ma & Payea, 2013). Baum et al. found that college graduates earned $21,000 more than those with only a high school diploma in 2011, while associate degree recipients enjoyed a premium of $9,400, and those with some college were paid $5,000 more.

A comparison of the first three models suggests the existence of substantial selection bias in Model 1, which does not account for systematic differences among those who obtained advanced levels of education and those who did not. At all attainment levels, the effect of education on earnings shrinks in magnitude between Model 1 and Model 3 as control variables are added. However, the impact of the control variables on the coefficients decreases monotonically as educational attainment increases, from a very large 59 percent reduction in the absolute value of the coefficient at the level of no credential to a tiny 2 percent reduction among those with graduate degrees. Coefficients shrink by 11 percent, 25 percent, and 40 percent at the bachelor's, associate, and some college levels, respectively. The differential effect of the control variables suggests that negative selection in terms of ability and socioeconomic status for those with low levels of educational attainment may be a much more serious problem than positive selection for those with advanced degrees.

It is also interesting to note that coefficients at the bachelor's and graduate degree levels actually increase when demographics are added in Model 2, before decreasing with the incorporation of ability and family socioeconomic status, although the demographic variables have the opposite effect at lower levels of attainment. This phenomenon is likely a product of controlling for gender, as the wage gap between high school and four-year college graduates is larger when disaggregated by gender than in the overall sample.

Models 4 and 5 in Table 5 display the returns to educational attainment separately for men and women, respectively. Consistent with the literature, the returns to associate, bachelor's, and graduate degrees were larger for women than for men (for example, see Bailey & Belfield, 2013). Specifically, the return to an associate degree was 14 percent larger for women compared with men, while the return to a bachelor's degree was 5 percent larger. In addition, the negative impact of having a GED or no educational credential was much smaller for women than for men and was not statistically significant for the former group.

Returns to Education by College Major

Table 6 presents OLS results for annual earnings and employment regressed on college major, educational attainment, and a rich set of control variables (Equation 1). As with Table 5, Model 1 includes only educational attainment and the major indicators, while Model 2 adds demographics and Model 3 incorporates ability and socioeconomic status. The reference category for the educational attainment and major indicators is those with a high school diploma. Therefore, the returns to the bachelor's degree majors can be interpreted as the return to having a bachelor's degree in a given subject compared with having only a high school diploma, with comparable interpretations applying to subjects at the associate degree and some college levels.

Table 6: Earnings and Employment Regressed on Major Field of Study

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Unlogged Earnings						Logged Earnings	Weeks Employed
Major Field of Study	Majors Only	Demo-graphics	Ability & SES	Males	Females	Workers Only	Workers Only	
Bachelor's degree								
Business and communications	24,214*** (1,331)	27,404*** (1,221)	21,169*** (1,323)	20,377*** (2,039)	21,964*** (1,625)	20,053*** (1,372)	0.887*** (0.065)	9.8*** (0.9)
Health science	26,165*** (3,064)	33,765*** (2,730)	27,628*** (2,753)	22,162*** (6,031)	31,061*** (2,773)	26,848*** (2,839)	1.202*** (0.135)	13.4*** (1.9)
STEM	31,341*** (1,937)	33,188*** (1,753)	26,849*** (1,838)	25,008*** (2,554)	29,266*** (2,599)	25,084*** (1,885)	0.916*** (0.089)	10.3*** (1.3)
Education	8,174*** (2,420)	15,110*** (2,192)	10,118*** (2,214)	8,989 (5,597)	12,200*** (2,173)	9,616*** (2,315)	0.741*** (0.110)	8.4*** (1.6)
Social science	17,176*** (1,811)	20,847*** (1,633)	15,796*** (1,676)	17,940*** (2,633)	14,047*** (2,015)	15,058*** (1,746)	0.684*** (0.083)	9.3*** (1.2)
Humanities and other academic majors	8,579*** (2,362)	14,241*** (2,125)	8,307*** (2,175)	1,982 (3,718)	13,760*** (2,457)	7,225*** (2,253)	0.503*** (0.107)	8.1*** (1.5)
Other major and no major reported	14,461*** (1,989)	18,359*** (1,790)	11,858*** (1,856)	7,429** (3,004)	16,200*** (2,176)	10,251*** (1,912)	0.617*** (0.091)	10.6*** (1.3)
Associate degree								
Business and communications	13,100*** (3,322)	11,875*** (2,964)	9,118*** (2,936)	6,701 (5,562)	12,888*** (3,115)	8,570*** (3,055)	0.377*** (0.145)	3.2 (2.1)
Health science	12,351*** (2,979)	17,932*** (2,653)	15,234*** (2,631)	10,660 (7,484)	17,360*** (2,483)	14,777*** (2,723)	0.729*** (0.129)	6.5*** (1.9)

