College Majors and Programs: Choices and Returns

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Higher Education

Introduction

One goal of post-secondary education is for students to have the opportunity to learn the skills needed to enter the workforce, with their career options largely depending on their choice of curriculum and major. The types of skills developed and, hence, the types of jobs available to, for example, engineering majors differ from those available to humanities majors and noncollege graduates. Since wages and employment opportunities across occupations vary considerably, the labor market benefits of picking particular majors vary as well. Students not only care about the financial returns to specific majors but also consider a variety of other factors when deciding on their major.

Importantly, students do not make these decisions in isolation. Their decisions are shaped by their environments, including the behavior of their peers and the opportunities created (or limited) by the institutions at which they are enrolled. These decisions are also shaped by public policies at the local, state, and federal levels that alter the costs and benefits of studying certain subjects. Based on all these factors, there is considerable variation across students in their choice of majors. How many and which students choose to study certain subjects have broad implications for society, as these matters affect economic inequality, racial and gender disparities, and the social return on investment from funding education.

This chapter covers research on the causes and consequences of major and program choice. We first highlight who chooses each type of program. We then provide evidence on what factors shape students' choices—including students' priorities, public policies, and the role of educational institutions—and the labor market returns to these choices. Based on the evidence available, most of this discussion centers on students in bachelor's degree programs, but we discuss the evidence on two-year institutions and graduate programs when available.

Key findings

Key finding #1: *Major choices vary widely across different types of students in terms of gender, race, family background, and academic preparation.*

Differences by gender and, in particular, the underrepresentation of women in science, technology, engineering, and math (STEM) fields have received much attention from research. Students' race and ethnicity are strongly related to their major choice, with

Asian and international students being more than twice as likely as Black and Hispanic students to choose STEM majors. Socioeconomic status also predicts major choice, with students with a higher socioeconomic status (SES) somewhat more likely to choose STEM majors. Students who enter college with stronger math skills are much more likely to select quantitative fields. These relationships are complex and potentially interactive. Although key finding #1 is largely descriptive, differences in major by race, gender, and SES appear to contribute to economic inequality along these dimensions.

Key finding #2: *Programs provide varying financial returns on investment for students (and society) after college.*

Lifetime earnings vary substantially across programs. The differences reflect both the causal effect of acquiring different skills on labor market outcomes and how program choices vary across different types of students based on their underlying potential earnings. STEM majors and more professional programs (such as business), as well as majors that are more closely tied to specific occupations, have larger average financial benefits. The returns for students differ from the social returns, partly because the social cost of educating students varies considerably across programs, although these costs are weakly correlated with the financial returns.

Key finding #3: *Students choose majors based on expected earnings, job prospects, and labor market conditions.*

To make their choices, students consider the wage profiles and associated job prospects of different majors. They do not necessarily possess accurate information on these topics while in school, offering significant over- and underestimates of expected salaries by major. However, students update their expectations in response to new information. Several studies also show that educational investments tend to align with shifts in employer demand in relevant labor markets.

Key finding #4: *Students also care about nonpecuniary aspects of programs, and different types of students weigh various aspects differently.*

In addition to labor market considerations, students choose their majors based on in-college experiences such as course difficulty and enjoyment, characteristics of their peers and instructors, and the grades that they receive. Parents and siblings also play a role via information sharing and role modeling. Nonpecuniary post-graduation considerations, such as job intensity and flexibility and expectations about marriage and fertility, play a larger role for women and may be a promising policy target.

Key finding #5: *Institutions matter.*

Colleges make major-specific decisions on curriculum, enrollment, and pricing that also matter for student choices and returns. Broadly speaking, colleges have introduced more majors over time, although many high-demand programs and courses are capped or require admission to enter, effectively limiting the number of students who would otherwise pursue the areas that these programs and courses represent. Regarding certain programs, institutions respond to labor market demand, but their responsiveness varies significantly by the level and selectivity of the college. Two-year and less selective colleges are more attuned to students and labor market demands than selective colleges are. Some colleges charge students differential tuition across

programs, which also affects investment decisions, particularly among low-income students.

Understudied topics:

The literature on college major and program choice, its determinants, and its implications is vast, but key gaps exist. There is a large and growing body of evidence explaining gender differences, but differences by race and SES are understudied, largely due to data limitations. The evidence overrepresents the four-year sector, and, in particular, elite institutions. More evidence on students and institutions spanning the post-secondary landscape is needed. Relatedly, many studies focus on students as decision makers, while relatively few study how institutions themselves and their policies shape students' choices. We conclude this chapter with a longer discussion of directions for future research.

Evidence

Key finding #1: *Major choices vary widely across different types of students in terms of gender, race, family background, and academic preparation.*

The evidence in this section is largely descriptive. Many of the facts come from the U.S. Department of Education's Integrated Postsecondary Education Data System (IPEDS), which collects degree information by field for institutions participating in Title IV federal financial aid programs. The findings relating major choice to family background and academic preparation come from nationally representative survey data.

