Does Immigration Affect whether U.S. Natives Major in Science and Engineering?*

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Abstract: Increased immigration may affect the likelihood that U.S. natives major in science or engineering. Foreign-born students may crowd U.S. natives out of science or engineering, or they may have positive spillovers on U.S. natives that attract or retain them in those fields. This study uses data on college majors from the 2009-2011 American Community Surveys to examine the effect of the immigrant share in U.S. natives’ age cohort while they are in high school or in college. We find some evidence that immigration adversely affects whether U.S.-born women who graduated from college majored in a science or engineering field. There is little evidence of negative effects among U.S.-born men.

Key words: immigration, higher education, STEM, college major

JEL codes: I21; J15

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I. Introduction

The number of workers in science, technology, engineering, and mathematics (STEM) fields is commonly viewed as critical to the future of the U.S. economy. Concern that not enough U.S. natives are studying science and engineering to maintain the nation’s pace of innovation and its long-term economic competitiveness underlie a number of recent policy proposals. Policymakers have proposed granting permanent resident status to foreign students who earn a U.S. graduate degree in STEM and revamping undergraduate education in those areas, for example, while corporations have advocated for increased resources in STEM education at the K-12 and college levels as well as for more temporary and permanent visas for high-skilled foreign workers.¹

Proposals to admit more immigrants trained in science and engineering and to improve STEM education are motivated by the view that not enough U.S. natives earn degrees in those fields. During the period 1977 through 2009, the proportion of U.S. citizens and permanent residents earning bachelor’s degrees in science and engineering (S&E) fields—which we define here as including life and physical sciences, engineering, mathematics, and computer science but not the social sciences—fluctuated between 15 and 20 percent with little discernible trend.²

During that period, the number of bachelor’s degrees in S&E fields awarded to temporary

¹ For example, S.B. 744 in 2013 proposes no limit on the number of green cards available to immigrants holding a Ph.D. in a STEM field; allocating up to 40 percent of numerically-limited employment-based green cards to holders of a master’s degree or higher in STEM earned in the last five years from a U.S. university who have a U.S. job offer in a related field; and allocating 25,000 H-1B visas to advanced degree graduates in STEM from U.S. universities. The President’s Council of Advisors on Science and Technology advocated changes to STEM undergraduate teaching (see http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-final_feb.pdf). For corporations, see for example Microsoft’s proposal urging an increase in educational resources and immigration in STEM (available at http://www.microsoft.com/en-us/news/download/presskits/citizenship/MSNTS.pdf).

² Authors’ calculations based on data from National Science Foundation (2002, 2012). Including psychology and other social sciences as S&E fields—as the NSF does—raises the proportion to about one third.
residents—foreigners on student visas—increased faster than the number awarded to U.S. citizens and permanent residents. The foreign-born proportion of U.S. permanent residents—U.S. natives, naturalized citizens, and green cards holders—who hold a bachelor’s degree in S&E rose as well, in part due to increases in the proportion of U.S. S&E degrees granted to immigrants but also as a result of inflows of S&E graduates of foreign universities. The foreign-born share of college graduates living in the U.S. who majored in S&E increased from 11 percent in 1990 to 17 percent in 2000 (Freeman 2009); it hit 29 percent during 2009-2011.3 This increase stemmed in large part from the creation of the H-1B visa program and an increase in the number of employment-based permanent resident visas implemented in the early 1990s.

The increase in the foreign-born share of S&E college graduates mirrors a general rise in the immigrant population share in the United States. The foreign-born proportion of the U.S. population rose from less than 5 percent in 1970 to more than 12 percent in 2010. Although most migrants arrive as adults, an increasing number are children or college students. The foreign-born proportions of high-school-age youth and of college students more than tripled from 1970 to 2000. During that period, the proportion of bachelor’s degrees earned by U.S. natives in S&E fields rose from just 15 percent to 17 percent.4 This modest rise occurred in the face of robust—and at times booming—demand for STEM workers and steady or increasing relative earnings in STEM occupations (Hanson and Slaughter 2013).

This study examines whether these patterns are related. Specifically, we examine the relationship between whether U.S.-born college graduates majored in an S&E field and the foreign-born share of their age cohort while in high school and college. We focus on whether U.S. natives choose S&E majors at the undergraduate level because this is a critical step toward a

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3 The 2009-2011 share is based on authors’ calculations from 2009-2011 ACS data on college graduates.
4 Authors’ calculations based on data from the 2009-2011 ACS on U.S.-born college graduates who were age 22 in 1970 or in 2000.
S&E graduate degree and a career in an S&E field. We are able to take advantage of a large-scale survey, the American Community Survey (ACS), that asks about college major. Although there is a large literature on the effects of immigration on natives’ labor market outcomes and a smaller literature on effects on natives’ educational outcomes, no previous research has directly examined whether immigration appears to affect natives’ choice of college major.

The paper goes a step further by looking separately at U.S.-born men and women. Women may be more sensitive to the influx of immigrants since they are already considerably less likely than men to major in S&E. In 1970, only 7 percent of bachelor’s degrees awarded to women were in S&E fields, and 11 percent in 2010. The corresponding shares for men were 25 percent in 1970 and 23 percent in 2010. Meanwhile, the share of all bachelor’s degrees awarded to women increased from 43 percent to 57 percent during that period (National Science Foundation 2013). Female (and racial/ethnic minority) students are less likely to persist in S&E majors than men (Griffith 2010; Ost 2010). Increasing the number of women and minorities who study and work in STEM fields is vital to maintaining the country’s economic competitiveness (National Academy of Sciences 2007a).

The endogeneity of immigrant shares to increased demand for STEM workers is an important consideration in this type of study. We control for potential endogeneity in immigrant shares by measuring them in U.S. natives’ state of birth and by using instruments based on historical immigrant settlement patterns. We also control for the attractiveness of STEM jobs using measures of the proportion of college graduates in a state working in STEM occupations, average annual earnings in those jobs relative to non-STEM jobs, and the 10-year changes in those measures. The instrumental variables results do not indicate an effect on whether men
major in an S&E field, although a higher immigrant share in the college cohort has a negative effect among women in our preferred specification.

The next section explains why immigration might affect natives’ educational outcomes and provides an overview of previous research in this area, focusing on the United States. Section III discusses the data and empirical methodology. Section IV presents the results. Section V concludes with a discussion of limitations of this study and directions for future research.

II. Literature Review and Theoretical Framework

Immigration can have a positive or negative effect on whether natives major in S&E. This study focuses on the effects of immigrants in natives’ own cohort. These effects can occur through several channels. First, immigrants may compete directly with natives for educational resources. Foreign-born students may crowd out natives from S&E courses in the short run if the supply of education is inelastic. This is more likely to occur at the college level than at the high school level. In the medium to long run, however, larger inflows of immigrant students may lead to more S&E course offerings and to new or larger programs, particularly since foreign students tend to boost college revenues and to disproportionately study S&E.