STEM	22,292***	16,803***	14,653***	14,485***	11,212**	13,939***	0.562***	6.2***
	(3,028)	(2,708)	(2,681)	(3,339)	(5,148)	(2,743)	(0.130)	(1.9)
Academic majors, including social science and humanities	3,632	4,199	1,278	8,070	–3,155	263	–0.148	-0.0
	(3,997)	(3,544)	(3,509)	(5,537)	(4,190)	(3,595)	(0.171)	(2.5)
Other major inc. education and no major reported	2,567	3,206	559	1,872	–929	–602	–0.081	1.9
	(2,470)	(2,204)	(2,194)	(3,215)	(2,862)	(2,252)	(0.107)	(1.5)
Some college, no degree								
Business and communications	9,609***	8,827***	6,378***	5,874**	6,427***	5,760***	0.307***	4.4***
	(1,807)	(1,599)	(1,592)	(2,324)	(2,074)	(1,658)	(0.079)	(1.1)
Health science	–543	3,520*	1,529	607	1,922	2,615	0.244**	−0.9
	(2,393)	(2,120)	(2,098)	(4,163)	(2,169)	(2,279)	(0.108)	(1.5)
STEM	9,781***	7,091***	4,401**	3,739*	4,428	3,964**	0.195**	2.2*
	(2,021)	(1,795)	(1,788)	(2,170)	(3,886)	(1,865)	(0.089)	(1.3)
Education	–2,336	1,842	–599	291	–118	–1,202	–0.064	1.2
	(2,967)	(2,627)	(2,602)	(5,093)	(2,700)	(2,733)	(0.130)	(1.8)
Social science	8,882***	8,673***	6,261***	7,477**	5,245**	5,769***	0.332***	1.7
	(2,351)	(2,081)	(2,067)	(3,215)	(2,499)	(2,149)	(0.102)	(1.5)
Humanities and other academic majors	1,403	4,328	1,046	835	2,587	1,556	0.341**	1.6
	(3,337)	(2,954)	(2,933)	(4,764)	(3,433)	(3,133)	(0.149)	(2.1)
Other major	5,878***	5,762***	2,730	4,288*	620	1,148	0.194**	5.2***
	(2,017)	(1,788)	(1,783)	(2,505)	(2,461)	(1,825)	(0.087)	(1.3)
No major reported	6,587***	4,653**	3,038	1,941	4,677	2,698	0.136	1.3
	(2,331)	(2,064)	(2,041)	(2,837)	(2,869)	(2,138)	(0.101)	(1.4)
Observations	5,074	5,074	5,074	2,726	2,348	4,567	4,567	5,211
R-squared	0.226	0.402	0.420	0.381	0.467	0.385	0.378	0.345

Note. Data are from the NLSY97 1997–2011, and are weighted using the 1997 cross-sectional weight. All models show OLS regressions results. In Models 1 through 5, the outcome is unlogged gross annual earnings averaged over 2008, 2009, and 2010, with a value of zero assigned to those with no earnings. Model 1 includes only indicators for educational attainment for those whose highest credential is no credential, a GED, or a graduate degree, with high school diploma as the reference category. Model 2 adds age, gender, race, region of residence at baseline, work experience in hours, the square of work experience, indicators for missing data on earnings and work experience by year, and indicators for having a second major at the bachelor's or associate level. Model 3 adds ASVAB percentile score, high school GPA, household income in 1997, father's education in years, and indicators for missing data on these variables. Model 4 shows results with all control variables for men only, and Model 5 shows results for women only. Models 6 through 8 include both men and women, and all control variables. Model 6 restricts the sample to those with a positive value for earnings, and Model 7 uses the natural log of (positive) earnings as the outcome. Model 8 uses weeks worked per year averaged over 2008, 2009, and 2010 as the outcome, with non-workers included and assigned a value of zero. Model 8 also includes indicators for missing data on weeks worked by year, and does not include indicators for missing data on earnings.

Standard errors in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$.

