Women's Representation among STEM College Majors: Are Gains Associated with Greater Representation in STEM Jobs for Women and Minorities?

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Isolation and discrimination are widely cited impediments to greater diversification of the STEM labor force. Gender remains an important basis of minority status within the natural sciences, reflecting uneven gains in women's representation across scientific fields. We use NSF's Scientists and Engineers Statistical Data System (SESTAT) to explore the association between women's representation among STEM majors in college (1970-2004) and those majors' likelihood of STEM employment after graduation. Women's representation ranges from a low of two percent in the 1970-74 engineering cohort to a high of 63 percent in the 2000-04 life science cohort. We find that women – especially Asians and Hispanics – whose cohorts included higher proportions of women are more likely to work in STEM than comparable women who experienced lower levels of women's representation. We also find gains for White, Black, Hispanic and, to a lesser extent, Asian men although these gains are more modest.

Introduction

Isolation and related discrimination are among the most widely cited impediments to greater diversification of the STEM labor force (Ong, Wright, Espinosa & Orfield, 2011; Xie & Shauman, 2003). Research documents the experiences of women and, more recently, underrepresented minorities who face a “chilly climate” related to their small numbers among both students and workers in many fields within engineering and the natural sciences (Gunter & Stambach, 2005). Studies of impediments to greater diversification of STEM fields emphasize multiple disadvantages of being in the minority – especially when that minority is very small (Ong et al., 2011).

Gender continues to be an important basis of minority status within the natural sciences. While women’s representation in scientific fields of study and in the STEM labor force has risen in recent decades, growth has been uneven across fields (England & Li, 2006). The largest gains have occurred in the life sciences where women now make up a majority of college graduates and almost half of STEM workers (National Science Foundation, 2013). In contrast, women remain a relatively small minority among college graduates with engineering degrees (18 percent) and among employed engineers (13 percent) (National Science Foundation, 2013). Women’s representation in the fields of computing and mathematics and in the physical sciences falls in between the high levels found in the life sciences and the much lower levels found in engineering.

This variation in women’s representation in STEM studies over time and across fields creates an opportunity to explore the role of group size in STEM achievement. While race and ethnicity are also important bases of minority status within the STEM labor force, a larger body of theoretical work explores the relationship between gender and group size (Riegle-Crumb &

King, 2010; Ong, et al., 2010). More importantly, women's high levels of representation within some STEM fields and the sizeable variation in women's representation over time and across fields provides a strong basis for empirical tests of the relationship between group size and group status. For these reasons, we focus on women's representation in this paper while acknowledging the potential importance of group size for relatively smaller race-ethnic minority groups in STEM, particularly Blacks and Hispanics, who respectively accounted for only six percent of all graduating life science majors and eight percent all graduating engineering majors in 2009 (National Science Foundation, 2013).

Scholars have long argued that group size within institutions – in school classes, professional occupations (such as law), and in the board room – can exert important effects on the status and success of numerical minorities (Dahlerup, 1988; England & Li, 2006; Kanter, 1977; Ma, 2011). Some scholars propose that particular thresholds constitute a "critical mass" at or above which the disadvantages of minority status diminish (Kanter, 1977). Others posit a linear or curvilinear relationship between group size and group status (England & Li, 2006; Ma, 2011).

Much scholarship on this topic has focused on women's representation in politics (see, for example, Dahlerup, 1988, 2006; Grey, 2006; McAllister & Studlar, 2002) or business (Konrad, Kramer & Erkhut, 2008). Far less research explores the effects of group size on persistence along the path to STEM careers. The limited scholarship exploring this question focuses almost exclusively on the effect of group size on the careers of women faculty in the natural sciences (Carrigan, Quinn & Riskin, 2011; Etzkowitz, Kemelgor, Neuschatz, Uzzi & Alonzo, 1994; Kulis, Sicotte, & Collins, 2002), rather than on the likelihood of STEM employment more generally. (See, however, Glass, Sassler, Levitte, & Michelmore, forthcoming, which examines the general STEM labor force rather than the academic market.)

While numerous programs (often funded by government dollars) profess that increasing the "pipeline" of women with STEM degree is imperative, to date this presumption has not been tested with nationally representative data. We ask if the increasing representation of women graduates among recent cohorts of STEM majors is associated with a greater likelihood of working in STEM occupations. A particular focus of our paper is to explore the association between women's representation in college and the likelihood of subsequent STEM employment among different minority groups – women overall, as well as among race-ethnic minorities.

We also investigate whether increases in women's representation in STEM studies are associated with declines in the likelihood of STEM employment among men after college, as suggested by theories of the devaluation of women and fields associated with women – such as nursing and elementary school teaching (England and Li, 2006). We broaden this question of devaluation by considering whether the relationship between the gender makeup of STEM fields in college and subsequent STEM employment differs for White and minority men.

The changing demographic composition of the U.S. population poses challenges and opportunities to narrow inequalities across gender, race, and ethnic groups (Lichter, 2013). White men make up a declining share of the U.S. student and working age populations. Thus, the traditional pool of potential U.S. scientists and engineers is shrinking. At the same time, rising global competition for scientists may reduce the ability of the U.S. to rely on immigrants to bolster this critical sector of the economy (Committee on Prospering in the Global Economy of the 21st Century, 2007; National Science Board, 2010). At least as important, failure to diversify the population of U.S.-born women and minority scientists represents a waste of resources and a missed opportunity to reduce gender and racial inequality in the workforce since science and engineering jobs offer above-average salaries and career opportunities compared with many other fields of employment (Bartol and Asprey, 2006; Bureau of Labor Statistics, 2012). Understanding the role of critical mass in STEM education could aid in the development of more effective policies and programs aimed at diversifying the STEM labor force.

We utilize data from the National Science Foundation's (NSF) Scientists and Engineers Statistical Data System (SESTAT) to explore the association between group size (field of study/major) and employment in the STEM labor force. Our analysis capitalizes on repeat cross-sectional, national samples of college graduates who completed degrees in STEM fields gathered by NSF since 1993. These data provide us with a large enough sample to study in detail the eight largest race-gender groups: Non-Hispanic White; non-Hispanic Black; Non-Hispanic Asian; and Hispanic men and women. We ask the following questions:

1. How has the representation of women in STEM majors changed across graduating cohorts of college students since 1970?
2. Are more recent cohorts of women and minorities more likely to work in STEM occupations than earlier cohorts?
3. Is women's representation among STEM majors positively associated with their likelihood of subsequent employment in STEM fields, and does this association vary by race-ethnicity?
4. Is women's representation among STEM majors inversely associated with men's likelihood of subsequent employment in STEM fields, and does this association vary by race-ethnicity?

Our work contributes to the existing literature on gender and STEM employment (Glass et al., forthcoming; Sassler et al., 2012; Xie & Shauman, 2003; Ong et al., 2010) by investigating the relationship between level of gender representation in college and subsequent STEM employment, a topic that has received limited previous study, and by considering potential variation in this relationship across race and gender (Riegle-Crumb & King, 2010).

Under-Representation and Isolation in the Stem Labor Force

Perspectives that emphasize isolation and discrimination stemming from minority status indicate that women, Blacks, Hispanics, and, in some cases, Asians face greater obstacles along the path to a scientific career than do White men. Recent scholarship, for example, has emphasized the “double bind” of dual outsider status experienced by women of color in the sciences, who are especially likely to find themselves the only student or one among very few students of their gender and race-ethnicity in their major (Espinosa, 2011; Johnson, 2007; Ong, 2005; Ong et al., 2010; Ong et al., 2011). Other scholars have examined obstacles to STEM persistence among specific race-ethnic groups whose low levels of representation among undergraduate STEM majors similarly compound challenges to perceiving themselves and being perceived as legitimate scientists (Cole & Espinoza, 2008; Maton, Hrabowski, & Schmitt, 2000; Perna, Lundy-Wagner, Drezner, Gasman, Yoon, Bose & Gary, 2009; Russell & Atwater, 2005).

These streams of research investigate a variety of mechanisms through which minority status disadvantages and discourages prospective scientists who do not fit standard expectations that scientists are White and male. Many of these mechanisms relate to the scarcity of female and minority students among STEM students and STEM workers and point to potential effects of group size at earlier points in the STEM trajectory on continued persistence along that trajectory.