Institution type/college sector

The distribution of majors varies by type of institution. Two-thirds of associate's degrees (primarily awarded by community colleges) are in the fields of liberal arts and sciences, general studies, and the humanities (39%), which are common pathways for students hoping to transfer to a four-year institution. The next most popular associate's degree fields are health professions and related programs (17%) and business (11%). The most popular fields for bachelor's degrees are business (19%), health professions and related programs (13%), social sciences and history (8%), biological and biomedical sciences (6%), psychology (6%), and engineering (6%).[1]

The relative popularity of various fields has changed over time. At the associate's level, the number of degrees in social sciences and history, physical sciences and science technologies, and psychology has more than doubled over the past decade. At the bachelor's level, health professions and related programs, engineering, biological and biomedical sciences, psychology, and computer and information sciences have grown especially fast.

Gender and race

There are dramatic and well-documented differences in major choice by gender.[2] At the bachelor's level, health professions and related programs are much more popular among women than among men (19% of female degrees vs. 5% of male degrees). Psychology (9% vs. 3%) and education (6% vs. 2%) also skew female. In contrast, business

is more popular with men (24%s vs. 15%), as are engineering (11% vs. 3%) and computer and information sciences (10% vs. 2%). In general, STEM fields are more popular with men, with the exception of biological and biomedical sciences. Figure 1(a) summarizes bachelor's degree major rates by gender.

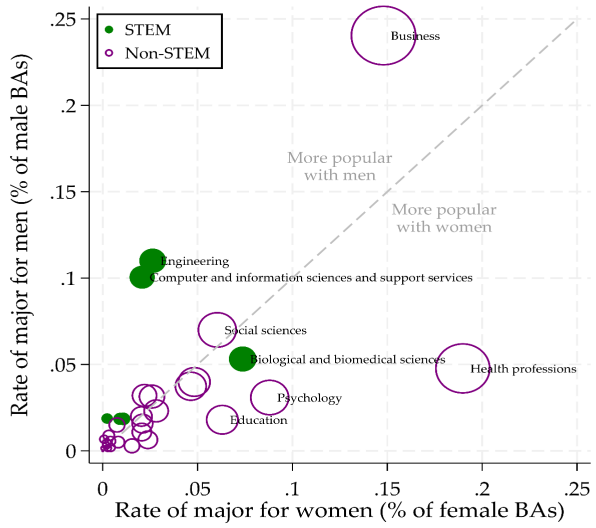
The patterns are similar at the associate's level, with education, health, and psychology being more popular among women and engineering technologies and computer and information sciences being more popular among men. Women and men earn business, social sciences, and general studies associate's degrees at similar rates.

Students from different racial and ethnic backgrounds also sort into different fields (Figure 1(b)). Asian students major in STEM fields at the highest rate: 38% of bachelor's degrees awarded to Asian students are in STEM fields compared to 20% for white students, 18% for Hispanic students, and 15% for Black students. U.S. nonresident students also major in STEM fields at a high rate (36%). Associate's degrees are less concentrated in STEM as a whole, but the patterns by race are similar: Asian and nonresident students receive STEM associate's degrees at a rate of 14% and 13%, respectively, compared to 9% for white students and 7% for Black and Hispanic students.[3]

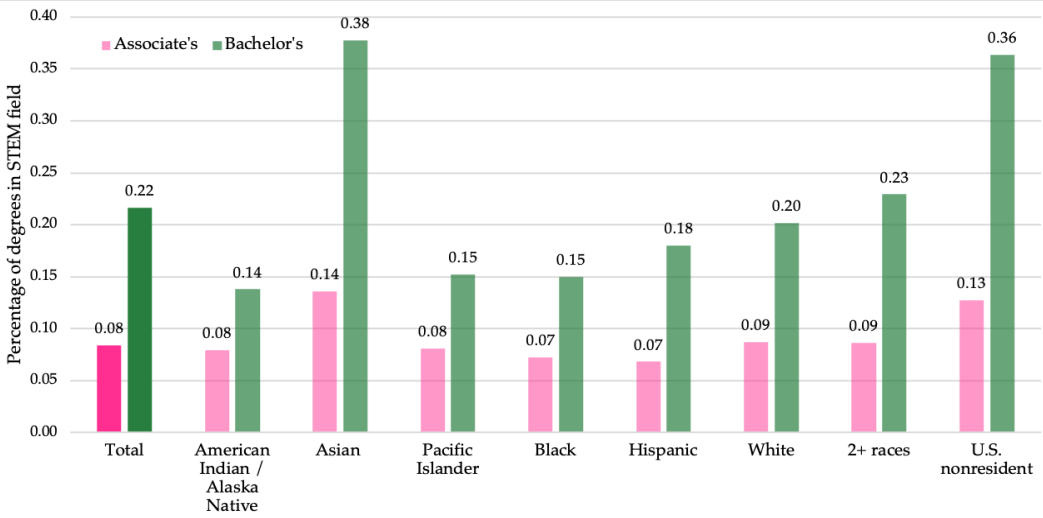
There is a debate in the economics literature about the extent to which race-based affirmative action—and its recent national ban—affects the major choice of underrepresented minority students. Critics argue that affirmative action harms less prepared minority students who enroll in highly selective universities that are worse academic fits. Some research finds that "overmatched" students take longer to graduate and are less likely to major in high wage fields, especially STEM fields.[4] However, the evidence is mixed, with other studies finding no effect on underrepresented minority students' performance or persistence in STEM courses.[5] Regardless, affirmative action is relevant at only the most selective institutions and is unlikely to fully explain race-based differences in major.

