Gender, college dropout, and the "structural characteristics" of STEM majors

Kimberlee A. Shauman
University of California, Davis

Research question

This paper engages with the structural explanation for the female advantage in college academic achievements (Alon and Gelbgiser 2010) by examining gender differences in the educational destinations of students who transition out of science, technology, engineering, and math (STEM) majors. It addresses the question: are the elevated rates of non-completion observed in STEM majors intrinsic to the structure of those majors, or do they reflect the aggregate educational behavior of men who are disproportionately concentrated in those majors?

Gender differences in the rate of exit from STEM majors are well documented – women are more likely than are men to leave STEM – but little is known about the destinations of those who leave. There are two general routes out of undergraduate STEM majors: students may remain in postsecondary education but switch to a non-STEM major, or they may leave postsecondary education altogether. Prior studies of attrition from STEM have neither disaggregated nor tested for gender differences in these exit routes from STEM. Using a unique data source that includes detailed enrollment, major, course-taking, and achievement information for multiple cohorts of postsecondary students, I examine gender differences in the rates, timing, and correlates of the two general off-ramps from STEM majors.

Theoretical framework

The growing female advantage in the attainment of postsecondary education has received a great deal of research attention (Alon and Gelbgiser 2010; Buchmann and DiPrete 2006; Buchmann, DiPrete, and McDaniel 2008; Conger and Long 2010; Rogers and Menaghan 1991). Studies that aim to explain the growing gap show that women's higher rates of college matriculation accounts for some of the male deficit, but that males' own higher rates of non-completion contribute significantly to their underrepresentation among baccalaureates (Conger and Long 2010). Alon and Gelbgiser (2010) argue that horizontal segregation in postsecondary education – the unequal distribution of males and females across college majors – contributes to the high rates of college dropout among males. Specifically, they argue that the male deficit in degree attainment is caused by their concentration in STEM majors which are "notorious for their tightfisted grading policies" and lower graduation rates. Other studies using course-level data associate males' lower rates of persistence in college to "their higher propensity to take more difficult college courses" in the male-dominated STEM fields (Conger and Long 2010).

This structural argument rests on the assumption that the lower rates of degree completion are an intrinsic or structural characteristic of STEM majors rather than a function of the overrepresentation of students who have lower rates of educational persistence, i.e., of men. The robustness of the assumption is undermined by the long history of higher rates of high school dropout among men than women in the US (Chapman, Laird, and KewalRamani 2010; Conger and Long 2010; Rumberger 2011). Male reticence to enter female-dominated major fields (Correll 2004; Jacobs 1995; Turner and Bowen 1999) also may drive up the non-completion rates among STEM majors. Since the postsecondary alternatives to the male-dominated STEM majors are the largely female-dominated majors (in the social science, education, the arts and humanities), male

students who are not achieving in STEM majors may choose to drop out of college rather than switch to another (female dominated) major. These gendered preferences will thus lead to higher rates of dropout, regardless of the difficulty of the coursework or grading systems in STEM majors. A full accounting of the structural explanation for the gender gap in college completion requires that the characteristics of college majors be disentangled from the gender composition of the students enrolled in the major.

Hypotheses

I use variation by gender in the rates and correlates of the educational transitions made by students who leave STEM majors to test the extent to which the relatively high rates of non-completion of STEM majors are due to (1) gender differences in achievement and/or (2) gender differences in educational behavior of students.

I hypothesize that male students will be more likely than females to leave STEM majors by dropping out of college rather than transitioning to a non-STEM major. I hypothesize that this gender gap will remain significant in the presence of robust controls for individual-level background characteristics, coursework patterns, and achievement measures. These results will provide a sound indirect test of the degree to which the male aversion to non-STEM majors generates relatively high levels of college dropout among STEM majors.

Research design

For this analysis I use data from the University of California, Davis (UCD), a large, land-grant university in the University of California (UC) system that serves about 22,735 undergraduates. UCD affords entry to only students from the top 12.5 percent of the state's graduating high school class and boasts recent cohorts of students with average combined SAT scores of 1180. It has the third highest enrollment of all 10 UC campuses (behind UCLA and UC Berkeley).

To examine the transitions of students leave STEM majors, I utilize individual-level longitudinal data for four cohorts of students (roughly 15,000 students) whose educational experiences are observed over 4 years. The academic calendar at UC Davis is organized according to the quarter system: the "academic year," is divided into three 10-week quarters which runs from late-September through mid-June; the summer months comprise the fourth quarter of the year. I focus on enrollment status and declared major among students during each of the three quarters of the academic year, and I operationalize educational transitions by comparing each student's status in sequential quarters.

I model the choice to drop-out of college versus enter a non-STEM major among students who leave STEM majors with sequential discrete-time event history models that first estimate and then control for selection into attrition from STEM majors. To account for gender differences in college drop-out, I include a rich set of explanatory variables that include course sequences and grades prior to leaving STEM, pre-college measures of aptitude (SAT scores, high school GPA), students' demographic characteristics, and financial aid information.

Preliminary descriptive results

Figure 1 presents the rates of STEM exit via the non-STEM and college-dropout routes separately

by gender and STEM field. These preliminary results show that attrition from STEM majors is common: among all students who start college as STEM majors, after 4 years of college, 45 percent of women and 43 percent of the men have left the STEM majors. It is also clear that while transitioning into a non-STEM major is the most common off-ramp from STEM (accounting for 29% of female and 23% of male students who begin college in a STEM major), dropping out of college accounts for a significant proportion of students who matriculate in STEM majors (20% of male students and 16% of female students).

These figures confirm that there are significant gender differences in the routes students take out of STEM: women are more likely than men to transition into a non-STEM major whereas dropping out of college is more common among men than women. In each of the fields, the dropout rates for men a quite high – accounting for between 19 and 24 percent of all students who enter a STEM major – and they exceed the dropout rates for women by significant amounts. The pattern consistently pronounced and in all of the broad fields of STEM, except in the Engineering majors.

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Figure 1: Proportion of students matriculating as STEM majors who exit STEM by switching to non-STEM majors or by dropping out of college, separately by gender and STEM field