For example, women and minority students report difficulty in developing peer networks to support them in their scientific endeavors due to the scarcity of other students of similar backgrounds in their areas of study and the tendency of informal and formal study groups to form along gender and race-ethnic lines (Chang, Eagan, Lin & Hurtado, 2011; Espinosa, 2011; Solorzano, Ceja and Yosso, 2000). Similarly, lack of diversity among STEM faculty and among STEM supervisors in the workforce hinders the ability of women and minorities to forge relationships with mentors who have similar backgrounds and experiences (Cole & Espinoza, 2008; Rayman & Brett, 1995; Turner, 2003; Turner, Gonzalez & Wood, 2008).

Theoretical Conceptualizations of Group Size

The premise that group size exerts important effects on the status and success of any group that constitutes a small minority within an institutional underlies Kanter's (1977) examination of the experiences of female sales representatives among a predominantly male sales force. Although Kanter studied women in a corporate setting, she developed theoretical claims pertaining more generally to group dynamics between any majority group and a "skewed" minority group accounting for 15 percent or less of the total population. In her widely cited article, subtitled "Skewed Sex Ratios and Responses to Token Women," Kanter distinguished between "skewed" and "tilted" minority groups, the former making up no more than 15 percent of the total population and the latter accounting for nearer to a third (p. 966). She argued that tokens have little success in banding together to influence the majority, while the larger number of members in "tilted" groups creates the potential for forming effective alliances for change.

The dynamics Kanter described more than three decades ago as characterizing relationships between skewed and majority groups are echoed in more recent observations by scholars studying the experiences of female, Black and Hispanic undergraduate STEM majors. These patterns include heightened visibility of women and minorities in science programs and classes, exaggeration by the majority of differences between members of the minority and majority groups, and stereotyping by the majority of minority group members that obscures variation among "tokens" based on other characteristics, such as social class or nativity (Kanter, 1977; Ong et al., 2011).

Critiques of critical mass theory, including one by Dahlerup (2006), counter that little empirical research undergirds the selection of 30 percent as the pertinent threshold across different institutional settings and minority groups (Grey, 2006). Critics also cite evidence that factors other than group size are needed to bring about significant institutional change. These include the need for institutionally powerful majority champions of the minority group in question, changes in institutional structure that foster integration and acceptance of the minority, the absence of backlash from the majority group as minority group size increases, and avoidance of bifurcation of the minority group into factions aligned with the majority and other factions striving for institutional change (Etzkowitz, Kemelgor & Uzzi, 2000; Etzkowitz, Kemelgor, Neuschatz, Uzzi & Alonzo, 1994).

Empirical research on critical mass in STEM fields, is limited, however, and focuses primarily on attainment of tenure by female faculty members. Results are mixed. Carrigan, Quinn and Riskin (2011), for example, found that female faculty members in STEM disciplines in which women accounted for at least 15 percent of all faculty enjoyed a more gender equitable allocation of time among teaching, research and service than female faculty in disciplines in which the proportion of women was lower. Greater critical mass was also associated with higher overall job satisfaction among female faculty members. Critical mass was negatively associated with female faculty members' satisfaction with their workload, however. In another study of academia, Kulis, Sicotte and Collins (2002) found no evidence that critical mass in a STEM sub-discipline related to the odds that a faculty position in that discipline was held by a woman after controlling for other demographic, institutional and labor force measures.

One of the few studies to consider the relationship between critical mass and STEM employment beyond academia by Glass et al. (forthcoming) found no effect of women's proportional representation in specific STEM occupations on women's likelihood of retention in the STEM labor force. This null finding remained consistent regardless of whether women's representation was measured using techniques that allowed for identification of potential threshold effects or was entered into the models as a linear term.

Although few studies have specifically explored relationships between group size and employment in the broader STEM labor force, research regarding the influence of the gender and race-ethnic makeup of fields of study and occupations on educational and career choices provides some guidance in anticipating how group representation may help shape employment outcomes. Ma (2011) found that college students with similar levels of academic achievement and socio-economic status were more likely to major in the natural sciences if members of their gender and race-ethnic group were more highly represented in the related occupational field. Specifically, college students were more likely to major in technical fields (defined as engineering, physical science, computing and math) if higher proportions of their gender and race-ethnic group worked in technical occupations. Similarly, students were more likely to major in life and health science if they belonged to gender and race groups that were better represented in those fields of employment. Ma hypothesized that higher group representation in scientific occupations made it easier for students to envision themselves as fitting into a given occupation and thus encouraged them to select a related college major.

A related theme in research on gender and women's representation in higher education and in the labor force predicts that men will shy away from college majors and careers that become too female dominated (England & Li, 2006). The devaluation perspective asserts that behaviors and activities associated with women are devalued by society, and that this devaluation means that women's numeric success in a given realm can lead to a form of gender "tipping" in which an arena previously associated with men becomes devalued and primarily associated with women as the number of men entering the arena declines in response to rising entry by women.

England and Li (2006) used National Center for Education Statistics data to test the this proposition by examining the association between the proportion of women in a college major and the number of men entering that same major four years later. They found that between 1975 and 1988 men's entry into a major rose until women accounted for more than 54 percent of students in that major. Once women's representation exceeded 54 percent, however, men's entry began to decline. Providing further evidence for the devaluation thesis, the authors found that as more majors "tipped," becoming majority female, between 1989 and 2002, the effect of women's representation became linear, such that all increases in the proportion of women in a major were associated with subsequent declines in male enrollment. England and Li's findings suggest that, in contrast to the positive association generally expected among women, among men, increases in women's representation in STEM majors may be associated with subsequent declines in men's employment in related STEM fields.

A different possibility is highlighted by research on dissatisfaction among many undergraduate science majors with the formal and often competitive organization of science courses and majors, particularly introductory STEM courses designed to weed out less successful students (Carlone & Johnson, 2007; Johnson, 2007; Seymour & Hewitt, 1997, Varma and Hahn, 2007). Although much of this research focuses on poor retention and high dissatisfaction among female and minority students (Busch-Vishniac & Jarosz, 2007; Gasiewski, Eagan, Garcia, Hurtado & Chang, 2012; Ong et al., 2011), this literature also points to dissatisfaction among men. To the extent that men value the more informal and welcoming culture some STEM majors and courses have adopted in an effort to attract a more diverse student body, women's representation in STEM majors may be positively associated with men's subsequent STEM employment.

The association between women's representation in college STEM majors and later STEM employment may also vary by race-ethnicity. One possibility is that members of race-ethnic minority groups may derive heightened benefits from gains in women's representation compared to Whites. For women in particular, this might occur if increases in the proportions of fellow women STEM majors partially alleviated the isolation experienced by minority women, encouraging the development of a sense of self as a scientist and decreasing perceptions of outsider status (Burke, 2007; Carlone & Johnson, 2007; Solorzano, Ceja & Yosso, 2000). For the same reasons, gains in women's representation may also be positively associated with STEM employment among minority men. Alternatively, very high levels of isolation and discrimination experienced particularly by women of color (Ong et al., 2010) could overwhelm the potential benefits of increased representation of women.

Data and Method

Data for this analysis are drawn from seven waves (1993, 1995, 1997, 1999, 2003, 2006 and 2008) of the National Science Foundation's restricted Scientists and Engineers Statistical Data System or "SESTAT." SESTAT integrates information from three ongoing surveys to create a nationally representative sample of recipients of science or engineering degrees at the baccalaureate level or higher and recipients of non-science baccalaureate degrees employed in a science or engineering occupation (Kannankutty & Wilkinson, 1999). The component surveys of SESTAT are The National Survey of College Graduates (NSCG); the National Survey of Recent College Graduates (NSRCG); and the Survey of Doctoral Recipients (SDR). Each component survey is conducted approximately biannually. Additional detail about the component surveys and their integration in SESTAT is available from Kannankutty & Wilkinson (1999). Response rates for the components surveys were generally in the range of 80-85 percent, with some response rates in the 70 percent range for recent waves of the NSCG and NSRCG (Kannankutty, 2012; Kannankuty & Wilkinson, 1999; National Science Foundation, 2012a, 2012b, 2012c). The restricted SESTAT data provide detailed information about the labor force, educational and demographic characteristics of respondents.