Differences by race and gender are particularly policy relevant because women and underrepresented minority students are overrepresented in fields associated with lower earnings, exacerbating the gender wage gap and racial inequality.[6]

Figure 1. Major Choice by Gender and Race, 2021–22



(a). Rate of bachelor's degree field by gender (weighted by the total number of degrees)



(b). Rate of STEM majors by race, ethnicity, and international status for associate's and bachelor's degrees

Notes: Both figures are based on the IPEDS Completions component and define fields using 2020 Classification of Instructional Programs (CIP) codes at the two-digit level. The source for Figure 1(a) is NCES Digest of Education Statistics Tables 322.40 and 322.50. The size of dots is weighted by the total number of BAs awarded in that field (to both genders). The source for Figure 1(b) is NCES Digest of Education Statistics Table 318.45. STEM includes biological and biomedical sciences, computer and information sciences, engineering and engineering technologies, mathematics and statistics, and physical sciences and science technologies. Subgroup categories are mutually exclusive. The race categories exclude persons of Hispanic ethnicity. The race/ethnicity categories exclude U.S. nonresidents.

Socioeconomic status

Family background also predicts major choice, although the reasons behind and policy solutions to narrow SES differences have received considerably less attention than gender differences.[7]

Conditional on enrolling in post-secondary studies, lower-income students are much more likely to enroll in two-year institutions than in four-year institutions (and in less selective four-year institutions), which, as mentioned above, emphasize different fields.[8]

Comparing bachelor's degree-receiving students from the bottom and top quartiles of family income, low-income students are more likely than high-income students to major in general studies (3.5% vs. 1.9%), social sciences (16.4% vs. 13.1%) and the humanities (11.1% vs. 9.5%) but are *less* likely to major in engineering (5.5% vs. 6.6%), healthcare (9% vs. 14.4%), and business (16.2% vs. 21.4%). The rates for natural sciences (13%) and education (4%) are similar between the two groups.[9]

Students with college-educated parents are more likely than first-generation students to major in STEM fields—computer and information sciences, engineering, biological and physical sciences, science technology, math, and agriculture—but are also more likely to major in the humanities. First-generation students are more likely to major in general studies and healthcare. The rates for social sciences, business, and education are similar by parental education level.[10]

As a general pattern, lower-SES students sort into lower-risk but lower-return fields, which may exacerbate economic inequality (at least among college graduates). We discuss this pattern more in regard to key finding #3 below.

Academic preparation and ability

Multiple studies have documented that precollege academic preparation, as measured by SAT scores, predicts major choice.[11] For example, among the most common majors in the Baccalaureate and Beyond survey, engineering majors have the highest SAT quantitative scores, while education, social work, and nursing majors have the lowest.[12] More formal models of major choice find that math ability matters more than verbal ability for both choice of field while in college and post-graduation earnings.[13] Differences in major choice by gender, race, and SES are partially—but not fully—explained by differences in academic preparation.

Major changes

Many students finish college with a major that is different from what they intended or initially declared, with more than one-third of students switching their broad field of study during college.[14] Sciences and health generally have the highest switch-out rates: approximately three-quarters of general and earth/physical science majors, two-thirds of medical/health services majors, and over half of biology majors switch out. Among STEM fields, engineering has an exceptionally low switch-out rate (31%). Business (19%), economics (29%), history (27%), and English (31%) also have low switch-out rates.

Initially lower-performing students are more likely to switch out. Conditional on completing a degree, women are more likely to have switched majors, but the reason is that men are more likely to drop out altogether than to change their major. Students tend to switch into majors with more demographically similar students, e.g., women into more female majors and Black students into more Black fields, suggesting that culture and nonacademic factors may be crucial.[15]

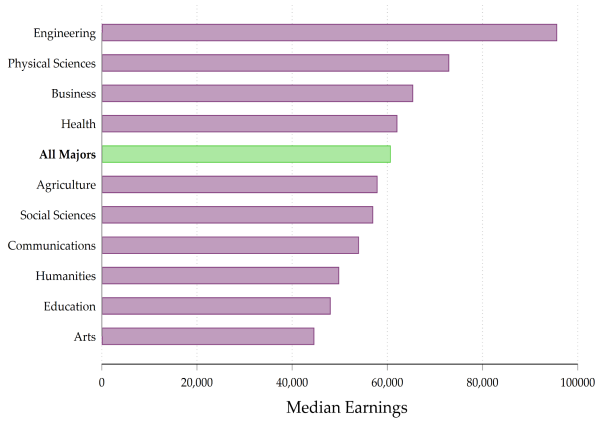
In the source for these statistics, the National Longitudinal Survey of Youth 1997 (NLSY97), majors are classified into 29 fields of study. Accounting for students switching within a field such as engineering or business would likely result in even higher switch-out rates. In a different survey, the Beginning Postsecondary Students Longitudinal Study (BPS) 2012/2017, over half of students reported changing majors by their sixth year of college.