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5 Bound and Turner (2007) report that the supply of higher education is inelastic. If natives may have more difficulty getting into required introductory math and science classes their first year of college as the number of foreign-born college students increases, they may become more likely to major in other disciplines. Bettinger (2010) reports that students who take more STEM classes their first semester of college are more likely to persist in STEM majors, although the direction of causality is unclear.

6 In addition, foreign graduate students may be complementary with undergraduate courses in S&E if increased inflows of graduate students, who serve as teaching assistants and instructors, result in expansion of undergraduate S&E course offerings and programs. In OLS and IV regressions, Bound and Turner (2010) find that the number of foreign PhD students in the sciences at a given university has a small positive effect on the number of undergraduate science majors; they find little evidence of a significant effect on the fraction of students at a given university majoring in science, however. The number of foreign graduate students may adversely affect natives’ performance in classes. Borjas (2000) finds that student performance in undergraduate economics principles classes is negatively related to having a foreign-born teaching assistant.
Relatedly, immigration may affect the quality of education and natives’ academic preparation. Academic preparation, particularly in math, is critical to students’ interest and persistence in S&E majors (e.g., Levine and Zimmerman 1995; Smyth and McArdle 2004; Arcidiacono, Aucejo, and Hotz 2013). Foreign-born students may require intensive English language instruction, reducing the resources that high schools devote to math and science and to natives’ academic preparation for college. Chin, Daysal, and Imberman (2012) find in a regression discontinuity analysis that bilingual education programs, which typically place limited-English-proficient (LEP) students in separate classrooms, appear to have positive spillovers onto non-LEP students’ standardized test scores, suggesting that attending school with LEP immigrants may adversely affect U.S. natives’ academic preparation. Students’ academic preparation may also worsen if school resources are inelastic and immigration increases the number of students.

Alternatively, attending high school or college with high-achieving immigrants may increase the quality of natives’ education and their interest in studying S&E through increased rigor, positive peer effects, and other spillovers. Highly skilled immigrants may put pressure on high schools to increase educational resources, particularly in math and science. Foreign students attending U.S. universities tend to be among the better students in their home country, and immigrants often outperform their U.S-born peers at the K-12 level, particularly within

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7 Several non-U.S. studies find a negative effect of immigration on native-born students’ educational outcomes. Brunello and Rocco (2011) find a negative relationship between natives’ test scores and the immigrant share of pupils across 27 developed countries. The effect is greatest for natives with a disadvantaged parental background. In OLS and instrumental variables (IV) regressions, Gould, Lavy, and Paserman (2009) find a negative effect of the immigrant share in the fifth grade on whether natives pass a high school matriculation exam in Israel. Jensen and Rasmussen (2011) find that children’s math test scores are negatively related to immigrant shares in school in Denmark. Hardoy and Schöne (2013) find a positive relationship between the immigrant share in secondary school and the dropout rate of natives in Norway. In the United States, Schwartz and Stiefel (2011) find a negative (positive) relationship between natives’ test scores and the immigrant share in the school (class) for children in third through eighth grade in New York City public schools.
racial/ethnic groups. However, attending high school or college with high-achieving immigrants may increase the competition for good grades in math and science classes, and natives who move down in the grade distribution may be less likely to major in S&E. Barnett, Sonnert, and Sadler (2012) report that immigrants earn higher grades, on average, than U.S. natives in college calculus classes, which are crucial gateway courses for S&E majors. Luppino and Sander (2012) show that weaker white, non-Hispanic students typically respond to more competition—higher math SAT scores among students majoring in STEM—by moving away from STEM majors; minorities persist in STEM majors but become less likely to graduate. Ost’s study of a large research university (2010) finds that females’ persistence in science majors is more sensitive than males’ to their grades while Rask’s (2010) study of a liberal arts college finds the opposite.

Immigration’s positive and negative effects may offset each other. Consistent with this, Neymotin (2009) finds in OLS, IV, and school fixed-effects regressions that SAT scores of U.S. natives living in California and Texas are not significantly negatively related to the immigrant share of SAT-takers from their high school.

Immigration may also affect natives’ educational outcomes through more indirect channels. For example, immigration may change the returns to education in general or the returns to S&E majors, leading to changes in natives’ choices regarding educational attainment or field of study (e.g., Arcidiacono, Hotz, and Kang 2012). Although the immigrant share in the labor market and in STEM occupations may be more important in driving such changes, the immigrant share in natives’ own cohort may matter as well. Students may perceive higher immigrant shares

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8 For studies comparing educational outcomes among foreign- and U.S.-born K-12 students, see Schwartz and Stiefel (2006) and references therein.
in their own cohort as increasing the competition for STEM jobs in the future, reducing their willingness to major in S&E.

Empirical findings on the effect of immigration on U.S. natives’ educational attainment are mixed. In a two-stage least squares (2SLS) analysis, Hunt (2012) finds that higher immigrant population shares, particularly of immigrants who have not completed high school, when U.S. natives are aged 11-17 increase natives’ high school completion; the effect is largest among blacks and is not significant among U.S.-born Hispanics. In contrast, Betts (1998) finds that black and Hispanic natives’ high school completion is negatively related to immigration in ordinary least squares (OLS) and difference-in-differences regressions. Betts and Lofstrom (2000) similarly find that U.S. natives’ years of schooling completed and probability of completing high school are negatively related to the immigrant share of their age cohort for all races/ethnicities in OLS regressions.

Results are also mixed for higher education attendance and completion. In a 2SLS analysis, Jackson (2011) finds that increases in the number of foreign-born college students do not affect the fraction of U.S. natives enrolled in college while increases in the ratio of low- to high-skilled immigrants in the labor force boost natives’ college enrollment. Betts and Lofstrom (2000) find a positive relationship between blacks’ college completion and the immigrant share of their age cohort in OLS regressions, and no significant relationship for other groups. At the graduate level, Borjas (2007) concludes from an OLS analysis that foreign graduate students may crowd out white male U.S. natives but not other groups of U.S. natives.9

Immigration also may affect natives’ choice of what college or university to attend. In OLS and IV results, Hoxby (1998) finds that foreign students appear to displace black and

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9 Regets (2001), Zhang (2004), and Bound and Turner (2010) report results that do not suggest crowd out in graduate programs.
Hispanic natives from selective colleges but not from other colleges. Neymotin (2009) finds that U.S. natives’ likelihood of applying to selective colleges is not significantly negatively related to the immigrant share of SAT test takers from their high school after controlling for school fixed effects. The potential effect on selectivity matters in this study’s context because student persistence in S&E majors is higher at more selective schools for better-prepared students but lower for less-prepared students (Arcidiacono et al. 2013). The returns to majoring in the sciences are higher at more selective schools (Arcidiacono 2004), which may prompt more students to major in the sciences at such schools. Griffith (2010) concludes that the sorting of women and minorities into different types of undergraduate institutions may play a significant role in gender and racial/ethnic differences in persistence in STEM.