For SESTAT respondents who participated in more than one of the seven surveys, we randomly select one wave to include in our analysis. Because our study focuses on the likelihood of employment in a STEM field among workers with training in the sciences, we limit our analytic sample to employed college graduates who majored in one of four broad STEM fields: life science; physical science; computer science and mathematics; and engineering. We defined scientists as workers employed in one of those four fields or in one of the following areas that NSF classifies as S&E related: health-related workers, including registered nurses, pharmacists, and health technicians; managers employed in STEM or STEM-related fields; secondary school teachers of natural science fields; and technicians and technologists, such as computer programmers and surveyors. As discussed further below, we also investigated the impact of narrowing our definition of scientists by excluding those in S&E related fields, a group among which women are over-represented.

Measures

Our dependent variable is a dichotomous measure of employment coded "1" if the respondent is employed in a STEM occupation and "0" if the respondent is employed in a non-STEM occupation. Our main models utilize the broader definition of STEM-employed, including workers employed in S&E related fields. Supplementary models examine the impact of applying a narrower definition that limits STEM employed to respondents working in one of the four broad STEM fields.

Our independent variable of central interest is the level of representation of women in a respondent's field of study and graduation cohort, for example, the percentage of life science majors graduating between 1970 and 1974 who were female. We include the square of this measure to test for curvilinear effects. We also test two alternative dichotomous measures of women's representation that are posited to be important theoretical thresholds of tokenism in the literature: at least 15 percent female and at least 30 percent female (Kanter, 1977).

Our models take into account factors related to college career, including STEM field of study (life science, physical science, computer science and mathematics, and engineering), graduation cohort (seven five-year cohorts beginning with 1970-74 and ending with 2000-04), number of years since college graduation, and geographic location of college (East, Midwest, South, West, outside the U.S.) We also control for nativity (foreign born is coded "1"), parents' educational attainment (neither parent college educated, mother only college educated, father only college educated, and both parents college educated), subsequent degree attainment after college (Master's in a STEM field, Ph.D. in a STEM field, and advanced degree in a non-STEM field), relationship status (married, cohabiting, unpartnered) and the presence of any children under age six in the household (yes="1") and any children between six and 17 (yes= "1").

Analytic Approach

We use logistic regression to model the probability of employment in a STEM field compared to employment outside STEM among college graduates who majored in the natural sciences. We construct separate models for each of our eight race-gender groups because many variables related to STEM employment may differ for men and women and across race-ethnicity, including women's representation, field of major, nativity and parental education. We interact dichotomous indicators of race-ethnicity with all co-variates in separate models for all women and all men and report significant differences ($p<0.05$) in our multiple regression models. Predicted probabilities illustrate our findings.

Model 1 includes characteristics of the respondent's undergraduate institution and career, including the level of representation of women in the respondent's field of study and graduation cohort, and demographic controls for years since degree receipt and nativity. Model 2 adds parents' educational attainment. Model 3 adds advanced degrees the respondent earned after college. And Model 4 adds relationship status and children.

These models use the broader definition of STEM employment, including respondents employed in STEM-related fields. As a sensitivity test, we rerun Model 4 using the narrower definition of STEM employment, that is, re-coding respondents employed in S&E related fields as working *outside* the STEM arena.

We perform additional sensitivity analyses to explore the use of threshold rather than linear or curvilinear measures of women's representation. First, we replace the linear and square terms with a dichotomous measure coded "1" if women accounted for at least 15 percent of members of the respondent's field-specific graduating cohort. Then, we construct a parallel model using a dichotomous measure coded "1" if women accounted for at least 30 percent of members of the respondent's field-specific graduating cohort.

Results

Summary statistics

Summary statistics in Table 1 indicate that the degree of gender difference in the likelihood of STEM employment depends on how strictly the STEM employment sector is defined. Gender differences are minimal based on the broader definition, including S&E related fields such as nursing and secondary school science teaching, which we use for our main analyses; Sixty four percent of women are STEM employed under this definition, compared to 66 percent of men. The narrower definition (excluding S&E related fields) leads to sizeable gender differences; only 35 percent of women are characterized as STEM employed compared to 51 percent of men.

Race-ethnic differences emerge regardless of whether the broader or narrower definition of STEM employed is used. Under either definition, Asian men are most likely to be STEM employed (76 percent including S&E related, 63 percent excluding S&E related), while Black men are least likely to be STEM employed (61 percent and 44 percent respectively). White men

(65 percent including S&E related, 50 percent excluding S&E related) and Hispanic men (64 percent and 47 percent) fall in between. Race-ethnic differences are less pronounced among women. Asian women are most likely to be STEM employed under either the broader (70 percent) or the narrower definition (46 percent), while White, Black and Hispanic women experience similar levels of STEM employment under both definitions: 63 percent, 63 percent and 61 percent respectively under the broader definition; and 33 percent, 30 percent, and 33 percent under the narrower definition.

A key element differentiating the college careers of STEM majors is the STEM fields they study in college. Women are slightly more likely than men to have majored in computer science and mathematics (24 percent compared to 19 percent) and dramatically more likely to have majored in the life sciences (48 percent compared to 23 percent). Men are almost three times as likely as women to have majored in engineering (45 percent compared to 16 percent). Some race-ethnic differences emerge, too. Compared to other men, Black male STEM graduates are especially likely to major in computer science and mathematics (31 percent). Asian male STEM graduates are more likely than other men to major in engineering (56 percent). Similarly, Black female STEM graduates are more likely to study computing and math than other female science majors, and Asian female STEM graduates are more likely to study engineering.

Differences in the majors men and women select lead to additional small differences in the level of women’s representation experienced by STEM college graduates across gender and race-ethnicity. Women made up 27 percent of students in the major of the average male STEM college graduate and 38 percent of students in the major of the average female STEM college graduate. Among both men and women STEM graduates, Asians experienced slightly lower levels of women’s representation than other race-ethnic groups. (Larger differences in women’s representation emerge across graduation cohorts and STEM fields, as evident in Chart 1 below.)

Other gender and race-ethnic differences in college career are also apparent. Reflecting recent increases in the representation of women and race-ethnic minorities in the U.S. college-age population (Lichter, 2013), women and minorities are more concentrated among recent graduation cohorts, and fewer years have elapsed since they earned their STEM undergraduate degrees. On average, men in the analytic sample were interviewed 15.4 years after degree receipt, compared with 13.3 years for women. Minority men were interviewed approximately 14 years after degree receipt, while minority women were interviewed 12 to 13 years after degree receipt on average. Black men and women STEM majors are especially likely to have attended college in the South, while Hispanic STEM major s are particularly likely to have attended college in the West. Hispanic STEM majors and, to an even greater extent, Asian STEM majors are disproportionately likely to have earned their STEM B.A. outside the U.S. The vast majority of Asian STEM graduates in the sample are foreign born (84 percent of men and 80 percent of women). A large minority of Hispanic STEM majors are also foreign born (40 percent of men and 34 percent of women), as are almost one fourth of Black male STEM majors.

Among this selective, highly educated population of STEM college graduates, race-ethnic differences generally exceed gender differences in parental education. Where gender differences do occur, women STEM college graduates appear somewhat more advantaged. Twenty-four percent of White men and 28 percent of White women report that both their parents are college graduates, compared to 17 percent of Black men and women, 18 percent of Hispanic men and 19 percent of Hispanic women, and 29 percent of Asian men and 35 percent of Asian women. In contrast, the relatively small gender differences evident in STEM graduates’ own educational attainment after college advantage men, 20 percent of whom have earned a Master's degree in a STEM field, compared to 16 percent of women. Race-ethnic differences are larger, once again, with White men and women slightly more likely to have earned an advanced degree in a STEM field than Blacks or Hispanics. Most notable are the exceptionally high levels of advanced STEM degree attainment among Asian men and women. Forty-two percent of Asian men and 30 percent of Asian women hold a STEM M.A. Eleven percent of Asian men and six percent of Asian women hold a STEM Ph.D.

Finally, both gender and race-ethnic differences distinguish STEM college graduates with regard to family formation.   Women are less likely than men to be married and more likely to be unpartnered. Women STEM graduates also have fewer children. Gender differences in family formation are especially pronounced among Black STEM graduates, who are less likely than their White counterparts to be married and slightly more likely to have children at home. Sixty-three percent of Black men in the sample are married, compared with 42 percent of Black women.