Model 3, the preferred specification, shows significant and substantially large returns to all majors for bachelor's degree holders. The annual premium ranged from a high of more than $27,600 for health science and nearly $27,000 for STEM subjects in comparison with a high school diploma to a low of just over $8,000 for humanities and other academic majors and $10,000 for education. A business major is also associated with a large increase in annual earnings of just over $21,000, while social science offered a benefit of nearly $16,000.

Among associate degree holders, majors in health science and the STEM subjects both provided a statistically significant return of approximately $15,000 per year, while a degree in business and communications offered a benefit of just over $9,000. By contrast, the academic subjects provided a statistically insignificant premium of just over $1,000. As mentioned above, these results should be interpreted with caution due to relatively small sample sizes for the associate degree major categories.

Finally, those with some college but no degree who reported a major in business and communications or social science enjoyed a statistically significant wage premium of about $6,000, while those who studied STEM subjects received an annual benefit of about $4,500. Interestingly, reporting a major in social science is also associated with a statistically significant increase in earnings of more than $6,000. The returns to health science and humanities and other academic majors at the some college level are positive but substantively small and statistically insignificant, while an education major is associated with a statistically insignificant earnings penalty.

In summary, the returns to bachelor's degrees are relatively large and statistically significant for all majors, although the career-oriented fields of business, health, and STEM offered much larger premiums than the humanities and the vocational but low-return field of education. At the associate degree level, only the results in the high-return fields of business, health, and STEM are statistically significant. As suggested by the descriptive statistics in Figures 1 and 2, an associate degree in health or STEM provided a larger economic benefit than a bachelor's degree in education or the humanities. These results are consistent with many other studies in the literature that report high returns for STEM, business, and health and low or negative premiums for education and the humanities (for example, Carnevale & Cheah, 2013; Zhang, 2009)

As discussed above, this study provides the first comprehensive estimates of the returns to reported major among those with some college but no degree. It is interesting that while the conventional high-return subjects of business and the STEM fields offered a significant premium to those who did not graduate, health science did not. Furthermore, it is perhaps surprising that a major in social science provided a return of $6,261, which is 70 percent larger than the overall return to some college of $3,677. The benefit of a social science major without a degree is consistent with the interpretation of traditional liberal arts subjects as general human capital that improves productivity and raises earnings without providing specific vocational skills. The absence of a return to majoring in health science without obtaining a degree may indicate that many health occupations have strict credentialing requirements, such that acquiring skills without a qualification does not help workers gain employment or raise their earnings.

An examination of the first three models of Table 6 indicates that as expected, selection bias is an important concern when estimating the returns to college major. At the bachelor's degree level, coefficients change modestly from Model 1 to Model 3 as control variables are added, with the largest difference a 14 percent decrease in the magnitude of the return to a STEM degree. As with the overall return to a bachelor's degree, the returns to individual majors at the bachelor's level actually increase when demographics are added to the model, dramatically so for the subjects of health science, education, and the humanities.

Interestingly, it appears that the direction of the selection bias induced by the control variables including ability and socioeconomic status varies among majors at the bachelor's degree level. Between Model 1 and Model 3, coefficients decrease for business and communications, social science, humanities, other majors, and the STEM fields, but increase for health science (by 6 percent) and education (by 24 percent). These trends suggest that young people who study health science and education are negatively selected in terms of ability, socioeconomic status, and demographics, while those in other fields, in particular STEM, are positively selected. This result is logical for education, which offers relatively low returns, but seems counterintuitive for health science, which is an extremely lucrative degree.

A similar pattern obtains at the associate degree level, with the return to business and communications, STEM, and academic majors decreasing between Model 1 and Model 3, while the premium associated with health science rises. The magnitude of these changes is larger than among bachelor's degree holders, with the health science coefficient increasing by 23 percent and the STEM return decreasing by fully 34 percent. Among those with some college but no degree, all coefficients decrease in absolute value from Model 1 to Model 3, with the return to STEM subjects falling by 55 percent.

Model 4 and Model 5 present gender-specific versions of the preferred specification in Model 3. Similar to the overall returns to degree level in Table 6, benefits associated with individual majors are generally larger for women than for men. Specifically, the return to a bachelor's degree in health science is 40 percent larger for women than for men, while the return to humanities and other academic majors is nearly seven times as large. Indeed, a bachelor's degree in the humanities provides a very small and statistically insignificant return for men, in comparison to a high school diploma. The returns to a bachelor's degree in education and associate degrees in business and health science are also insignificant for men, and are dramatically smaller in magnitude than the comparable premiums for women. These gender differentials are similar to those found in the literature (again, see Bailey & Belfield, 2013). By contrast, the return to social science is larger for men than for women at all attainment levels, as is the benefit associated with an associate degree in the STEM subjects.