Key finding #2: *Programs provide varying financial returns on investment for students (and society) after college.*

There are large differences in earnings by field of study, with STEM and business majors earning the most in adulthood and education and arts majors earning the least. Figure 2 summarizes the median annual earnings by bachelor's degree field.

Despite the wide variation, it is unclear whether these differences in expected earnings are causal or, instead, reflective of different types of students selecting different majors. A growing body of research tries to disentangle selection from the causal effects of major choices on various labor market outcomes, mainly focusing on early career earnings and wages. The differences in the total or net financial return largely reflect the gross return because costs such as tuition and delaying employment to attend college mostly do not vary by major within an institution. Additionally, more descriptive work has documented potential drivers of these differences, especially the skills that different majors teach and the associated occupational choices.[16] The evidence focuses on undergraduate majors at four-year institutions and builds on substantial earlier work that studied the average returns to any post-secondary education and the returns across institution types.

Figure 2. Median Earnings by Broad Field of Study, Ages 31–50



Notes: Medians are calculated using individuals with at least a bachelor's degree in the 31–50 age ranges when sampled for the American Community Survey (ACS), 2009–2019. Annual earnings from work are adjusted for inflation using the personal consumption expenditures (PCE) price index and represent 2019 dollars. Major refers to the bachelor's degree awarded to individuals.[17]

Major differences in earnings

The characteristics of programs themselves, as well as the types of students who choose them, contribute to cross-field earnings differences. As we discuss in regard to key finding #1, major choices are driven not only by the labor demand for one field versus another but also by the kind of students who choose one field over another. Students with higher earnings potential (regardless of major) may select into high-paying majors and occupations. Typically, researchers aim to remove student "selection" and isolate the causal effect of the major itself. Using data from nationally representative surveys in the U.S., one study estimates that the lifetime earnings of STEM bachelor degree holders are approximately 145% higher than those of high-school graduates without accounting for selection. The returns are smaller for graduates in other fields but are at least 76% more than those of high school graduates.[18] However, when aptitude test scores and demographics are controlled for, the gains for STEM fall to 99%, with all fields being above 45%. These estimates account for selection based on known characteristics of the student (e.g., demographics and standardized test scores) but may still be biased since they do not account for unobserved (to the researcher) forms of selection. For example, students with highly involved parents may earn high wages in whichever field they study, but they also receive better guidance on how to enter high-paying fields. This suggests at least some of the differential earnings by major are due to differing parental investment rather than the major itself.

The best causal evidence systematically evaluating programs comes from countries where post-secondary systems use cutoffs for admission to specific majors. Prospective students just above and below the cutoffs should be otherwise very similar, but only some are admitted. Hence, the cutoffs allow researchers to estimate the causal effects using a regression discontinuity design that links student test scores and admissions to labor market outcomes. A Norwegian study showed that fields of study have substantially different causal effects on labor market outcomes and that these returns are significantly different when conditioning on observable student characteristics. In Norway, professional fields—that is, medicine, law, and business—have the highest returns, while the humanities, social sciences, and other health fields have the lowest.[19]

In the U.S., the causal evidence is more limited in terms of the scope of the institutions and majors covered. Researchers have used major-specific policies at individual four- and two-year institutions.[20] However, since these researchers examine the effect of specific majors at specific institutions (e.g., 46% higher early-career earnings for economics majors at the University of California Santa Cruz), we lack causal evidence on how the effects vary by major across institution types.[21] A few papers also conduct correspondence study experiments where researchers randomize the education, including the program, of fictitious job applicants.[22] We also have minimal evidence overall on the returns to different programs at two-year institutions and of graduate degrees, and this evidence relies on individual fixed effects and controls.[23]

Moving beyond the average causal effect, we note that more recent descriptive work shows that there are also important differences in earnings trajectories. Overall, fields with high initial earnings also have high growth.[24]

Overall, the earnings differences between fields of study are large and are only partially explained by differences in the types of students who choose each field, suggesting some causal effects of studying the field itself.