Overall, Table 1 suggests that gender differences are larger than race-ethnic differences, raising the possibility that gender may play a particularly important role in differentiating the educational and workforce experiences of STEM college graduates, a topic we investigate further in the analyses that follow.

<u>The Changing Gender Makeup of STEM Graduating Cohorts</u>

Chart 1 illustrates the changing gender make-up of recent cohorts of STEM college

[Chart 1 about here]

graduates, the subject of our first question. Several patterns are notable. First, women's representation rose markedly between 1970 and 2004 in three of the four STEM fields – life science, physical science, and engineering. Second, in sharp contrast to this first pattern, women's representation declined over the period in computer science and mathematics. Third, the rates of change in women's representation and the level of their representation varied widely across fields and over time.

Women's representation grew most dramatically in the life sciences. In 1970-74, women already accounted for 28 percent of life science majors. This proportion rose until the second half of the 1980s and first half of the 1990s when women accounted for just under half of all life science majors. Women's representation rose sharply again between 1995 and 1999 and between 2000 and 2004. By the end of the period, women made up the majority of life science majors – 63 percent – making life science the first broad STEM field in which women dominate among college students.

Women also made sizeable gains in the physical sciences, steadily increasing their representation from almost 20 percent in the early 1970s to 35 percent in the early 1990s. Women's representation in the physical sciences dipped slightly to 33 percent in the second half of the 1990s before increasing sharply to 42 percent among the 2000-04 graduating cohort.

In engineering, women achieved gains of similar magnitude to those in the physical sciences although starting from a much lower base. Women accounted for only two percent of engineering majors among the 1970-74 graduating cohort. Their representation rose sharply to near 14 percent a decade later. Slower gains during the second half of the 1980s and the early 1990s were followed by slightly faster ones among the two subsequent graduating cohorts. By 2004-04, women made up 21.5 percent of engineering majors.

Women's representation in computer science and mathematics followed an entirely different pattern. In the first half of the 1970s, women accounted for more than one in three computing/math majors, more than in any of the other three STEM fields, including the life sciences. But after rising to 36.5 percent in the second half of the 1970s, women's representation in computing and math increased by only 1.5 additional percentage points over the subsequent three graduating cohorts. After 1990-94, women's representation in computing and math dropped steeply to slightly less than 30 percent, less than it had been at the start of the period.

Thus, the answer to our first question is that women's representation grew dramatically in three of the four broad STEM majors between 1970 and 2004, that is, the life sciences, the physical science and engineering. But the level of women's representation at the beginning of the period varied widely across these three fields, and that remained true at the end of the period when women accounted for a majority (63 percent) of life science majors, well over a third (42 percent) of physical science majors, but only one fifth (22 percent) of engineering majors. In contrast, computer science and mathematics – the field in which women enjoyed the highest level of representation at the beginning of the period – experienced only slight gains in women's representation until the early 1990s followed by steep losses. By 2000-04, only engineering had fewer female students than computing and math.

An investigation of the factors underlying these distinctive patterns in women's representation across the four major STEM fields is beyond the scope of this paper. We focus instead on probing whether higher levels of women's representation among graduating cohorts are associated with increased odds of subsequent STEM employment among women and increased – or decreased – odds of STEM employment among men. We capitalize on variation in women's representation across STEM fields and graduating cohorts to explore these questions in our multivariate analyses, to which we turn next.

Multivariate Results: Cohort, Gender, Race-Ethnicity and STEM Employment

Table 2 presents logistic regression models for women in our analytic sample. Predictors related to undergraduate institution and career, including women's representation in the respondent's field of study and graduating cohort, are entered in Model 1. Parental education is added in Model 2, advanced degree receipt in Model 3, and family formation in Model 4. These models allow us to address our second question, regarding cohort effects, and our third and fourth questions, regarding the relationship between women's representation in college and subsequent STEM employment for women and men respectively.

[Table 2 about here]

To ease interpretation of patterns across the eight graduating cohorts, we use the margins command within Stata 12 to calculate predicted probabilities of STEM employment compared to non-STEM employment averaging across the values of the other co-variates. Results for women are presented in Chart 2. Asian women exhibit the highest rates of STEM employment, followed by White and Hispanic women, and then Black women. All four groups of women appear to experience small declines in the likelihood of STEM employment over time between 1970-74 and 2000-04 although these declines are statistically significant only for Asian and White women ($p<.05$).

[Chart 2 about here]

Chart 3 presents parallel results for men. Variation in levels of STEM employment across

[Chart 3 about here]

race-ethnicity follows similar ordering to that observed among women; Asian men demonstrate the highest odds of STEM employment followed by White, Hispanic and Black men. (Apparent differences between Black men and White and Hispanic men are not statistically significant at the $p<.05$ level.) Small declines in the likelihood of STEM employment over the observation period are apparent among White, Hispanic and Black men although these declines are statistically significant only for White men. (Small apparent increases in STEM employment among Asian men are not statistically significant either.) Thus, the answer to our third question is that, averaging across co-variates, the likelihood of STEM employment remains stable or falls slightly between 1970-74 and 2000-04. The odds of STEM employment do not increase for any of the eight gender-race groups we study.

Multivariate Results: Women’s Representation and STEM Employment

Our key predictor, the level of women’s representation, is significantly related to STEM employment among all four groups of women (Table 2). In all cases, the linear measure of women’s representation is positive while the squared measure is negative, indicating a curvilinear relationship between women’s representation and STEM employment although the magnitude of the coefficients (and the corresponding shapes of the curves) varies. Coefficients for both the linear and the squared terms change little across models, indicating that parental education, advanced degree receipt and family formation are not strong mediators of the relationship between women’s representation and STEM employment.

Chart 4 presents predicted probabilities of STEM employment across the levels of women’s representation observed in the data. Over the time period we study, 1970-74 to 2000-04, levels of women’s representation ranged from a low of two percent (Chart 1, engineering, 1970-74) to a high of 63 percent (Chart 1, life sciences, 2000-04). The effect of women's representation is especially striking for Hispanic and Asian women. Hispanic women's likelihood of STEM employment rises most steeply with gains in women's representation, increasing from 36 percent when women account for five percent of STEM majors to 75 percent when women account for 30 percent of majors. After this point, further increases in women's representation correspond to smaller gains in STEM employment, which stabilizes around 82 percent once women make up 45 percent or more of STEM majors. Asian women's likelihood of STEM employment similarly rises more steeply as women make initial gains in representation among STEM majors and more slowly as women achieve higher levels of representation. White and Black women experience similar initial increases in STEM employment as women's representation rises, but experience small declines in the odds of STEM employment above the point at which women make up 45 percent of STEM majors.

These findings provide support for the hypothesis that women's representation among women STEM college graduates encourage their subsequent STEM employment. Our results suggest that the positive association between women's representation in STEM studies and STEM employment holds true among all four groups of women despite the "double bind" of dual minority status experienced by Black, Hispanic and Asian women (Ong et al., 2010).

How is women's representation among STEM majors associated with the subsequent odds of STEM employment among men? Results from Model 4 (Table 3) indicate that both the linear and the squared term measuring women's representation are statistically significant in models predicting the odds of STEM employment among White, Black and Hispanic – but not Asian – men. (We return to the case of Asian men in our sensitivity analyses of threshold models below).

As in models for women, the linear terms are positive and the squared terms negative, pointing to curvilinear effects in which STEM employment rises more rapidly at first and then slows or declines. Chart 5 presents predicted probabilities of STEM employment among White, Black and Hispanic men across levels of women's representation among STEM majors. Compared to corresponding predicted probabilities for women, those for men follow a less pronounced curve, reflecting smaller gains to STEM employment as women's representation among STEM majors rises, particularly for White men. Among Black men, for example, STEM employment increases from 55 percent to 80 percent as women's representation grows from five percent to 45 percent and plateaus at higher levels of women's representation. A similar pattern is evident among Hispanic men.

Among White men, however, levels of STEM employment rise only from 74 percent to 80 percent as levels of women's representation among STEM majors increase from five percent to 45 percent. Increases beyond 45 percent are associated with small but noticeable declines in the likelihood of STEM employment, which falls gradually to 72 percent. These patterns provide some support for the hypothesis that gains in women's representation among STEM majors encourage STEM employment among some minority to a greater degree than among White men, consistent with the devaluation hypothesis.