On balance, previous research thus suggests that immigration does not reduce U.S. natives’ educational attainment, including college attendance and completion, and may even increase it. Immigration may affect how selective of a college or university natives attend, however. Student persistence in S&E majors depends on school selectivity and students’ own academic preparedness, both absolutely and relative to their competition. Immigrants account for a growing share of the competition in S&E majors, making it important to understand their effect on whether U.S. natives major in S&E.

III. Data and Methodology

A. Data

We use data from the 2009-2011 ACS together with immigrant shares derived from decennial Censuses. The ACS is a large-scale survey that replaced the long-form decennial Census but is conducted every year. The ACS asks about demographic characteristics and labor
market outcomes. Since 2009, it has asked respondents who have at least a bachelor’s degree to report their college major. We examine only U.S.-born respondents who hold at least a bachelor’s degree.\textsuperscript{10} We classify those who report majoring in biology and life sciences, physical sciences, engineering, computer and information sciences, or mathematics and statistics as S&E majors.

The main advantage of the ACS is that it offers very large, nationally-representative samples of multiple cohorts. However, it lacks data on important factors that are related to the choice of college major, such as family background and academic ability.\textsuperscript{11} Other datasets that include such measures, such as the Baccalaureate and Beyond Studies and the National Longitudinal Surveys of Youth, have much smaller samples and include fewer age cohorts.

We examine four 5-year age cohorts in the ACS. The cohorts are all U.S.-born college graduates aged 28-32, 38-42, 48-52, and 58-62 in the 2010 ACS (one year younger for the 2009 ACS, and one year older for the 2011 ACS). These cohorts were chosen because they were aged 18-22, or traditional college age, when a decennial Census was conducted. For example, people aged 28-32 in the 2010 ACS were aged 18-22 at the time of the 2000 Census, and those aged 58-62 in the 2010 ACS were aged 18-22 at the time of the 1970 Census.

Figure 1 shows the proportion of U.S.-born college graduates who majored in S&E by the year in which they were age 22, the modal age at college graduation. This proportion in the ACS data corresponds well to similar measures from the 1993 and 2003 National Surveys of College Graduates (NSCG) and from the National Science Foundation (NSF).\textsuperscript{12} The proportion of U.S.

\textsuperscript{10} We term people who have at least a bachelor’s degree “college graduates” throughout; all measures of college graduates shown here include people who hold an advanced degree as well as people who only hold a bachelor’s degree.

\textsuperscript{11} Altonji, Blom, and Meghir (2012) provide an overview of the relatively sparse literature on the determinants of college majors.

\textsuperscript{12} One concern with retrospective data is recall bias. Comparisons across datasets and between retrospective and contemporaraneous data suggest that survey respondents can reasonably accurately recall their major. The correlation
natives majoring in S&E rose from 1974 until 1986, declined precipitously from 1986 to 1991, and was fairly flat from the mid-1990s through 2008. The increase in the 1970s and early 1980s likely reflects the emphasis on science and math while those age cohorts were in school (the “Sputnik generation”). The Internet boom of the late 1990s did not have a major effect on the proportion of S&E majors; if it led students to switch from science to computer science majors, that would be not be discernible here.

Figure 1 also shows an estimate of the foreign-born proportion of U.S. college graduates who majored in S&E. This measure only includes people living in the U.S. at the time of the ACS and so misses foreign students who have returned home. We excluded immigrants who appeared to have earned their bachelor’s degree abroad, based on their age and year of arrival in the United States\textsuperscript{13}.

The foreign-born proportion of U.S. college graduates who majored in S&E rose fairly steadily from the mid-1970s until 1995 and shows a slight downward trend since then. The downward trend may be due to the U.S. attracting fewer foreign students who want to study S&E or to fewer foreign students remaining in the U.S. after receiving a bachelor’s degree in S&E. The difficulty foreign students experienced getting visas for a few years after the 9/11 terrorist attacks and expansions in higher education in other countries in recent years may have contributed to fewer foreign students earning bachelor’s degrees in STEM in the U.S.; the

\textsuperscript{13} We assume that immigrants who have a bachelor’s degree or higher and arrived in the U.S. by age 20 are U.S. college graduates. We use the ACS data here because the National Science Foundation data on degree recipients groups together U.S. citizens and permanent residents, making it impossible to distinguish between immigrants and U.S. natives.
The number of international undergraduates studying in the U.S. fell from 2001-2002 through 2005-2006 and then began rebounding. The Great Recession of 2007-2009 and relatively strong economic growth in China and India may have led to a decline in the number of foreign-born S&E graduates staying in the United States.

The top row of Table 1 reports the share of U.S.-born college graduates who majored in S&E for the four cohorts we examine. This share reflects the pattern shown in the figure—it is higher for the cohort who were college age in 1980 than for the 1970 cohort, and it is lower for the 1990 and 2000 cohorts than for the 1980 cohort. The rest of the analysis focuses on these four college cohorts and how the probability that they majored in S&E is related to immigrant shares while they were in high school and college.

We created two measures of immigrant shares from the 1970-2000 decennial Censuses. The first is the share of the age cohort—the population aged 18-22 in the Census—that is foreign born. Immigrants who report arriving in the U.S. in the five years prior to the Census are not included in the construction of this variable so that it approximates the immigrant intensity of U.S. natives’ high school experience and does not capture immigrants who arrived as undergraduates or graduate students. The second immigrant share variable is the foreign-born share of 18-22 year olds who are enrolled in college at the time of the decennial Census. This

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14 The fraction of U.S. natives who are the children of immigrants—the second generation—also may affect the likelihood of majoring in S&E. We attempted to control for the proportion of the age cohort that is second generation (the children of immigrants) by merging children’s and parents’ records in the Census 10 years prior, when most children were living with their parents (the Census stopped asking about parental birthplace in 1970, making it impossible after then to calculate the second generation share like we do the immigrant share). However, first-stage regressions using either of the instruments used here did not have enough power to instrument for this variable, which may be endogenous if parents’ locational choices depend on factors that also affect whether U.S. natives major in S&E. We also cannot distinguish second-generation immigrants from the children of U.S. natives in the ACS.

15 The Census educational categories and questions have changed over time. The 1990 Census does not ask what grade the student is attending, so we classify people ages 18-22 who are enrolled in school and are at least high school graduates as enrolled in college; we classify people in the 2000 Census in the same manner for comparability. For the 1980 and earlier Censuses, which did not ask specifically about high school graduation, we include people are 18-22 who report being college undergraduates.
measure captures the immigrant intensity of U.S. natives’ college educational experience. Since 1950, college students have been instructed to give their current residence, not their parents’ residence, in the Census if they live in campus or off-campus housing instead of with their parents. Foreign students studying in the U.S. are instructed to answer the Census with their household location in the U.S. (Cork and Voss 2006).

The rise in immigrant shares across cohorts reflects the general increase in the foreign-born fraction of the U.S. population since the 1960s. The immigrant share while in college is consistently higher than the immigrant share while in high school. This pattern primarily reflects foreign students coming to the United States for college, although it also captures a slightly higher likelihood of college enrollment among immigrants than among U.S. natives in the 1980 and 1990 cohorts.