Causes of wage differences

To explain cross-field wage differences, research has largely focused on the role of human capital as a mediator. The skill content of majors affects which industries and occupations graduates work in. Certain majors, such as economics and business, increase earnings, partly because they increase students' sorting into high-paying industries and occupations.[25] Graduates benefit from majoring in fields where the skills that they develop are closely tied to specific occupations, especially when they choose to work in these occupations.[26]

In addition to human capital, the signaling value may differ by program. If some programs are more difficult (e.g., require more time and effort to complete), then higher-aptitude students—those who find it easier to do well—can reveal their capabilities to employers by choosing these programs and ultimately completing them. Hence, students' completion of a more challenging program may be informative of their potential productivity on the job, beyond the skills learned. However, we lack direct causal evidence that parses each of these factors.[27]

Returns to society

The returns to society across programs partly depend on the social value of increasing certain types of human capital and skills among graduates and the occupations that they enter. For this reason, state and federal governments offer major- or occupation-specific tuition subsidies to increase employment in high-demand and socially valuable fields and to encourage students to enter high-paying professions. For example, the federal government previously offered Science and Mathematics Access to Retain Talent (SMART) grants to increase low-income students' enrollment in STEM and certain other fields (such as foreign languages critical for national security). A study using data on Texas public university students and Brigham Young University students found that the subsidy was effective.[28] State and federal governments also offer grants or student loan[29] forgiveness for educational training to enter specific occupations, such as teaching, nursing, and other fields tied to local workforce needs and public service, rather than for the degrees themselves. These subsidies affect the returns to students by lowering the cost that students incur to study certain fields. However, in doing so, the subsidies redirect the cost to state and federal governments, which increases the private returns to students and decreases the returns to society.

The returns to society also partly depend on the cost that institutions incur to educate students. Based on a national survey weighted to be representative of U.S. four-year colleges, one study documents considerable differences in instructional costs across fields of study. While there is some speculation that these program differences are driven by differences in learning technology (equipment, class size, etc.) and the nonacademic career options of faculty, we lack direct evidence.[30] These cost differences are economically large enough to meaningfully affect the relative social return compared to measures that consider only financial benefits.[31] For example, although engineering graduates earn high salaries, they are also expensive to train. Overall, though, graduates' earnings and institutional costs are minimally correlated.

Moreover, graduates' earnings and field-specific costs do not fully capture the social returns, and some socially valuable occupations closely tied to specific majors, such as teaching and social work, have relatively low earnings. This reality motivates the need for certain field- and occupation-specific subsidies to encourage students to enter related programs. Majors may also differentially affect other socially valuable behaviors and moral attitudes, such as concern for others or concern for social order, because these topics are part of specific course content, for example, in the humanities. We lack causal evidence of how these nonfinancial benefits differ across programs.[32]

The social returns of different types of human capital are a function of both the social value of producing workers in specific occupations and industries and the cost to educate students to be successful in these workplaces.

Key finding #3: *Students choose majors based on expected earnings, job prospects, and labor market conditions.*

Much of the major choice literature related to labor markets focuses on the salience of salary or wage information and the accuracy of students' expectations on this dimension. In general, this research finds that expected earnings are important for students' major choice but not to the extent of other factors, such as "taste" or nonpecuniary benefits (discussed more in regard to key finding #4 below).[33]

In addition to average wages, students may consider the earnings trajectories and employment risk associated with different majors. Students with lower family income and less educated parents tend to choose "safer" majors or majors with higher, more guaranteed earnings in the early career but less growth and upside risk.[34] "Safe" majors include accounting, engineering, and education. According to one study, the financial constraints of students themselves from debt taken out to attend college could be one mechanism through which these different major choice patterns emerge;[35] however, this study was conducted with students attending highly selective institutions. Another study using a more representative sample of students finds a weak relationship between family income and the wage profiles of the majors chosen. Nonetheless, causal evidence on students' overall awareness of these different wage profiles when making decisions is lacking.

The net financial benefits also depend on the cost of studying in a particular field. At many institutions, tuition does not depend on a student's field of study, but there are now a growing number of institutions using differential pricing (see key finding #5). However, certain fields have lower average costs because of state and federal subsidies available only to students in these fields, such as the SMART grants and student loan forgiveness policies previously discussed. These policies affect both major and career choices, especially since many students are debt averse.[36]

Salary expectations and beliefs

Expected pay matters for major choice, but students tend to make significant errors in estimating earnings or ranking majors based on their financial returns. These errors are common among both undergraduate students pursuing bachelor's degrees[37] and community college students.[38] In diverse educational settings, students consistently report salary expectations with absolute error ranging from 15% to 50%, on average, with little consensus on the direction of the bias (under- or overestimation). Even when

asked to rank their top three major choices in order of salary, one study found two-thirds of students did so incorrectly.[39]

Several studies have endeavored to provide students with more accurate salary or labor market information to observe potential responses. Undergraduate students tend to revise their beliefs and intentions based on new information. These results typically rely on randomly assigning information and then resurveying students to obtain their updated beliefs or future observed choices.