Model 6 is identical to the preferred specification in Model 3, except that the sample is restricted to those with a positive value for earnings in 2008, 2009, or 2010. Results for workers only are in general modestly smaller but very similar to those for the entire sample, suggesting that some portion of the returns to postsecondary education compared with a high school diploma may be due to an increased probability of employment. Model 7 examines logged earnings as the outcome, again restricting the sample to those who are employed, in order to compare these results with the literature on the returns to college major, which primarily uses logged earnings as the outcome.

Findings in Model 7 are consistent with Model 3, with high returns accruing to health science, STEM, and business at the bachelor's and associate degree level, and to STEM, business and social science among those with some college but no degree. A major in the STEM subjects, for example, is associated with a 150 percent increase in earnings for those with a bachelor's degree, a 75 percent increase among associate degree holders, and a 22 percent increase for those with some college, in comparison with only having a high school diploma. In contrast to Model 3, in Model 6 a bachelor's degree in education offers a relatively robust return of 110 percent. In addition, majoring in health science without obtaining a postsecondary credential is associated with a statistically significant 28 percent increase in earnings in Model 6, while in Model 3 the health science coefficient for those with some college is small and statistically insignificant.

Finally, Model 7 displays OLS results for weeks worked per year regressed on educational attainment, college major and the full set of control variables. At the bachelor's degree levels, all majors are associated with a statistically significant increase in the number of weeks worked, with the size of the effect ranging from approximately 8 to 10 weeks with the exception of health science, which raises the number of weeks worked by more than 13 weeks. At the associate degree level, health science and STEM are associated with an increase in the number of weeks worked by between six and seven weeks, while the other majors do not have a significant impact. Among those with some college but not degree, only majors in business and the other major category increase the number of weeks worked, by approximately five weeks.

Related Employment and Earnings

Table 7 presents OLS results for estimates of Equation 2, which includes indicators for college major, occupation, and major–occupation interactions at the bachelor's degree, associate degree, and some college levels. It is important to note that the results in Table 7 constitute a single regression specification that is similar to Model 3 of Table 6, but is restricted to those with positive earnings in 2008, 2009, or 2010 and includes the occupation and match dummies. Those with administrative, clerical, and sales occupations comprise the reference category for the occupation indicators.

Table 7: Earnings Regressed on Major Field of Study, Occupation, and Major-Occupation Interactions

Major Field of Study and Occupation Category	Major	Occupation	Major–Occupation Interaction
Bachelor's degree			
Business and communications	21,040***	15,627***	–8,423***
	(1,706)	(2,323)	(2,927)
Health science	18,006***	–4,229	22,707***
	(4,231)	(3,861)	(6,499)
STEM	14,772***	6,575**	14,604***
	(2,826)	(2,955)	(4,238)
Education	10,954***	–9,664***	11,850**
	(3,954)	(2,324)	(4,939)
Social science	17,016***		
	(2,099)		
Humanities and other academic majors	12,105***		
	(2,533)		
Other major and no major reported	14,196***		
	(2,242)		
Other professional and managerial occupations		–119	
		(1,840)	
Non-professional and low-skill occupations		–6,069***	
		(2,025)	
No occupation reported		15,715*	
		(8,401)	

Associate degree			
Business and communications	5,495	5,347	13,879
	(3,599)	(5,104)	(9,445)
Health science	1,622	–4,186	23,438**
	(5,824)	(10,047)	(11,697)

STEM	12,156***	17,353***	–14,501*
	(3,885)	(6,320)	(8,331)
Academic majors, including social science and humanities	841		
	(3,995)		
Other major inc. education and no major reported	–1,975		
	(3,166)		
Other professional and managerial occupations		356	
		(3,709)	
Non-professional and low-skill occupations		4,944	
		(3,362)	
No occupation reported		–14,023	
		(8,963)	
Some college, no degree			
Business and communications	7,619***	15,521***	–7,861
	(1,951)	(2,862)	(5,153)
Health science	2,211	2,105	7,105
	(2,744)	(3,329)	(5,734)
STEM	5,018**	10,613**	10,133
	(2,223)	(4,361)	(7,740)
Education	1,036	4,494	–5,476
	(3,031)	(4,687)	(10,168)
Social science	6,880***		
	(2,364)		
Humanities and other academic majors	3,123		
	(3,167)		
Other major	4,690**		
	(2,129)		
No major reported	4,305*		
	(2,356)		