Multivariate Results: Control Variables

A number of our control variables are associated with levels of STEM employment. Both women and men STEM graduates are less likely to be employed in STEM fields as the number of years since graduation rises. Attrition out of STEM jobs into non-STEM employment occurs at the rate of between two percent and four percent per year, with the steeper declines in STEM employment occurring among Asian women and Black men. Majoring in engineering is generally positively associated with the likelihood subsequent STEM employment, particularly compared to majoring in the life sciences or in computer science and mathematics. Other college characteristics vary widely by race-ethnicity and gender. Attending college outside the U.S., for example, is (positively) related to STEM employment for Asian women and for Asian and White men. Foreign birth is positively associated with STEM employment among Asian women and among Black and Asian men but inversely associated with STEM employment among White men.

Effects of parental education are limited, especially once the larger effects of respondents' own attainment of advanced degrees are taken into account. (Effects associated with advanced STEM degree receipt are large and positive, while effects associated with advanced non-STEM degree receipt are generally negative.) Marriage (compared to being unpartnered) is positively associated with STEM employment in the few cases when this relationship is statistically significant (White and Black women, White men). In contrast, the presence of children between the ages of six and 17 is inversely associated with STEM employment among all men and among White women.

Sensitivity Analyses: Narrowing the Definition of STEM Employment

We construct alternative models to test the sensitivity of our findings to the use of other definitions of STEM employment. This is important because the effects of women's representation may be sensitive to the inclusion or exclusion of more female dominated professions among those deemed to be STEM occupations. Our main models conceptualize STEM occupations broadly, including heavily female STEM-related fields such as nursing. Our first set of alternative models tests the effects of women's representation using a narrower definition of STEM occupations, excluding all fields NSF deems S&E related.

Predicted probabilities based on these models (not shown) are presented in Chart 6 (for women) and Chart 7 (for men). Among women, results follow a similar pattern to that shown previously. Although probabilities of STEM employment are lower, gains to women's representation are greater at lower levels of representation and slow at higher levels. The most notable difference is that women's representation is not associated with the probability of STEM employment among Black women using the narrower definition. Among men, the two sets of predicted probabilities are even more similar. As with women, use of the narrower definition of STEM employment reduces predicted levels of STEM employment for men.

Sensitivity Analyses: Threshold Measures of Women's Representation

[This subsection will examine the impact of replacing linear and curvilinear measures of women's representation with threshold measures indicating whether or not at least 15 percent or at least 30 percent of STEM majors are women.]

Conclusion and Discussion

Despite widespread interest in diversification of the STEM labor force and particular emphasis on the importance of increasing the "pipeline" of women who persist in STEM studies, little research has directly examined the relationship between women's representation and STEM employment. We contribute to the literature on gender and diversity in the scientific labor force by investigating the relationship between women's representation among STEM majors in college and the likelihood of subsequent STEM employment – not only among women, but also among men, and among Blacks, Hispanics and Asians as well as Whites.

Results of our analyses of NSF's SESTAT data for cohorts of STEM majors who graduated college between 1970-74 and 2000-04 point to three conclusions. First, women's representation among STEM college majors has grown substantially but unevenly across the major STEM fields. By 2000-04, women accounted for a majority of life science majors and substantial minorities of physical science and computer science and mathematics majors despite declines in women's representation among recent graduating cohorts in the latter field. But women make up only one in five students graduating college with an engineering degree.

Second, we find no evidence that STEM employment has increased among recent graduating cohorts of STEM majors. Indeed, small declines in the likelihood of STEM employment relative to employment in non-STEM fields occurred among some race-gender groups. These conclusions are not inconsistent with those of Xie and Killewald (2012), who found some evidence of declines in the utilization of science degrees after the late 1980s.

Third, and most important, we find strong evidence that women's representation among STEM majors in college is generally positively associated with the likelihood of subsequent STEM employment, not only among women, but also among men – at least up until the point at which women account for nearly half of STEM majors. Among women, this association is particularly strong among Hispanics and Asians, with especially rapid gains in STEM employment occurring at the lower end of the spectrum of women's representation (less than 30 percent female) and no evidence of significant declines in STEM employment at the high end of the spectrum (currently 60 percent). For White and Black women, gains in STEM employment are smaller, less consistent between broader and narrower measures of STEM employment, and may stop or even reverse once women make up 50 percent or more of STEM majors.

Among men, gains in STEM employment are more modest than those seen among women, consistent with the hypothesis that increases in women's representation benefit women more than men. As is the case for women, findings for men vary by race-ethnicity. Gains are particularly small among White men for whom the curve of predicted levels of STEM employment is especially shallow. Among Black men, declines in STEM employment at high levels of women's representation are more substantial when the narrower definition of STEM employment is used. Among Asian men, the linear measure of women's representation is not associated with the odds of STEM employment. But supplemental analyses using threshold measures of women's representation indicate that Asian men in graduating cohorts in which women made up at least 30 percent of students were 35 percent more likely to be STEM employed than comparable men in cohorts with lower representation of women. Overall, evidence for the devaluation hypothesis is inconclusive.

Like all non-experimental data, the SESTAT data have weaknesses as well as strengths. Although nationally representative and large enough to allow analysis of variation across race-ethnicity as well as gender, the data are mainly cross-sectional. We cannot follow STEM college graduates over time, and we do not know the timing of their entrances into or departures from the STEM labor force. We only know their employment status at the time they were interviewed.

Our ability to assess the association between women's representation among STEM college majors and subsequent STEM employment is also limited by the range of this representation itself. Substantial variation in past and current levels of women's representation across the four main STEM fields allows us to predict patterns of employment when women account for as few as five percent and as many as 60 percent of STEM college graduates. Whether clearer evidence of devaluation might emerge if women's representation grew to 70 percent or 80 percent in, for example, the life sciences can currently be only a matter of conjecture. Despite these limitations, our analysis contributes to the literature on gender and diversity in the natural sciences by providing one of the first studies of the relationship between group size and employment in the national STEM labor force and by investigating the effects of women's representation on men as well as women, and on Hispanics, Blacks and Asians as well as Whites. We hope that future research will incorporate measures of group size into studies of diversification of the STEM workforce.