Students who were offered accurate information on typical earnings within majors tended to change their own beliefs about what they might earn after college, and many switched their intended majors.[40] Another study randomly assigned students to accurate salary information for their five top-ranked majors and found that students who were provided the information were 9 percentage points (p.p.) more likely to later choose one of those majors, which generally had higher salaries than the students initially believed.[41] In Chile, when the government began providing salary information on different majors to prospective students, those from low-income backgrounds shifted toward higher-paying majors.[42]

Job prospects and labor demand

The importance of expected earnings for major choice is neither dominant nor consistent, and a growing number of studies suggest that job prospects and the implied employability of different majors may be more important for determining educational investments. One experimental study suggested that earnings information on particular majors provided to students may not alter their major preferences; however, informing students of the job prospects of different majors does—students updated their preferences toward majors with better job prospects.[43]

This discussion offers a window into a larger literature on the responsiveness of college investments to changes in the labor market. For instance, when unemployment is higher, students tend to choose majors with better employment prospects, with women responding more acutely than men to labor market conditions.[44]

Several studies also show that college investment responds to changes in local employer demand for skills. Using job advertisements and their listing of desired college majors as a measure of demand, one study shows that the number of bachelor's degrees awarded and the number of credits earned tend to respond proportionately to employers' demand for them.[45] Similarly, large sector-specific events such as the fracking boom and the financial crisis saw corresponding changes in the number of bachelor's degrees awarded in the same direction as the employment shocks, with larger responses at colleges in close proximity to the shocks.[46] Community college students also respond to local labor market shocks. Mass layoff events and plant closings in Michigan led to declines in two-year college enrollment in programs related to the industry in which the layoffs were concentrated.[47] These studies all highlight the heterogeneity in employer demand across different labor markets, but they also indicate that colleges are differentially exposed to these changes. Part of the response (or lack thereof) of colleges and their students may be due to institutional differences, which we discuss further in key finding #5.

Key finding #4: *Students also care about nonpecuniary aspects of programs, and different types of students weigh various aspects differently.*

Recent research on college major choice has reflected a growing interest in nonpecuniary aspects of majors and their associated fields. Much of this work has concerned itself with explaining gender differences, particularly along the STEM margin; there is relatively scant evidence on differences by race, ethnicity, SES, or other dimensions.[48] Researchers have increasingly used experimental methods—many of which involve providing information—to causally isolate various determinants of major choice. Other researchers exploit naturally occurring, arguably random variation in instructors, peers, grades, schedules, and other academic characteristics. The availability of detailed administrative transcript data has also made it possible for researchers to measure course-taking and major decisions accurately and at large scale, although research universities, selective liberal arts institutions, and military academies are overrepresented in the studied populations.

Peers, role models, and family

Peers—classmates, roommates, and friends—could influence students' choices, whether through information sharing or by directly affecting a student's experience of a major. At an Italian university specializing in business and economics, students were more likely to choose a major when it was also chosen by their peers in randomly assigned, mandatory courses.[49] On the other hand, a study exploiting the random assignment of first-year roommates at Dartmouth College found no effect on choice of major.[50] Several studies have investigated whether the gender and racial composition of peers can explain differences in major choice and persistence, generally finding positive effects of similar peers for underrepresented students.[51] One study leveraged the differential timing of previously all-women's U.S. colleges transitioning to coeducation and found that allowing men to matriculate caused the share of women majoring in STEM fields to drop by 3.0 to 3.5 p.p. (30–33%).[52] In a selective undergraduate engineering program, higher proportions of female students increased persistence for *all* students; additionally, the presence of more underrepresented minority peers increased minority students' grades (but not their persistence).[53]

Numerous studies have asked whether the presence of female faculty encourages women to persist in male-dominated fields. The evidence is decidedly mixed, with some finding positive same-gender effects in certain subjects[54] and others finding none.[55] A smaller number of studies have suggested positive effects of matching students' race to that of their instructors (in community college) and mentors.[56] Two studies tested field interventions that invited recent alumni to visit introductory economics courses and found positive effects of same-gender role models on students' persistence in the field.[57]

There is some evidence at the K-12 level that discrimination and bias by teachers may discourage girls from continuing in STEM subjects (but there is no documented direct link to college major choice).[58] Toxic culture and sexual harassment may be deterring women from male-dominated fields in college and advanced study.[59]

Families also seem to play a role in major choice. When choosing their major, students care about parental approval.[60] Like peers and instructors, parents and siblings can serve as role models and information channels.[61] The most rigorous evidence on family

influence comes from regression discontinuity designs that exploit test score cutoffs for programs, finding that parents' and siblings' field choices cause students to follow similar paths.[62] This evidence largely comes from non-U.S. contexts with centralized admissions systems that require students to select majors earlier than they typically do in the U.S. It is unclear whether these findings translate to American students. However, paired with strong evidence in the U.S. that older siblings influence the college that their younger siblings attend, it is likely that family members also affect students' choice of major in the U.S.[63]

Overall, the evidence shows that students are affected by other students and adults around them. On the one hand, this suggests a certain stickiness in sorting by, e.g., gender and family background; on the other hand, policies leveraging peer and role model effects may be especially effective.