Other professional and managerial occupations		4,279* (2,441)
Non–professional and low–skill occupations		–4,594*** (1,695)
No occupation reported		1,884 (5,723)
Observations	4,567	
R-squared	0.430	

Note. This table presents results from a single OLS regression. Data are from the NLSY97 1997–2011, and are weighted using the 1997 cross-sectional weight. The sample is restricted to those with a positive value for earnings in 2008, 2009, or 2010. The outcome is unlogged gross annual earnings averaged over 2008, 2009, and 2010. The reference category for occupation is administrative, clerical and sales occupations. Respondents are coded as having a particular occupation if they reported this occupation in their main job in 2008, 2009, or 2010. Therefore, neither the occupation nor the interaction indicators are mutually exclusive, although the major indicators are mutually exclusive. The model also includes indicators for educational attainment for those whose highest credential is a GED or graduate degree (with high school diploma as the reference category) and indicators for having a second major at the bachelor's or associate degree level. In addition, the model controls for age, gender, race, region of residence at baseline, work experience in hours, the square of work experience, ASVAB percentile score, high school GPA, household income in 1997, and father's education in years, and includes indicators for missing data on earnings (by year), work experience (by year), ASVAB score, GPA, household income, and father's education. Finally, the model includes indicators by attainment level for reporting more than one main occupation in 2008 through 2010.

Standard errors in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$

With the addition of the occupation and match variables, the health science coefficient at the bachelor's degree level, for example, can now be interpreted as the return to a bachelor's degree in health science relative to a high school diploma, holding constant occupation and excluding any interaction effect that occurs when someone both studies and works in health science. Similarly, the STEM occupation coefficient at the associate degree level estimates the return to having an associate degree and working in a STEM field, in comparison with having an associate degree and working in an administrative, sales, or clerical job. Finally, the match coefficients estimate the additional premium or penalty associated with both studying and being employed in a particular field, controlling for the main effect of that major and occupation. Match variables only exist for the four vocationally oriented major fields, namely business and communications, health science, STEM, and education.

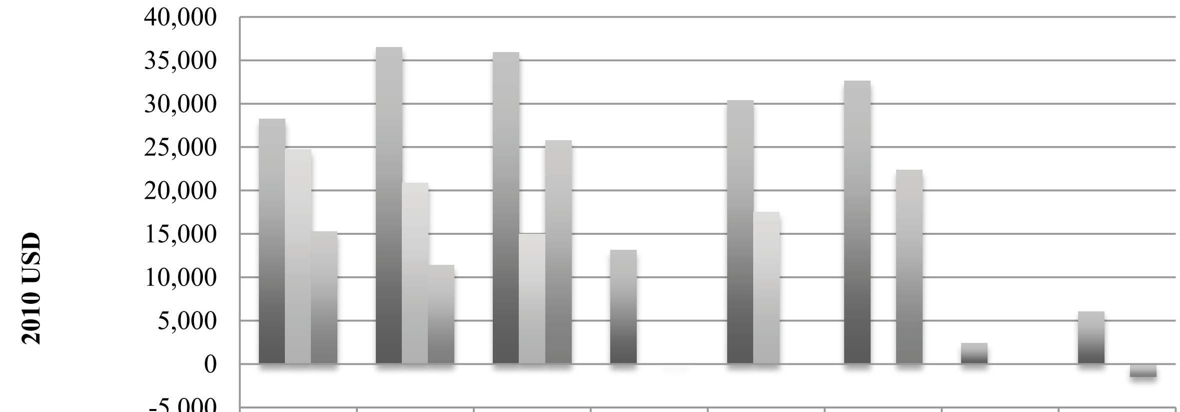
At the bachelor's degree level, all the major coefficients remain positive, statistically significant, and generally similar in magnitude to Model 3 of Table 6, although the health science and STEM returns are noticeably smaller. Compared with the omitted occupation category of administrative, clerical, and sales jobs, only business and STEM occupations offer a statistically significant annual premium, of about $15,600 and $6,600, respectively. As might be expected, non-professional occupations are associated with an earnings penalty of about $6,000, while a job in education lowered earnings by nearly $9,700.