The immigrant share measures are created from the decennial Censuses at the state level. We merge the immigrant share measures with the ACS data by individuals’ cohort and their state of birth, which is the only place of residence available in the ACS data besides current place and place one year ago. Other studies similarly use state of birth to examine state-level variables related to education.16 Using state of birth mitigates endogeneity bias that would arise if immigration affects U.S. natives’ place of high school or college attendance, although we also instrument for the immigrant share below. Because only about 80 percent of people go to high school in their state of birth (and about 65 percent go to college in their state of birth), the estimates below likely underestimate any effect of immigration on U.S. natives’ college major. The estimates we present below are robust to controlling for the share of U.S. natives in an

individual’s state of birth who are no longer living in that state during high school or during college; this variable should control for migration in response to immigration.

As noted earlier, women are less than half as likely as men to major in S&E. Figure 2 shows the fraction of college graduates majoring in S&E by cohort and sex. The share of women majoring in S&E increased over time, although it dipped between 1980 and 1990. The share of men majoring in S&E fields is more similar to the pattern shown in Figure 1, with the 1980 cohort having the highest share of S&E majors.

The share of S&E majors who are female increased across cohorts, as the top row of Table 2 reports. This reflects both the increase in the share of women majoring in S&E but also the increase in the share of bachelor’s degrees awarded to women. The share of bachelor’s degrees in non-S&E fields awarded to women also increased across cohorts, although not as much as the share of S&E degrees.

Table 2 also reports the share of S&E and non-S&E degrees awarded to non-Hispanic whites, blacks, Asians and Hispanics among our sample of U.S. natives. We control for race/ethnicity in these categories in the regressions discussed below. The share of bachelor’s degrees earned by each minority group increased across cohorts, with the exception of blacks between 1990 and 2000. The last two rows of the table report the immigrant share measures for S&E majors and non-S&E majors. They are similar, indicating that S&E and non-S&E majors are not systematically from different states.

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17 We attempted to estimate regressions stratified by race/ethnicity. We do not present those estimates because the first-stage regressions for the samples of blacks and Asians using either of the instruments discussed below did not have enough power to instrument for the immigrant share variable. This is because of differences in the distribution of different races/ethnicities across states. Blacks are concentrated in the South while Asians are highly concentrated in California (and Hawaii). Since the South and California experienced substantial changes in their relative shares of immigrants during 1970-2000, the instrumental variable strategy does not work well for those groups.
B. Empirical Methodology

We use linear probability regressions to examine the relationship between whether U.S.-born college graduates majored in S&E and the various measures of the immigrant share. The basic regression model is

$$S&E_{ist} = \alpha + \beta \ln(\text{Immigrant Share})_{st} + \delta \text{Characteristics}_{ist} + \theta \text{Labor Market}_{st} + \sigma \text{State}_{s} + \tau \text{Cohort}_{t} + \epsilon_{ist}. \quad (1)$$

The dependent variable equals one if individual $i$ who was born in state $s$ and cohort $t$ majored in S&E; the ACS sample is conditioned on having graduated from college. Immigrant Share is one of the two immigrant share variables described above, with one focused on the high school experience and the other on college. Only one of the measures is included at a time because they are highly collinear. Again, these variables are measured when individuals were aged 18-22 and are for the state of birth. They are not sex-specific. Characteristics includes age and its square and, as noted above, dummy variables for race/ethnicity (black, Hispanic, Asian, and other are the mutually exclusive categories, with non-Hispanic whites as the omitted category). These variables control for systematic differences in the probability of majoring in S&E across races/ethnicities.

The relative attractiveness of STEM jobs may influence students’ decision whether to major in S&E. Some specifications control for conditions in the STEM labor market by including variables that measure the fraction of college graduates who are employed in STEM occupations (versus non-STEM occupations) in the state, the change in that fraction during the

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18 If both immigrant share measures are included, the standard errors on the immigrant share variables increase dramatically and their coefficients occasionally change signs.
19 The results are robust to including a variable measuring the share of U.S. natives aged 18-22 in an individual’s state of birth who still live in that state at the time of the Census. For specifications with the immigrant share while in high school, we used the share of all U.S. natives aged 18-22; for specifications with the immigrant share while in college, we used the share of U.S. natives aged 18-22 attending college.
past 10 years, the ratio of log average annual earnings of college graduates working in STEM occupations to log average annual earnings of college graduates working in non-STEM occupations in the state, and the change in that ratio during the past 10 years. These measures of the relative labor market attractiveness of STEM jobs are calculated from the decennial Censuses.

The regressions also include state and cohort fixed effects. The state of birth fixed effects control for unobservable factors that are specific to a state but constant over time, such as proximity to international borders, size, and climate. The cohort fixed effects control for unobservable factors that are specific to a college cohort, such as changes in the national labor market and the economy and changes in the national emphasis on math and science education. Some specifications add state-specific linear time trends, which control for any unobservable, smooth changes within states that affect the likelihood that U.S.-born students major in S&E. The standard errors are robust and clustered on the state and cohort.

C. Instrumental Variables

An important concern about the regression model is whether immigrant shares are exogenous. Factors that affect the propensity of immigrants (and natives) to live in a state may also affect whether natives from a state opt to major in S&E. Labor market shocks, such as the Internet boom in Silicon Valley in the 1990s, may attract immigrants to a state and also make natives from that state more interested in majoring in S&E. If our measures of the relative attractiveness of STEM jobs and the state and cohort fixed effects and state trends do not fully control for this, ordinary least squares (OLS) estimates will have a positive or upwards bias.
Another source of upwards bias is if immigrants are attracted to states with educational systems that put more emphasis on math and science and therefore generate more S&E majors.

Alternatively, the OLS estimates may display a negative or downward bias. Families whose children disproportionately major in S&E in college (i.e., natives who themselves work in STEM occupations) may move away from states that are receiving large numbers of immigrants. In this case, the likelihood that a U.S. native majors in S&E ends up lower (higher) in states with high (low) immigrant shares than it would be otherwise, making OLS estimates too negative. To bias our estimates, such endogenous mobility would have to take place before children are born since our immigrant share measures are for the state of birth. However, if families move out of high-immigration states after having children and this increases the likelihood that those children ultimately major in S&E in college, then the OLS estimates have a positive or upward bias.

We control for the potential endogeneity of the immigrant shares by using one of two instrumental variables. Both instrumental variables are closely based on Smith (2012), who also uses only one instrument at a time.\(^{20}\) The first instrument is based on immigrants’ historical settlement patterns. Immigrants tend to settle in the same areas as earlier immigrants from their country of origin (although this tendency lessened in the 1990s as immigrants moved to new destinations in the South and West, as discussed in Massey (2010)). This instrument is based on reallocating immigrants across states based on their distribution, for 16 countries or regions of origin, across states in 1960.\(^{21}\) Specifically, we calculate the predicted immigrant share in state \(s\) in Census year \(t\) as

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\(^{20}\) Smith (2012) also uses distance from Mexico as an instrument. We do not since variation in immigrant shares driven by Mexican immigration is of less interest in this context. Other research using instruments for the immigrant share based on historical settlement patterns includes Card and DiNardo (2000), Card (2001), Saiz (2007), and Hunt (2012).