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Table 1. Summary Statistics

	All Men		All Women		White Men		Black Men		Hispanic Men		Asian Men		White Women		Black Women		Hispanic Women		Asian Women	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Employment																				
Employed in STEM (broad)[1]	0.66	0.47	0.64	0.48	0.65	0.48	0.61	0.49	0.64	0.48	0.76	0.43	0.63	0.48	0.63	0.48	0.61	0.49	0.70	0.46
Employed in STEM (narrow)[2]	0.51	0.50	0.35	0.48	0.50	0.50	0.44	0.50	0.47	0.50	0.63	0.48	0.33	0.47	0.30	0.46	0.33	0.47	0.46	0.50
College major																				
Computer science & math	0.19	0.39	0.24	0.43	0.19	0.39	0.31	0.46	0.18	0.38	0.20	0.40	0.23	0.42	0.33	0.47	0.21	0.41	0.26	0.44
Life science	0.23	0.42	0.48	0.50	0.25	0.43	0.21	0.41	0.23	0.42	0.14	0.34	0.51	0.50	0.43	0.49	0.48	0.50	0.35	0.48
Physical science	0.12	0.33	0.12	0.32	0.13	0.34	0.11	0.31	0.09	0.28	0.11	0.31	0.12	0.32	0.10	0.30	0.12	0.33	0.14	0.34
Engineering	0.45	0.50	0.16	0.37	0.43	0.50	0.37	0.48	0.50	0.50	0.56	0.50	0.14	0.35	0.15	0.35	0.19	0.40	0.25	0.43
Graduating cohort																				
1970-74	0.14	0.34	0.07	0.26	0.15	0.36	0.10	0.30	0.08	0.26	0.09	0.28	0.08	0.27	0.05	0.22	0.03	0.18	0.07	0.25
1975-79	0.15	0.35	0.12	0.33	0.16	0.36	0.13	0.33	0.11	0.31	0.10	0.30	0.14	0.34	0.09	0.28	0.09	0.28	0.08	0.27
1980-84	0.18	0.38	0.16	0.37	0.18	0.39	0.16	0.36	0.18	0.38	0.15	0.36	0.16	0.37	0.15	0.36	0.16	0.37	0.15	0.36
1985-89	0.17	0.38	0.17	0.38	0.17	0.37	0.18	0.38	0.18	0.38	0.18	0.39	0.17	0.38	0.17	0.38	0.18	0.39	0.16	0.36
1990-94	0.16	0.37	0.18	0.38	0.15	0.36	0.19	0.39	0.18	0.38	0.20	0.40	0.17	0.38	0.21	0.41	0.17	0.37	0.19	0.39
1995-99	0.13	0.34	0.18	0.38	0.12	0.33	0.16	0.37	0.17	0.38	0.16	0.37	0.17	0.37	0.21	0.41	0.21	0.41	0.21	0.41
2000-04	0.08	0.27	0.12	0.32	0.07	0.25	0.09	0.28	0.11	0.31	0.13	0.33	0.11	0.31	0.12	0.32	0.15	0.36	0.15	0.36
Percent female[3]	26.90	14.59	38.16	13.68	27.16	14.76	29.17	13.68	27.37	14.86	24.63	13.48	38.82	13.43	38.33	12.91	38.40	14.51	34.85	14.43
Years since degree	15.44	9.20	13.32	8.78	15.88	9.31	13.99	8.90	13.89	8.70	13.86	8.53	13.64	8.93	11.99	8.15	12.21	8.51	12.86	8.37
College region																				
East	0.12	0.33	0.14	0.34	0.14	0.34	0.10	0.30	0.07	0.26	0.08	0.27	0.15	0.36	0.09	0.29	0.09	0.29	0.09	0.28
Midwest	0.14	0.34	0.13	0.34	0.16	0.37	0.07	0.26	0.04	0.21	0.05	0.22	0.16	0.37	0.07	0.25	0.05	0.21	0.05	0.22
South	0.14	0.34	0.16	0.37	0.14	0.35	0.29	0.45	0.13	0.34	0.06	0.23	0.16	0.37	0.37	0.48	0.13	0.34	0.06	0.24
West	0.49	0.50	0.48	0.50	0.52	0.50	0.47	0.50	0.56	0.50	0.30	0.46	0.49	0.50	0.44	0.50	0.59	0.49	0.37	0.48
Outside US	0.11	0.31	0.10	0.30	0.04	0.19	0.07	0.25	0.19	0.39	0.52	0.50	0.03	0.18	0.03	0.18	0.15	0.35	0.43	0.50
Foreign born	0.20	0.40	0.20	0.40	0.07	0.25	0.24	0.43	0.40	0.49	0.84	0.37	0.07	0.25	0.14	0.34	0.34	0.48	0.80	0.40
Parental education																				
Neither earned college degree	0.49	0.50	0.46	0.50	0.49	0.50	0.59	0.49	0.58	0.49	0.43	0.50	0.45	0.50	0.59	0.49	0.55	0.50	0.38	0.49
Father earned college degree	0.20	0.40	0.19	0.39	0.20	0.40	0.13	0.34	0.17	0.38	0.22	0.41	0.19	0.40	0.09	0.29	0.17	0.38	0.22	0.41
Mother earned college degree	0.06	0.23	0.07	0.25	0.06	0.24	0.08	0.27	0.05	0.22	0.04	0.19	0.07	0.25	0.10	0.31	0.08	0.27	0.03	0.18
Both earned college degree	0.24	0.43	0.28	0.45	0.24	0.43	0.17	0.38	0.18	0.38	0.29	0.45	0.28	0.45	0.17	0.38	0.19	0.39	0.35	0.48
Advanced degrees																				
STEM Masters	0.20	0.40	0.16	0.37	0.17	0.37	0.14	0.35	0.15	0.36	0.42	0.49	0.14	0.35	0.10	0.30	0.12	0.32	0.30	0.46
STEM PhD	0.05	0.21	0.04	0.19	0.04	0.19	0.03	0.16	0.03	0.16	0.11	0.31	0.03	0.18	0.02	0.14	0.02	0.15	0.06	0.24
Non-STEM advanced degree	0.19	0.39	0.21	0.41	0.19	0.39	0.18	0.39	0.19	0.39	0.15	0.36	0.22	0.41	0.23	0.42	0.18	0.39	0.19	0.40
Marriage and family																				
Married	0.72	0.45	0.61	0.49	0.73	0.45	0.63	0.48	0.69	0.46	0.70	0.46	0.62	0.49	0.42	0.49	0.60	0.49	0.65	0.48
Cohabiting	0.02	0.14	0.03	0.17	0.02	0.14	0.02	0.12	0.03	0.16	0.01	0.10	0.03	0.18	0.02	0.15	0.03	0.17	0.02	0.13
Unpartnered	0.26	0.44	0.36	0.48	0.25	0.44	0.35	0.48	0.28	0.45	0.29	0.45	0.35	0.48	0.56	0.50	0.37	0.48	0.33	0.47
Any children<6	0.25	0.43	0.22	0.41	0.24	0.43	0.26	0.44	0.29	0.46	0.28	0.45	0.21	0.40	0.24	0.42	0.24	0.43	0.25	0.43
Any children 6-17	0.35	0.48	0.29	0.46	0.36	0.48	0.37	0.48	0.37	0.48	0.31	0.46	0.29	0.46	0.31	0.46	0.31	0.46	0.28	0.45
N	92087		36111		65234		4649		6453		15751		23061		3604		3243		6203	

Note: [1] Including S&E related fields. [2] Excluding S&E related fields. [3] Among students within STEM field and graduating cohort.

Table 2. Logistic Regression Models of STEM Employment versus Non-STEM Employment among Women