All four of the match coefficients at the bachelor's degree level are statistically significant and substantial in size. These estimates imply that there is a positive interaction between major and occupation in the fields of health science, STEM, and education. Specifically, both studying and working in these areas provided an annual earnings premium of approximately $22,700 for health science, $14,600 for STEM, and $11,850 for education, holding constant the main effects of major and occupation. These positive interactions suggest that majoring in these career-oriented fields may indeed provide specific human capital.

By contrast, the match coefficient on business and communications is negative, indicating that both studying and working in the field of business lowers earnings by about $8,400 after controlling for the main effects of major and occupation. To interpret this negative interaction, it is useful to consider the overall return to matched employment in business, including the major, occupation, and interaction coefficients, and compare this quantity to other possible major and occupation choices. Figure 4 displays estimated returns to selected major and occupation combinations at different attainment levels, calculated using the coefficients in Table 7. The total return to matched employment in business and communications for bachelor's degree holders compared with a high school diploma is $28,244, derived by adding together the major coefficient of $21,040, the occupation coefficient of $15,627, and the interaction coefficient of –$8,423. The main effects of both major and occupation for business are larger than any other field at the bachelor's degree level. Therefore, the overall return to a "business match" is still quite substantial, despite the negative interaction coefficient. However, those who majored in STEM or social science but worked in business actually enjoyed a larger total premium than the matched business majors, of $30,399 and $32,643, respectively. As discussed above, Table 2 reveals that non-negligible portions of both STEM and social science majors do indeed work in business. These results suggest that studying business does provide economically valuable human capital, as evidenced by the large main effect of a business major, but that a major in social science or STEM may actually instill skills and knowledge that is even more useful to business employers.

Figure 4 also demonstrates that the largest overall return— nearly $36,500—was enjoyed by those who studied and were working in health science, followed closely by those in matched employment in the field of STEM, who experienced a premium of nearly $36,000. It is important to note that the occupation coefficient for STEM is relatively small while the health science occupation coefficient is actually negative, although statistically insignificant. These results suggest that the substantial economic benefits of these working in these fields only accrue to those who have acquired relevant training through their college major. Similarly, the negative main effect of working in education is more than compensated for by the positive education match coefficient. Thus the overall premium associated with matched employment in education is about $13,000, only modestly smaller than the overall return to a bachelor's degree of about $18,000.

Figure 4: Estimated Returns to Major and Occupation



	Business match	Health science match	STEM match	Education match	STEM major, Business job	Social science major, Business job	Humanities major, Education job	Humanities major, Non-professional job
Bachelor's Degree	28,244	36,484	35,951	13,140	30,399	32,643	2,441	6,036
Associate's Degree	24,721	20,874	15,008		17,503			
Some College	15,279	11,421	25,764	54		22,401		-1,471

Note. This figure presents the estimated returns to bachelor's degrees, associates degrees, and some college with no degree for selected combinations of majors and occupations, as displayed in Table 7. Data are from the NLSY97–1997–2011.

By contrast, those who studied the humanities but worked in education experienced a very small overall return of under $2,500, which is even lower than the premium of about $6,000 that accrued to those with degrees in the humanities employed in non-professional and low-skill occupations. Education and non-professional occupations were the two most common employment destinations for those with bachelor's degrees in the humanities, according to Table 2.

At the associate degree level, very few coefficients in the major–occupation match specification in Table 7 are statistically significant. The main effects of major and occupation in STEM are large, positive, and significant, but the match coefficient is large and negative, although only marginally significant. The overall return to related employment in STEM among associate degree recipients is just over $15,000, which is larger than the premium associated with matched employment in education at the bachelor's degree level. The only significant match coefficient at the associate degree level is for health science. It is interesting to note that the main effect of an associate degree in health science is extremely small while the health science occupation coefficient is actually negative. Thus although matched employment in health science provides a large return of nearly $21,000, neither the occupation nor the major appears to offer much of an economic benefit in the absence of the interaction. Matched employment in business also appears to provide a large return of nearly $25,000, but this result should be interpreted with caution, as none of the business coefficients at the associate level are statistically significant.