\(^{21}\) The 16 countries or regions are the U.K; Canada; Ireland; Italy; Germany; Poland; Russia/USSR; other Europe; Mexico; Central America; South America; Cuba; other Caribbean; Southeast Asia and other Asia; Middle East and South Asia; and the rest of the world. These 16 groups were chosen because they are identified in the 1960-2000
Predicted immigrant share_{st} = \frac{\sum_{j=1}^{16} \text{Number of immigrants from } j \times \% \text{ of immigrants living in } s_{1960}}{\text{Population}_{st}} \tag{2}

where j represents country or region of origin. The immigrant share instrument is calculated separately for each of the immigrant share variables based on the relevant immigrants and U.S. natives. However, we calculate the distribution of immigrants in 1960—the second term in the numerator in equation (2)—using all immigrants from a given country or region, not just young adults or college students.

To be valid, this instrument requires assuming that the distribution of immigrants by country or region of origin across states in 1960 is not correlated with shocks occurring 10 to 40 years later that affect whether U.S. natives born in a given state majored in S&E. In other words, shocks that affect both the distribution of immigrants across states in 1960 and U.S. natives’ college major do not persist over time. This seems reasonable given that 1960 predates much of the “space race” and the computer revolution. Further, immigration patterns were considerably different in 1960 than in later years. At the time, the foreign-born population share was below 6 percent, versus 13 percent in 2010. Most immigrants were from Europe and had been in the United States—mainly in the Northeast and Midwest—for many years. The 1965 Immigration and Nationality Act led to dramatic increases in immigrant inflows and a shift in origins to Latin America and Asia. Immigrant destinations also have shifted to the West and South over time.

The instrument also requires assuming that immigrant inflows are not systematically related to factors that affect whether U.S. natives major in S&E in a way that is also related to immigrants’ distribution across states in 1960. If more immigrants come from China, for example, because of state-specific factors that also encourage young adults born in those states to major in S&E, the instrument would be biased. Such factors need to be at the state level because Census and the ACS and because they are each a relatively large share of immigrants in 1960. This avoids having large numbers of states with zero immigrants from a given group.
the cohort fixed effects control for any national changes, such as the Internet bubble of the 1990s or changes in immigration policy. The highly aggregated nature of the 16 immigrant origin groups helps alleviate concerns here. We group together immigrants from all East Asian countries. Mainland China, Japan, Korea, and Taiwan—major origin countries of high-skilled immigrants who disproportionately work in S&E—are grouped together with Cambodia, Laos, and Vietnam. India is grouped together with Iran, Turkey, and other countries in South Asia and the Middle East. We also control for the relative attractiveness of STEM jobs within states at a point in time and the change in their relative appeal over time.

The second instrument is also based on immigrants’ settlement patterns but within states instead of across them. The instrument uses the share of immigrants in a given state from each of the 16 origin groups 10 years prior and the contemporaneous number of all immigrants from each of the 16 origin groups in all other states to create a measure of predicted immigration in that state. The measure is

\[
\text{Predicted immigrant share}_{st} = \frac{\sum_{j=1}^{16} \left( \frac{\text{immigrants living in } s_{t-10}}{\text{immigrants living in } s_t} \right) \text{immigrants not living in } s_t}{\text{Population}_{st}}.
\]

(3)

The measure far exceeds the actual immigrant share in a given state because it is based on the number of immigrants living elsewhere, but it is nonetheless well correlated with actual immigrant shares, as shown below. As with the across-state (first) instrument, the immigrant shares for the within-state (second) instrument—the fraction in the numerator in equation (3)—are created using all immigrants from the previous census.

The second instrument has the advantage of not being based on the number of immigrants in a given state relative to other states. Instead, it is based on the composition of immigrants

---

22 Smith (2012) and Wozniak and Murray (2012) similarly use the number of immigrants in all other states to create an instrument.
within a state. This avoids concerns about long-lasting state-specific shocks that affect both immigrant shares and the likelihood that U.S. natives major in S&E. It does require assuming that shocks that affect the distribution of immigrants across origins within a state that also affect whether U.S. natives major in S&E do not persist for 10 years. The highly aggregated origin groups we use reduce the applicability of this concern, as do the labor market controls, state and cohort fixed effects, and state-specific linear time trends. In addition, results using this instrument were robust to using the distribution of immigrants across origin groups within a state in 1960 instead of 10 years prior. Shocks would have to last for a long time—up to 40 years—for that instrument to be biased.

IV. Results

Table 3 reports the OLS results for the relationship between majoring in S&E and the two measures of the immigrant share. We show three specifications by sex: with state and cohort fixed effects but without the labor market controls, with the labor market controls, and also with state-specific linear time trends. Without the labor market controls or the time trends, whether men majored in S&E is not related to the immigrant share while they were in high school (row 1, column 1). Women, in contrast, were less likely to major in S&E the higher the immigrant share while they were in high school (row 1, column 4). Adding labor market controls (columns 2 and 5) and then time trends (columns 3 and 6) has little effect on the estimated coefficients.

Both men and women were less likely to major in S&E the higher the immigrant share while they were in college, as the second row of Table 3 shows. The only exception is among men when both labor market controls and time trends are included (column 3), our preferred specification.
The implied marginal effects are very small. In our linear probability model with the log of the immigrant share, an estimated coefficient of 0.01 suggests that a 10 percent increase in the immigrant share reduces the probability that a U.S. native majors in S&E by 0.1 percentage points. Evaluating this at the sample means, a 10 percent increase in the immigrant share—going from 3.8 percent to 4.18 percent in high school or from 5.9 percent to 6.5 percent while in college—corresponds to a decrease in the share of women majoring in S&E from 9.1 percent to 9 percent. However, the changes in the immigrant share that actually occurred were much bigger: the immigrant share in high school increased by 270 percent over 1970-2000, and the immigrant share in college by 300 percent. Evaluating the OLS estimates at those magnitudes implies that the share of women majoring in S&E would have been 13.8 percent to 14.3 percent instead of about 11 percent in the 2000 cohort—a non-trivial difference—if immigrant shares had remained at their 1970 levels.

In results not shown here, the estimated coefficients on the other variables are largely as expected. Women in more recent cohorts were more likely to major in S&E. Hispanics are less likely than non-Hispanic whites to major in S&E, and Asians more likely. Black women are more likely than white women to major in S&E while the opposite is true among black men. The probability of majoring in S&E tends to be positively related to the fraction of college graduates working in STEM occupations and to the income ratio of college graduates in STEM occupations to those in non-STEM occupations but not significantly related to the 10-year changes in those variables.