	White Women				Black Women				Hispanic Women				Asian Women			
	model1	model2	model3	model4	model1	model2	model3	model4	model1	model2	model3	model4	model1	model2	model3	model4
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
College major^1																
Computer science & math	-0.258 ***	-0.248 ***	-0.090	-0.093	-0.358 **	-0.358 **	-0.275 *	-0.277 *	-0.468 **	-0.456 **	-0.276	-0.276	-0.550 ***	-0.541 ***	-0.417 ***	-0.422 ***
	(0.054)	(0.055)	(0.055)	(0.055)	(0.118)	(0.119)	(0.122)	(0.122)	(0.145)	(0.145)	(0.149)	(0.149)	(0.116)	(0.116)	(0.117)	(0.117)
Life science	-0.253 **	-0.255 **	-0.275 ***	-0.274 ***	-0.215	-0.216	-0.244	-0.243	-0.428	-0.430	-0.328	-0.324	-0.621 ***	-0.625 ***	-0.510 **	-0.509 **
	(0.080)	(0.080)	(0.082)	(0.082)	(0.185)	(0.185)	(0.188)	(0.188)	(0.228)	(0.228)	(0.239)	(0.240)	(0.181)	(0.181)	(0.186)	(0.186)
Engineering	0.629 ***	0.633 ***	0.864 ***	0.855 ***	0.317	0.320	0.444	0.443	1.113 ***	1.133 ***	1.339 ***	1.332 ***	0.806 ***	0.802 ***	0.944 ***	0.931 ***
	(0.119)	(0.119)	(0.122)	(0.122)	(0.262)	(0.262)	(0.268)	(0.269)	(0.302)	(0.302)	(0.321)	(0.321)	(0.235)	(0.236)	(0.241)	(0.242)
Graduating cohort^2																
1975-79	0.032	0.021	-0.030	-0.026	0.191	0.186	-0.012	-0.014	-0.274	-0.291	-0.729	-0.721	0.082	0.064	0.009	0.005
	(0.083)	(0.083)	(0.086)	(0.087)	(0.237)	(0.238)	(0.250)	(0.251)	(0.316)	(0.316)	(0.374)	(0.376)	(0.180)	(0.180)	(0.184)	(0.184)
1980-84	0.132	0.106	-0.060	-0.063	0.743 **	0.729 **	0.317	0.302	-0.018	-0.041	-0.590	-0.585	0.106	0.078	-0.081	-0.092
	(0.098)	(0.098)	(0.102)	(0.102)	(0.255)	(0.257)	(0.268)	(0.270)	(0.342)	(0.343)	(0.394)	(0.396)	(0.202)	(0.203)	(0.206)	(0.207)
1985-89	0.362 **	0.325 **	0.025	0.015	0.799 **	0.780 **	0.073	0.048	0.160	0.123	-0.582	-0.581	0.061	0.019	-0.187	-0.205
	(0.112)	(0.113)	(0.117)	(0.118)	(0.276)	(0.278)	(0.296)	(0.297)	(0.369)	(0.369)	(0.421)	(0.423)	(0.227)	(0.228)	(0.233)	(0.233)
1990-94	-0.076	-0.123	-0.373 **	-0.377 **	0.695 *	0.674 *	-0.131	-0.154	0.149	0.105	-0.740	-0.738	-0.304	-0.361	-0.558 *	-0.587 *
	(0.119)	(0.120)	(0.127)	(0.127)	(0.292)	(0.296)	(0.319)	(0.320)	(0.382)	(0.382)	(0.440)	(0.442)	(0.238)	(0.240)	(0.247)	(0.248)
1995-99	0.006	-0.046	-0.353 **	-0.359 **	0.654 *	0.632 *	-0.259	-0.276	0.032	-0.014	-0.939 *	-0.939 *	-0.348	-0.401	-0.580 *	-0.614 *
	(0.128)	(0.129)	(0.136)	(0.137)	(0.305)	(0.308)	(0.334)	(0.336)	(0.401)	(0.401)	(0.458)	(0.460)	(0.259)	(0.261)	(0.267)	(0.268)
2000-04	-0.056	-0.108	-0.356 *	-0.356 *	0.615	0.589	-0.284	-0.298	0.117	0.065	-0.863	-0.862	-0.578 *	-0.623 *	-0.750 **	-0.762 **
	(0.140)	(0.141)	(0.147)	(0.148)	(0.317)	(0.321)	(0.342)	(0.344)	(0.422)	(0.423)	(0.478)	(0.480)	(0.282)	(0.283)	(0.287)	(0.288)
Years since degree	-0.002	-0.004	-0.025 ***	-0.024 ***	0.027 **	0.027 **	-0.022	-0.024 *	0.025 *	0.023 *	-0.024 *	-0.025 *	-0.030 ***	-0.031 ***	-0.040 ***	-0.039 ***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.010)	(0.010)	(0.012)	(0.012)	(0.010)	(0.010)	(0.011)	(0.012)	(0.008)	(0.008)	(0.008)	(0.008)
College region^3																
Midwest	0.052	0.056	0.094 *	0.087	0.161	0.158	0.202	0.202	0.131	0.141	0.241	0.232	0.011	0.014	0.053	0.044
	(0.046)	(0.046)	(0.047)	(0.047)	(0.153)	(0.153)	(0.158)	(0.159)	(0.197)	(0.197)	(0.202)	(0.203)	(0.155)	(0.155)	(0.156)	(0.157)
South	0.007	0.007	0.056	0.052	0.102	0.100	0.100	0.097	0.237	0.263	0.258	0.249	0.319	0.324 *	0.454 **	0.452 **
	(0.046)	(0.046)	(0.047)	(0.047)	(0.111)	(0.111)	(0.114)	(0.114)	(0.145)	(0.146)	(0.151)	(0.152)	(0.163)	(0.163)	(0.166)	(0.166)
West	-0.098 *	-0.086	0.177 ***	0.176 ***	-0.136	-0.130	0.299	0.305 *	0.053	0.071	0.253	0.245	-0.073	-0.053	0.205	0.192
	(0.045)	(0.045)	(0.049)	(0.049)	(0.142)	(0.142)	(0.155)	(0.155)	(0.131)	(0.131)	(0.138)	(0.139)	(0.108)	(0.109)	(0.114)	(0.115)
Outside US	0.231 *	0.224 *	0.096	0.093	0.264	0.267	0.087	0.067	0.163	0.187	-0.132	-0.141	0.590 ***	0.589 ***	0.357 **	0.335 **
	(0.113)	(0.114)	(0.117)	(0.117)	(0.284)	(0.284)	(0.299)	(0.302)	(0.189)	(0.190)	(0.205)	(0.206)	(0.118)	(0.118)	(0.128)	(0.129)
Foreign born	0.233 **	0.229 **	0.147	0.146	0.204	0.209	0.184	0.179	-0.053	-0.039	0.023	0.018	0.180 *	0.196 *	0.254 **	0.255 **
	(0.078)	(0.079)	(0.080)	(0.080)	(0.128)	(0.129)	(0.129)	(0.130)	(0.113)	(0.114)	(0.115)	(0.115)	(0.089)	(0.090)	(0.092)	(0.093)
Percent female^a	0.061 ***	0.061 ***	0.070 ***	0.070 ***	0.041	0.042	0.053	0.053	0.123 ***	0.123 ***	0.127 ***	0.127 ***	0.071 **	0.070 **	0.076 **	0.075 **
	(0.012)	(0.012)	(0.012)	(0.012)	(0.029)	(0.029)	(0.029)	(0.029)	(0.031)	(0.031)	(0.033)	(0.033)	(0.023)	(0.023)	(0.024)	(0.024)
Percent female squared	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001	-0.001	-0.001 *	-0.001 *	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 *	0.000 *	-0.001 *	-0.001 *
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Reference groups are ^{1}physical science, ^{2}1970-74 , ^{3}east, ^{4}neither college educated, and ^{5}unpartnered. ^{a}Among students within STEM field and graduating cohort.

*p<.05; **p<.01; ***p<.001

Table 2. Logistic Regression Models of STEM Employment versus Non-STEM Employment among Women (cont'd)

	White Women				Black Women				Hispanic Women				Asian Women			
	model1	model2	model3	model4	model1	model2	model3	model4	model1	model2	model3	model4	model1	model2	model3	model4
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
Parental education[4]																
Father earned college degree		0.041	-0.003	-0.003		0.000	-0.010	-0.015		-0.186	-0.298 *	-0.300 *		0.032	0.001	-0.003
		(0.043)	(0.044)	(0.044)		(0.127)	(0.128)	(0.129)		(0.113)	(0.117)	(0.117)		(0.094)	(0.095)	(0.096)
Mother earned college degree		0.055	0.020	0.022		0.118	0.081	0.091		0.186	0.158	0.156		-0.058	-0.051	-0.053
		(0.064)	(0.064)	(0.064)		(0.122)	(0.124)	(0.124)		(0.166)	(0.169)	(0.169)		(0.205)	(0.206)	(0.207)
Both earned college degree		0.114 **	-0.001	0.001		-0.003	-0.065	-0.057		0.089	-0.139	-0.143		0.092	0.003	0.002
		(0.037)	(0.038)	(0.038)		(0.095)	(0.098)	(0.098)		(0.107)	(0.112)	(0.113)		(0.083)	(0.086)	(0.086)
Advanced degrees																
STEM Masters			0.628 ***	0.621 ***			0.803 ***	0.792 ***			1.131 ***	1.126 ***			0.734 ***	0.722 ***
			(0.040)	(0.040)			(0.104)	(0.104)			(0.118)	(0.118)			(0.084)	(0.085)
STEM PhD			0.921 ***	0.907 ***			0.783 ***	0.771 ***			1.398 ***	1.388 ***			0.764 ***	0.741 ***
			(0.052)	(0.052)			(0.151)	(0.152)			(0.171)	(0.172)			(0.091)	(0.092)
Non-STEM advanced degree			-0.244 ***	-0.253 ***			-0.090	-0.099			-0.025	-0.031			-0.395 ***	-0.412 ***
			(0.048)	(0.048)			(0.118)	(0.119)			(0.147)	(0.147)			(0.103)	(0.104)
Marriage and family[5]																
Married				0.094 *				0.199 *				0.079				0.120
				(0.037)				(0.093)				(0.101)				(0.089)
Cohabiting				0.005				-0.097				0.016				0.215
				(0.093)				(0.275)				(0.228)				(0.289)
Any children<6				0.014				0.009				-0.028				0.071
				(0.045)				(0.106)				(0.119)				(0.093)
Any children 6-17				-0.116 **				-0.118				-0.061				-0.162
				(0.044)				(0.101)				(0.119)				(0.094)
Constant	0.009	0.007	-0.209	-0.225	-0.624	-0.624	-0.141	-0.143	-1.820 **	-1.822 **	-1.342	-1.334	0.049	0.057	-0.392	-0.381
	(0.233)	(0.234)	(0.243)	(0.243)	(0.613)	(0.615)	(0.644)	(0.646)	(0.638)	(0.637)	(0.694)	(0.694)	(0.462)	(0.464)	(0.478)	(0.478)
N	23,061				3,604				3,243				6,203			
Likelihood Ratio	381	398	1,221	1,234	76	77	189	195	68	75	301	302	203	207	454	460
df	17	21	24	28	17	21	24	28	17	21	24	28	17	21	24	28

Reference groups are [1] physical science, [2] 1970-74 , [3] east, [4] neither college educated, and [5] unpartnered. [a] Among students within STEM field and graduating cohort.