Finally, there is little evidence of a return to related employment among those with some college but no degree, as none of the match coefficients are statistically significant. The main effects of major are similar to the comparable coefficients in Table 6. In comparison with the omitted category of administrative occupations, a job in business or STEM offered a significant earnings premium, while non-professional positions are associated with a wage penalty. Given that the interaction coefficients are not significant, the estimated returns to matched employment at the some college level in Figure 4 should not be given much weight. It is interesting to note, however, the relatively large return of about $22,400 to studying social science and then working in business.

In summary, the findings presented in Table 7 support the notion that certain college majors instill specific human capital that is particularly useful in linked occupations. At the bachelor's degree level, those who work in health science and STEM earn high salaries only if they hold a related degree, while an associate degree in health science is highly lucrative for those who work in that field, but not otherwise. On the other hand, there is evidence that bachelor's degree in many subjects, including both the academic field of social science and the career-oriented STEM subjects, provide robust returns regardless of where graduates work. Thus it seems that even some explicitly vocational subjects should not be interpreted as solely providing specific human capital. It may be that a major in STEM, for example, offers both technical skills that are required in obviously related occupations and more general quantitative or critical thinking skills that are useful in fields such as business.

6. Conclusion

This study explores the complex relationship between college major, occupation, and early-career annual earnings. The analysis contributes to the literature by providing nationally representative estimates of the returns to college major using a relatively underutilized ongoing survey—the National Longitudinal Survey of Youth of 1997 (NLSY97)—that includes some of the first longitudinal data from the Great Recession period. In addition, I create a crosswalk between college major and occupation to measure related employment and provide initial estimates of the effect of college major on earnings for those with some college but no degree.

Results suggest that rates of matched employment in career-oriented majors are generally between 40 and 60 percent among bachelor's degree recipients, but much lower for those with some college but no degree. At the associate degree level, the field of health science in particular exhibits a high incidence of related employment.

I find that the early-career returns to postsecondary education vary greatly by college major as well as level of attainment. Consistent with the literature, I estimate large premiums associated with bachelor's and associate degrees in health science, STEM subjects, and business, and much smaller benefits for degrees in education and the humanities at the bachelor's level and academic majors generally at the associate level. The returns to bachelor's degrees are generally larger than the comparable premiums for associate degrees, although high-return subjects at the associate level are more economically valuable than low-return bachelor's degree majors. Among those with some college but no degree, I find modest but statistically significant returns associated with a reported major in business, STEM, and social science.

Finally, I find a positive and statistically significant premium associated with matched employment in the fields of health science, STEM, and education at the bachelor's degree level, but a negative return associated with the interaction of studying and working in business and communications. Among those with associate degrees, matched employment provides a positive and significant return in the field of health science only, while none of the major–occupation interactions are significant for those with some college but no degree.

While the preferred specifications control for measures of ability and family socioeconomic status, the analysis remains vulnerable to selection bias induced by unobserved individual preferences and characteristics. Therefore, this study should be interpreted as providing descriptive rather than causal estimates.

The data used in this analysis include early-career earnings information from the height of the Great Recession, which may affect the pattern or magnitude of results. It is important to note that all subjects at the bachelor's degree level and several major fields among those with associate degrees and some college provide a substantial economic return in this period, despite the chaos in the labor market. It is possible that college major has a greater effect on employment and earnings in a slack labor market, when competition for jobs is more intense and employers can be more selective. On the other hand, it may be that the benefits of postsecondary schooling are lower in a period of recession than they would be otherwise. As additional years of NLSY97 data become available, it will be possible to explore whether the returns estimated in this study are influenced by changing economic conditions.

It is also important to note that this study analyzes only three years of earnings data collected early on in sample members' working careers. It is highly likely that the returns to college major and related employment change over the course of individuals' working lives. Indeed, there is evidence that the returns to education grow over time. As more information is collected on the NLSY97 sample, it will be possible to examine how the returns to major develop as these individuals age.

Taken together, these results support the theory that some forms of postsecondary education function as specific training that offer a boost in productivity and earnings in matched occupations in particular. However, these findings also suggest that even career-oriented fields such as STEM can offer a substantial premium in jobs that are not explicitly related, challenging the notion that specific versus general training constitutes a strict dichotomy.

While these findings are tentative, they have potentially important policy implications for educators as well as for young people selecting a college major. Although students may be aware of the distinction between fields linked to high-earning occupations and majors with limited professional prospects, this study reveals that students also face a more nuanced tradeoff between narrow and broad applicability. Further research is needed to test the robustness of these findings and shed light on the mechanisms by which postsecondary education affects labor market outcomes.

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