A. Instrumental Variables Results
Endogeneity of the immigrant share variables may bias their coefficients either positively or negatively, as explained above. Table 4 presents the first-stage regression results for each of the instruments. For simplicity, we only present results for the pooled sample and control for sex in the regressions; results stratified by sex are similar. Both instruments do well, with F-test statistics above 20 with only one exception.

Table 5 presents the instrumental variables (IV) results. The top panel presents estimates using the predicted immigrant share based on the distribution of immigrants across states in 1960. The bottom panel presents estimates using the predicted immigrant share based on the distribution of immigrants across origins within states 10 years prior. Each coefficient is from a separate IV regression.

The IV estimates tend to be closer to zero than the OLS estimates, and few of the estimated coefficients are statistically significant. The standard errors are large enough that we cannot rule out finding no difference between the OLS and the IV results within or across specifications. Nonetheless, most of the estimated marginal effects remain very small.

The one exception is the relationship between whether women major in S&E and the immigrant share while they are in college, shown in column 6 of Table 5. Both IV estimates are negative, significantly different from zero, and larger (in absolute value) than most of the other estimates. The estimate using the across-states instrument suggests that a 10 percent increase in the immigrant share reduces the probability that a woman majors in S&E by 0.25 percentage points, and the within-states instrument suggests the probability falls by 0.43 percentage points. Evaluating those estimates at the actual changes that occurred and assuming that nothing else changed, the across-states instrument suggests that the share of women majoring in S&E would have been 18.6 percent instead of 11 percent in the 2000 cohort if the immigrant share had
remained at its 1970 level. The within-states instrument suggests an even bigger counterfactual: that the share of women majoring in S&E would have been 24 percent. This is equivalent to the share of men majoring in S&E in the 2000 cohort. Taken at face value, the estimated coefficients in the specifications with time trends thus suggest that immigration can explain all of the gender gap in S&E. However, the other specifications do not indicate that the immigrant share has a significant negative effect on whether women major in S&E.

B. Robustness

Because California is the center of the high-tech industry and is home to many immigrants, it may drive the results. Almost 9 percent of the sample was born in California, where the immigrant share for the 2000 cohort was over 18 percent in high school and 22.5 percent in college. Table 6 presents IV results without U.S. natives born in California for the specification that includes labor market controls and state-specific linear time trends; the first-stage results are not shown here but are strong. The results continue to indicate a sizable negative relationship between the probability that women majored in S&E and the immigrant share while they were in college. The other estimated coefficients are also similar to those reported in the equivalent specifications shown in columns 3 and 6 of Table 5. In results not shown here, we also found similar results dropping Texas, another large immigrant state, or DC from the sample.

The results also were robust to creating the within-state instrument using 1960 Census data instead of data from the 10-years-prior Census. As noted above, this suggests that any shocks that bias the results would have to be very long lasting. The results also were robust to controlling for the log of the fraction of U.S. natives in a given cohort who remained in their
state of birth, which helps control for the possibility that U.S. natives moved in response to immigrant inflows.

**C. Consequences**

If women were less likely to major in S&E because the immigrant share rose, what did they ultimately major in? We examine this using the same methodology we used to examine whether U.S. natives were less likely to major in S&E but with the dependent variable equal to one if a college graduate majored in the humanities, the social sciences, psychology, business, medical and health sciences and services (nursing), or education. We estimated separate regressions for each of those majors. The results indicate that women were more likely to major in education and in psychology as the immigrant share while in college increased.

Higher immigrant shares while in college also may have affected which women chose to major in S&E. Women with the highest or the lowest ability in that area may have disproportionately shifted to other majors. The ACS does not have any measure of ability that would allow us to directly examine this, such as SAT scores or high school grades. However, we can look at whether women who majored in S&E were less likely to go on to graduate school, which may be a signal of ability. The ACS has a measure of completed education, which we use to examine whether U.S. natives who majored in S&E had an advanced degree. The ACS does not ask the field of the advanced degree, so the data would also capture MBAs and law degrees.

Table 7 presents the results for linear probability regressions on whether S&E college graduates earned an advanced degree. The regressions include state-specific linear time trends as well as the other variables noted earlier. Column 1 reports results for men from OLS and IV regressions while column 3 reports results for women. The OLS results suggest that the
probability that men earned an advanced degree is negatively related to the immigrant share while in college, and the probability among women is positively related to the immigrant share while in high school. The across-states IV results indicate that a higher immigrant share while in college increases the probability that female S&E majors earn an advanced degree. The IV results thus suggest that women with higher ability in S&E, as signaled by earning an advanced degree, may be the ones who remain S&E majors as a result of immigration but this finding is not conclusive given the limitations of the ACS data.

Whether immigration affects the likelihood that U.S. natives work in STEM is ultimately more important than whether it affects the likelihood that U.S. natives major in S&E. We therefore look at the relationship between whether a U.S. native who majored in S&E is working in a STEM occupation at the time of the ACS and the immigrant shares when he or she was in high school and college. Columns 2 and 4 of Table 7 report the results for men and women, respectively. The immigrant share does not have a negative effect on whether men who majored in S&E are working in STEM, but it is consistently negatively related to whether women are working in STEM. Interestingly, the results are negative—although smaller in absolute value—for the immigrant share while in high school as well as in college even though the IV results did not indicate a negative effect of the immigrant share in high school on whether women majored in S&E. The results (not shown) are also negative for women—but not for men—if the sample is not conditional on majoring on S&E. We note that our goal here is not to explain gender differences in working in STEM—which would require a considerably more rigorous

23 As in Hanson and Slaughter (2013), we classify engineering occupations, software developers and programmers, computer and information analysts, database administrators and network architects, life and physical scientists, mathematicians, and computer scientists as STEM occupations. Because there may be selection in employment status, particularly among women, we include all S&E graduates regardless of current employment status. STEM occupation is based on the current occupation reported in the ACS by people who are currently employed; for people who are currently unemployed or not in the labor force but have worked within the last five years, the ACS reports the occupation of the last job. People who have been unemployed or out of the labor force for more than five years are not included in this part of the analysis.
approach—but rather to focus on whether immigration appears to affect the choices men and women make.

These results also serve as a check on the validity of our instruments. If the instruments reflected a tendency of immigrants to settle in areas that experienced long-lasting positive trends in STEM fields, we would expect to see the IV estimates in columns 2 and 4 be more positive than the OLS results; the same factors that attracted immigrants would presumably also make college graduates more likely to work in STEM. Instead, the IV results for women are consistently more negative than the OLS results. The IV results for men are also smaller than the OLS results, albeit not significantly so.

D. Why Do Women Respond Differently to Immigration than Men?

The above results indicate that the immigrant share of the age cohort has a more adverse effect on women than on men. This difference is particularly important since women are less than half as likely as men to major in S&E. Considerable attention has been devoted to examining why women are less likely than men to major in S&E, but no single factor appears to be the smoking gun.  

Xie and Shauman (2003) report that most female STEM baccalaureates decided to major in STEM while in college; in contrast, most male STEM baccalaureates already planned on majoring in that area when they entered college. This is consistent with our finding that the immigrant share in college has a more adverse effect than the immigrant share in high school on whether women major in S&E and on whether they ultimately work in S&E.