Post-college factors

In addition to expected future wages and employment (see key finding #3), students choose their major based on the expected nonwage characteristics of majors and the jobs associated with them. In an information experiment with Northwestern University undergraduates, female students expect a "marriage penalty" from a STEM or business degree; women but not men choose majors based on these marriage expectations and the expected fertility associated with different majors.[64] Women also appear to value fields with less demanding and more flexible hours and more family-friendly policies.[65] One study found that when certain medical fields capped their weekly work hours for residents, more women chose those specialties.[66] Policies that support working parents and/or shift gendered norms around childcare may be especially fruitful targets for policymakers interested in closing gender gaps.[67]

Other in-college experiences

A number of other in-college experiences and policies—some seemingly small, others more structural—have been shown to affect major choice. Experimental evidence has revealed that how much students enjoy their coursework, how difficult a major is perceived to be, and (a lack of) information about the content of a major are all determinants of specialization.[68] One study at the U.S. Military Academy found that when students were randomly assigned to take an introductory class early in the morning, they were 10% less likely to continue in that subject, implying behavioral biases in major choice.[69]

The grades that students receive and the underlying grading policies have been found to shift major choice in multiple settings.[70] Researchers using structural economic modeling, selection-on-observables designs, and regression discontinuity designs exploiting letter grade cutoffs have generally (but not universally) found that grades are associated with subsequent course-taking and major choice, with higher grades leading students to continue in a subject.[71] However, the literature disagrees on whether women respond differently to grades than men do.[72]

The evidence suggests that fairly small changes to students' in-college experiences could result in a different distribution of students across fields.

Beliefs and ability

A number of studies have documented students' beliefs about their own academic performance and self-efficacy. Students tend to enter college overly confident in their ability to succeed in a science major, and they switch when they receive new information in the form of initial performance.[73] The literature has paid particular attention to gender differences in beliefs as an explanation for gender gaps in STEM. Men tend to display overconfidence in their performance, at least on male-typed tasks and subjects, while women are more underconfident.[74] Although these beliefs are correlated with major choice and can be corrected, an intervention that successfully narrowed the gender gap in beliefs among college students taking introductory STEM courses did not ultimately close the gap in major choice.[75] Although beliefs are a promising target for closing the gender gap in major choice, they are formed over a lifetime and may require earlier intervention.

Key finding #5: *Institutions matter.*

The literature on how students choose majors often ignores the fact that choices are bound by colleges' curricular offerings and policies governing enrollment. Furthermore, colleges vary significantly in their respective goals and missions; hence, they respond differently in the face of changing student or employer demand for education. A growing group of studies has endeavored to understand some of the supply-side policies and behaviors of colleges and how they affect student major choice and outcomes.

Program and course offerings

A long view of bachelor's degree production in the United States shows that colleges have diversified their bachelor's degree production significantly by expanding their program offerings over the last several decades.[76] However, colleges' choices of the number and types of courses to offer do not necessarily align with student demand. One recent study found that four-year institutions across the U.S. only weakly consider student demand in choosing new course offerings.[77]

The responsiveness of colleges to student and employer demand varies significantly by institution type. Compared to less selective colleges, selective colleges tend to change their course offerings, enrollment, and degree production less in response to student and employer demand.[78] For example, less selective four-year institutions likely increase their use of non-tenure-track faculty in high-demand fields to meet demand.[79] Additionally, community colleges, which typically hold close ties to local labor markets and vocational training, are arguably more nimble and willing to adjust things such as course and faculty allocations toward high-demand fields when both students and the labor market require such adjustments.[80]

Another study analyzing new course offerings at a mid-sized public four-year college in Arkansas revealed the college's preference for offering introductory STEM and business courses above most others. In this model, students derive well-being from course offerings, and the implied total student utility would have been higher had the university reallocated some introductory courses away from STEM and business.[81]

Capacity constraints and major restrictions

Colleges often ration seats in particular majors and courses due to capacity constraints and quality considerations. Several papers estimate the returns to different majors using GPA admission cutoffs for specific programs and regression discontinuity designs.[82] While these cutoffs provide a convenient way to estimate returns to a particular program, they also underscore the importance of such policies in shaping major choices. By failing to meet demand for certain courses and programs, colleges likely hurt some students' chances at a significant return on their college investment. At least one study suggests that these types of major restrictions tend to disproportionately shut out underrepresented minority and low-income students.[83] These policies are most common at large and selective public four-year institutions.