\footnote{For example, Turner and Bowen (1999: 308) report that differences in academic preparation help explain gender differences in choice of major, but differences in SAT scores “capture much less of the dynamics of change over the past 35 to 40 years than do the panoply of residual forces, including differences in preferences, labor market expectations, gender-specific effects of the college experience, and unmeasured aspects of academic preparation.” Zafar (2013) attributes gender differences in major to differences in beliefs about enjoying coursework and differences in preferences, but the source of those differences is unclear.}
The mechanism via which immigration affects women in college is unclear, however. One possibility is cohort crowding. If most male S&E majors are already planning on majoring in S&E but most female majors decide when they get to college, women’s experience in first year courses may be critical. Women who do not get into S&E gateway courses as freshman may choose other majors. Immigration also may affect where U.S. natives end up in the grade distribution in S&E courses, and women who earn lower grades may be less likely to persist in S&E majors (Ost 2010). However, grades are unlikely to be the whole story. Women are less likely than men to persist in natural science, engineering, and economics majors at Duke University even after controlling for grades and SAT scores (Arcidiacono et al. 2012).

Peer effects may play a role in other ways as well. Zafar (2013) finds that female undergraduates at Northwestern University are less likely than males to major in S&E because they believe that they will not enjoy the courses. Why women believe they will not enjoy S&E courses is unclear; it does not appear to be related to beliefs about ability but may be related to the small number of other women in S&E courses. Women appear to be more likely to major in male-dominated fields such as S&E if they attend a single-sex college instead of a co-ed institution (Solnik 1995).

Another possibility is that higher levels of immigration result in some women attending institutions in which they are less likely to major in S&E. As discussed above, research does not show that immigration adversely affects the likelihood that U.S. natives go to college (Betts and Lofstrom 2000; Jackson 2011), but some evidence suggests that it may change the type of institution they attend (Hoxby 1998). Persistence in and returns to S&E vary across types of

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25 Professor gender also appears to matter. Carrell, Page, and West (2010) show that women at the U.S. Air Force Academy are more likely to major in STEM if they have female instructors in introductory math and science courses.
Discussion and Conclusion

The National Academy of Sciences (2007b) warned that the United States is losing its competitive edge because of insufficient investments in STEM education and research and the small share of U.S. citizens entering STEM fields. Along with urging increased funding for STEM education and research, it recommended that the United States adopt immigration policies that would encourage immigrant scientists and engineers to study and work in the United States. Immigration policy is important since immigrants comprise 21 percent of U.S. STEM workers with a bachelor’s degree, 41 percent of those with a master’s degree, and 58 percent of those with a Ph.D. (Hanson and Slaughter 2013). The foreign born are also a high and growing share of undergraduate and graduate students in the United States, especially in S&E fields. This study examined the link between these trends and policy recommendations by examining whether the immigrant share of high school and college students affects U.S. natives’ decision to major in S&E at the undergraduate level, a crucial first step toward a career in STEM.

The results suggest that, when controlling for state-specific linear time trends, women are less likely to major in S&E the higher the immigrant share in their college cohort. In addition, the higher the immigrant share while in high school and college, the less likely female college graduates are to later be working in a STEM occupation. Instrumental variables results do not indicate negative effects among men, in contrast. This gender difference is striking given that women are much less likely to major or work in S&E. Being less likely to major in S&E and
other lucrative fields plays a major role in the gender wage gap among college graduates (e.g., Brown and Corcoran; Weinberger 1999).

Although the results suggest that immigration may make women less willing to major in S&E, there are several caveats to this finding. First, we condition on being a college graduate. The fraction of the population that graduates from college has increased over time, particularly among women, and the selectivity of this pool may have decreased at the same time as immigrant shares have risen. Immigration may raise the bar in STEM fields, increase the selectivity of U.S. natives into S&E majors, and ultimately have a positive effect on innovation. Looking at whether immigration affects selectivity into S&E majors using data with a better measure of ability is an important area for future research.

Even if immigration discourages U.S.-born women from choosing S&E majors, we caution against drawing strong policy implications. If foreign students are on average better at S&E fields or have a stronger preference for those fields and are therefore more likely to major in those fields, this frees up U.S. natives to pursue other careers. Research shows that foreign students in S&E who remain in the country are at least as innovative and productive as similarly-educated U.S. natives (Hunt 2011), and foreign graduate students appear to have positive effects on patent activity (Challaraj, Maskus, and Mattoo 2008). To the extent that people choose a profession in accordance with their comparative advantage, the resultant distribution of majors by nativity is optimal. Exceptions to this outcome might be situations where U.S. citizenship is a condition for STEM employment, such as in the defense industry and at national security agencies.
References


Jackson, Osborne. 2011. Does immigration crowd natives into or out of higher education? Mimeo, Northeastern University.


Figure 1. The Proportion of College Graduates Majoring in S&E by Nativity

Note: Calculations based on 2009-2011 American Community Survey data for college graduates ages 25-65 at the time of the survey. Proportion of S&E U.S. college graduates who are foreign born is based on natives and immigrants who arrived in the U.S. by age 20, and only includes people living in the U.S. at the time of the survey. S&E does not include psychology or the social sciences.
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>% S&amp;E major</td>
<td>16.4</td>
<td>16.8</td>
<td>15.8</td>
<td>18.2</td>
<td>14.7</td>
</tr>
<tr>
<td></td>
<td>(4.1)</td>
<td>(5.4)</td>
<td>(4.6)</td>
<td>(2.3)</td>
<td>(1.2)</td>
</tr>
<tr>
<td>% foreign born while in high school</td>
<td>3.8</td>
<td>6.3</td>
<td>4.5</td>
<td>2.9</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>(4.1)</td>
<td>(5.4)</td>
<td>(4.6)</td>
<td>(2.3)</td>
<td>(1.2)</td>
</tr>
<tr>
<td>% foreign born while in college</td>
<td>5.9</td>
<td>9.2</td>
<td>7.2</td>
<td>5.1</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>(5.4)</td>
<td>(6.7)</td>
<td>(6.0)</td>
<td>(3.4)</td>
<td>(1.6)</td>
</tr>
<tr>
<td>Sample size</td>
<td>641,971</td>
<td>149,731</td>
<td>159,212</td>
<td>165,099</td>
<td>167,929</td>
</tr>
</tbody>
</table>

Note: Shown are sample means (standard deviations). The sample is U.S.-born college graduates who were aged 18-22 in the year indicated as the cohort. Data are from the 2009-2011 American Community Surveys. Percentages foreign born are from decennial Census data based on state of birth; see text for details. Observations are weighted using the person weights rescaled to sum to the same total for each cohort. Sample sizes are unweighted.
Figure 2. Proportion of U.S. Natives Majoring in S&E, by Sex and Cohort

Note: Calculations based on 2009-2011 American Community Survey data for college graduates. Cohorts are people aged 18-22 in the year indicated.
Table 2  
Characteristics of S&E and Non-S&E Majors, by Cohort

<table>
<thead>
<tr>
<th></th>
<th>S&amp;E Majors</th>
<th>Non-S&amp;E Majors</th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>% Female</td>
<td>29.3 37.0 31.0 28.3 20.5</td>
<td>56.9 60.0 58.0 57.4 52.6</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>% non-Hispanic white</td>
<td>85.5 78.4 83.0 88.7 91.7</td>
<td>85.0 80.3 83.1 86.6 89.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% non-Hispanic black</td>
<td>6.2 7.3 7.5 5.7 4.2</td>
<td>7.9 8.2 8.9 7.8 6.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Asian</td>
<td>3.0 6.2 3.3 1.5 1.3</td>
<td>1.5 2.8 1.4 0.9 0.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Hispanic</td>
<td>3.6 5.6 4.5 2.8 1.6</td>
<td>4.1 6.6 5.0 3.2 2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% foreign born while in high school</td>
<td>3.8 6.2 4.4 2.9 1.8 (4.1) (5.4) (4.6) (2.3) (1.3)</td>
<td>3.8 6.3 4.5 2.9 1.7 (4.1) (5.4) (4.6) (2.3) (1.2)</td>
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<td></td>
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<tr>
<td>% foreign born while in college</td>
<td>5.9 9.0 7.2 5.1 2.4 (5.4) (6.6) (6.0) (3.4) (1.6)</td>
<td>5.9 9.3 7.2 5.1 2.3 (5.5) (6.7) (6.0) (3.4) (1.6)</td>
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</table>

Note: Shown are sample means (standard deviations). The totals for race/ethnicity do not sum to 100 because non-Hispanic other race is not shown.
Table 3
OLS Regression Estimates for Relationship between Majoring in S&E and Immigrant Share

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th></th>
<th></th>
<th>Females</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>% foreign born while in high school</td>
<td>-0.004</td>
<td>-0.004</td>
<td>0.001</td>
<td>-0.010**</td>
<td>-0.011**</td>
<td>-0.012**</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.003)</td>
<td>(0.004)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>% foreign born while in college</td>
<td>-0.012**</td>
<td>-0.011**</td>
<td>-0.001</td>
<td>-0.013**</td>
<td>-0.013**</td>
<td>-0.009*</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.006)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Labor market controls included</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>State linear time trends included</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: Each estimated coefficient is from a separate linear probability regression. Regressions also include controls for age and its square, race/ethnicity, and state and cohort fixed effects. Standard errors are robust and clustered on state*cohort.
Table 4
First-Stage Regression Estimates for Immigrant Share

<table>
<thead>
<tr>
<th></th>
<th>1960 Distribution of Immigrants across States</th>
<th>Lagged Immigrant Composition within States</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>% foreign born while in high school</td>
<td>0.609** (0.104)</td>
<td>0.634** (0.091)</td>
</tr>
<tr>
<td>F test</td>
<td>34.09</td>
<td>48.86</td>
</tr>
<tr>
<td>% foreign born while in college</td>
<td>0.553** (0.109)</td>
<td>0.564** (0.098)</td>
</tr>
<tr>
<td>F test</td>
<td>25.97</td>
<td>33.14</td>
</tr>
<tr>
<td>Labor market controls included</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>State linear time trends included</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Note: Each estimated coefficient is from a separate OLS regression. Regressions also include controls for age and its square, sex, race/ethnicity, and state and cohort fixed effects. Standard errors are robust and clustered on state*cohort.
<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>A. IV: 1960 distribution of immigrants across states</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% foreign born while in high school</td>
<td>-0.007</td>
<td>0.001</td>
<td>-0.004</td>
<td>-0.004</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.006)</td>
<td>(0.009)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>% foreign born while in college</td>
<td>-0.006</td>
<td>0.001</td>
<td>0.004</td>
<td>-0.007</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.009)</td>
<td>(0.012)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>B. IV: lagged immigrant composition within states</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% foreign born while in high school</td>
<td>0.001</td>
<td>0.003</td>
<td>0.007</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.011)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>% foreign born while in college</td>
<td>0.009</td>
<td>0.009</td>
<td>0.012</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.012)</td>
<td>(0.018)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>Labor market controls included</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>State linear time trends included</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Note: Each estimated coefficient is from a separate IV regression. Regressions also include controls for age and its square, race/ethnicity, and state and cohort fixed effects. Standard errors are robust and clustered on state*cohort.
Table 6
Robustness of IV Regression Estimates to Excluding California

<table>
<thead>
<tr>
<th>% foreign born while in high school</th>
<th>IV: 1960 Distribution of Immigrants across States</th>
<th>IV: Lagged Immigrant Composition within States</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males (1)</td>
<td>Males (3)</td>
</tr>
<tr>
<td></td>
<td>Females (2)</td>
<td>Females (4)</td>
</tr>
<tr>
<td>% foreign born while in high school</td>
<td>-0.006 (0.012)</td>
<td>0.007 (0.012)</td>
</tr>
<tr>
<td></td>
<td>-0.008 (0.012)</td>
<td>-0.016 (0.013)</td>
</tr>
</tbody>
</table>

| % foreign born while in college   | 0.006 (0.015)                                  | 0.011 (0.017)                                 |
|                                   | -0.031† (0.017)                                | -0.042* (0.019)                               |

Note: Each estimated coefficient is from a separate IV regression. Regressions also include controls for age and its square, race/ethnicity, STEM labor market conditions, state and cohort fixed effects, and state linear time trends. Standard errors are robust and clustered on state*cohort.
Table 7
Regression Estimates for Relationship Post-College Outcomes among S&E Majors and Immigrant Share

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Advanced degree</td>
<td>Work in STEM</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>A. OLS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% foreign born while in high school</td>
<td>-0.017 (0.012)</td>
<td>0.008 (0.009)</td>
</tr>
<tr>
<td>% foreign born while in college</td>
<td>-0.034** (0.013)</td>
<td>0.019† (0.011)</td>
</tr>
<tr>
<td>B. IV: 1960 distribution of immigrants across states</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% foreign born while in high school</td>
<td>0.007 (0.027)</td>
<td>-0.004 (0.023)</td>
</tr>
<tr>
<td>% foreign born while in college</td>
<td>0.026 (0.040)</td>
<td>0.013 (0.028)</td>
</tr>
<tr>
<td>C. IV: lagged immigrant composition within states</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% foreign born while in high school</td>
<td>-0.030 (0.043)</td>
<td>-0.020 (0.029)</td>
</tr>
<tr>
<td>% foreign born while in college</td>
<td>-0.062 (0.063)</td>
<td>0.004 (0.039)</td>
</tr>
</tbody>
</table>

Note: Each estimated coefficient is from a separate regression. Samples are conditional on having an S&E major. Regressions also include controls for age and its square, race/ethnicity, STEM labor market conditions, state and cohort fixed effects, and state linear time trends. Standard errors are robust and clustered on state*cohort.