Individual course scarcity can similarly change and derail some students' academic trajectories. In the four-year college sector, one study of Purdue University found that female students shut out of oversubscribed courses were less likely to major in STEM fields and were even more likely to drop out altogether.[84] In contrast, male students did not experience the same negative effects, although they were somewhat less likely to major in business after being shut out. These patterns also appear in the community college sector. One study of a California community college showed that students unable to enroll in the courses they wanted due to capacity constraints were more likely to sit out the entire term and more likely to transfer to another two-year institution.[85]

In Italy in the 1960s, the government expanded access to STEM programs by allowing more students to pursue those fields in college. While STEM enrollment increased, many programs did not have the resources to expand offerings or faculty, driving up class sizes. This crowding led students who originally had (and maintained) access to the STEM programs to achieve worse grades, on average, and it led many of these students to choose non-STEM majors instead.[86]

Grading policies

Majors vary quite significantly in terms of the average difficulty of coursework and grades. We discussed how these systematic differences often sway students toward or away from different fields in regard to key finding #4. However, with growing concerns over grade inflation in higher education, institutions have occasionally introduced new grading policies across departments, leading to changes in students' course and major choices.[87]

For example, Cornell University began making median course grades public on the Internet in 1997. This move, representing only half of an initiative to address grade inflation, led to higher enrollment in more leniently graded courses—the opposite of the initiative's intent. This shift in enrollment was more pronounced among students with lower initial grades.[88]

In 2004, Wellesley College began requiring all 100- and 200-level courses to have a maximum average grade of a B+. Some fields, such as economics and physics, already met this criterion and were arguably unaffected, while others, mainly in the humanities and other social sciences, were forced to lower their grades to adhere to the policy. Using a difference-in-differences empirical approach, the authors evaluating this policy found that enrollment, the number of majors, and professor evaluations all fell substantially in the treated departments as a result of the change.[89]

Differential tuition pricing

Many colleges also charge differential prices for specific majors or broad disciplines (e.g., engineering). These policies relate to the large variation in the cost of delivering courses across fields. For example, nursing and engineering may require expensive equipment for training, whereas English and social sciences typically do not.[90]

A few studies have examined how charging differential tuition across fields affects realized student choices, obtaining mixed overall findings. Differential tuition charged in engineering tended to reduce degree production in this area by 7.5%, whereas tuition increases for business and nursing led to noisier responses.[91] In follow-on work on tuition deregulation in Texas, researchers found that charging higher tuition caused an increase in enrollment in the affected fields among low-income students.[92] This result is particularly interesting because one would expect low-income students to be the most price sensitive. However, the authors posited that increased price discrimination in the form of more generous use of grant aid to low-income students was the likely cause of their shift toward higher-earning (and higher-priced) majors in this setting.

Directions for future research and policy

In this chapter, we discussed five key findings based on available research on why students choose certain majors and the returns to those majors. We conclude by highlighting several areas that have received less attention and where future research would hence be valuable, especially for shaping policy. Some of these topics are understudied because researchers lack the necessary data on individual students that connect their paths through high school and post-secondary education to labor market and other adult outcomes. To better address many of these areas, investments in data infrastructure are a necessary step.

- *Gaps in major choice by race/ethnicity and SES*: Differences in major choice by race and SES have implications for economic inequality, but they have received considerably less attention in the literature than differences by gender. Future research should seek to better understand these gaps and their consequences for inequality after college.

- *Do major choices based on labor market information offer better outcomes for individuals and society?* The literature has been increasingly effective in identifying whether and how choices react to labor market shocks. However, very few studies are able to follow students far enough into the future to understand the outcomes of such choices. *Should* students change course based on salary expectations or job prospects at a given point in time? How much weight these factors receive could be informed by a more thorough measurement of post-choice outcomes, such as academic performance, earnings, and career paths.

- *Alternative factors that contribute to heterogeneity in financial returns:* Past research has largely focused on major-specific skills and their relationships with occupations. It is unclear how much of the variation in the causal effect of programs comes from this channel compared to alternative channels, such as

signaling from the completion of more difficult coursework or differences in major-specific networks.

- *Disentangling student and institution effects:* While researchers often consider the heterogeneous effects of policies across individuals (based on their demographics) and across institutions (based on their research intensity or selectivity) or fields of study, it is often unclear how much of the variation is due to each side—students or institutional/program factors. There are two main challenges. First, different students choose to enroll in different institutions/programs. Hence, the average effects across one dimension potentially conflate heterogeneity across both dimensions. For example, do STEM programs respond differently because of the features of these programs or because men respond differently than women? Second, institutional responses are infrequently captured in the data. Understanding the drivers of these effects is important for designing policies appropriately.

Endnotes and references

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National Center for Education Statistics. 2024. Undergraduate Degree Fields. Condition of Education. U.S. Department of Education, Institute of Education Sciences.
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See also evidence from Chile: Hastings, Justine S., Christopher A. Neilson, and Seth D. Zimmerman. 2013. Are Some Degrees Worth More than Others? Evidence from College Admission Cutoffs in Chile (Working paper No. 19241). National Bureau of Economic Research.
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See also Grosz, Michel. 2020. The Returns to a Large Community College Program: Evidence from Admissions Lotteries. American Economic Journal: Economic Policy 12(1): 226–253. This paper considers nursing degrees at a community college.

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