*p<.05; **p<.01; ***p<.001

Table 3. Logistic Regression Models of STEM Employment versus Non-STEM Employment among Men

	White Men				Black Men				Hispanic Men				Asian Men			
	model1	model2	model3	model4	model1	model2	model3	model4	model1	model2	model3	model4	model1	model2	model3	model4
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
College major[1]																
Computer science & math	-0.154 ***	-0.141 ***	0.005	0.007	-0.462 ***	-0.456 ***	-0.31 **	-0.31 **	-0.483 ***	-0.463 ***	-0.276 *	-0.273 *	-0.324 ***	-0.318 ***	-0.168	-0.165
	(0.039)	(0.039)	(0.040)	(0.040)	(0.117)	(0.117)	(0.120)	(0.120)	(0.112)	(0.113)	(0.114)	(0.115)	(0.095)	(0.095)	(0.098)	(0.098)
Life science	-0.294 ***	-0.291 ***	-0.235 ***	-0.227 ***	-0.55 **	-0.549 **	-0.527 **	-0.517 **	-0.511 **	-0.51 **	-0.382 *	-0.379 *	-0.056	-0.051	0.253	0.252
	(0.060)	(0.060)	(0.061)	(0.061)	(0.188)	(0.188)	(0.193)	(0.193)	(0.177)	(0.177)	(0.180)	(0.180)	(0.162)	(0.163)	(0.173)	(0.173)
Engineering	0.226 **	0.235 **	0.341 ***	0.334 ***	0.569 *	0.545 *	0.672 **	0.647 **	0.467 *	0.469 *	0.696 ***	0.691 **	-0.21	-0.205	-0.113	-0.119
	(0.078)	(0.078)	(0.079)	(0.079)	(0.221)	(0.221)	(0.226)	(0.227)	(0.205)	(0.205)	(0.211)	(0.211)	(0.183)	(0.183)	(0.188)	(0.188)
Graduating cohort[2]																
1975-79	0.129 **	0.114 *	0.077	0.089	0.116	0.112	0.036	0.056	-0.005	-0.031	-0.113	-0.105	0.188	0.183	0.139	0.155
	(0.047)	(0.047)	(0.049)	(0.049)	(0.170)	(0.171)	(0.179)	(0.180)	(0.162)	(0.162)	(0.170)	(0.170)	(0.114)	(0.114)	(0.118)	(0.118)
1980-84	0.215 ***	0.187 **	0.091	0.098	0.045	0.032	-0.163	-0.151	0.042	0.007	-0.124	-0.12	0.472 **	0.46 **	0.392 *	0.392 *
	(0.064)	(0.065)	(0.066)	(0.066)	(0.205)	(0.206)	(0.214)	(0.215)	(0.196)	(0.196)	(0.202)	(0.202)	(0.152)	(0.153)	(0.158)	(0.157)
1985-89	0.324 ***	0.284 ***	0.144	0.143	0.271	0.247	-0.139	-0.124	0.245	0.2	-0.026	-0.034	0.487 **	0.476 **	0.447 *	0.42 *
	(0.075)	(0.075)	(0.077)	(0.077)	(0.234)	(0.236)	(0.248)	(0.249)	(0.223)	(0.222)	(0.230)	(0.230)	(0.175)	(0.175)	(0.180)	(0.179)
1990-94	-0.088	-0.141	-0.213 *	-0.219 **	0.035	0	-0.452	-0.451	0.065	0.004	-0.225	-0.241	0.407 *	0.395 *	0.435 *	0.393 *
	(0.080)	(0.081)	(0.084)	(0.084)	(0.251)	(0.254)	(0.272)	(0.272)	(0.235)	(0.236)	(0.245)	(0.245)	(0.186)	(0.187)	(0.193)	(0.192)
1995-99	0.057	-0.001	-0.1	-0.109	-0.073	-0.109	-0.565	-0.564	0.152	0.085	-0.139	-0.157	0.497 *	0.48 *	0.496 *	0.443 *
	(0.088)	(0.089)	(0.092)	(0.092)	(0.270)	(0.273)	(0.291)	(0.291)	(0.255)	(0.255)	(0.264)	(0.265)	(0.205)	(0.206)	(0.213)	(0.212)
2000-04	-0.039	-0.096	-0.145	-0.158	-0.13	-0.17	-0.595 *	-0.595	-0.044	-0.115	-0.306	-0.328	0.304	0.291	0.355	0.32
	(0.100)	(0.101)	(0.103)	(0.103)	(0.284)	(0.286)	(0.302)	(0.304)	(0.270)	(0.271)	(0.278)	(0.280)	(0.232)	(0.233)	(0.240)	(0.239)
Years since degree	-0.015 ***	-0.017 ***	-0.028 ***	-0.028 ***	-0.005	-0.005	-0.038 ***	-0.036 ***	-0.008	-0.012	-0.028 ***	-0.026 ***	-0.036 ***	-0.037 ***	-0.034 ***	-0.029 ***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.008)	(0.008)	(0.010)	(0.010)	(0.007)	(0.007)	(0.007)	(0.007)	(0.005)	(0.005)	(0.005)	(0.005)
College region[3]																
Midwest	0.016	0.021	0.044	0.044	-0.07	-0.073	-0.059	-0.053	0.346 *	0.351 *	0.398 **	0.393 **	0.185	0.185	0.197	0.195
	(0.030)	(0.030)	(0.030)	(0.030)	(0.139)	(0.139)	(0.141)	(0.142)	(0.149)	(0.149)	(0.149)	(0.150)	(0.111)	(0.111)	(0.114)	(0.114)
South	-0.113 ***	-0.111 ***	-0.081 **	-0.082 **	-0.128	-0.131	-0.135	-0.135	0.022	0.029	0.097	0.092	0.154	0.163	0.217	0.216
	(0.030)	(0.030)	(0.031)	(0.031)	(0.106)	(0.106)	(0.108)	(0.109)	(0.107)	(0.107)	(0.108)	(0.109)	(0.113)	(0.113)	(0.115)	(0.116)
West	-0.095 **	-0.08 **	0.14 ***	0.14 ***	-0.179	-0.164	0.196	0.201	0.1	0.12	0.295 **	0.292 **	0.291 ***	0.301 ***	0.462 ***	0.461 ***
	(0.029)	(0.029)	(0.031)	(0.031)	(0.123)	(0.124)	(0.135)	(0.136)	(0.098)	(0.098)	(0.101)	(0.102)	(0.085)	(0.085)	(0.088)	(0.089)
Outside US	0.297 ***	0.294 ***	0.176 *	0.175 *	0.318	0.319	0.172	0.182	0.09	0.086	-0.031	-0.032	0.72 ***	0.725 ***	0.471 ***	0.469 ***
	(0.067)	(0.067)	(0.068)	(0.068)	(0.182)	(0.182)	(0.188)	(0.188)	(0.133)	(0.133)	(0.137)	(0.138)	(0.083)	(0.083)	(0.087)	(0.089)
Foreign born	-0.07	-0.065	-0.119 *	-0.118 *	0.223 *	0.267 **	0.211 *	0.223 *	0.067	0.076	0.143	0.144	0.134 *	0.129	0.132	0.151 *
	(0.045)	(0.045)	(0.046)	(0.046)	(0.093)	(0.094)	(0.096)	(0.097)	(0.076)	(0.076)	(0.078)	(0.078)	(0.066)	(0.067)	(0.069)	(0.069)
Percent female[a]	0.041 ***	0.041 ***	0.036 ***	0.036 ***	0.07 ***	0.068 ***	0.066 ***	0.065 **	0.075 ***	0.074 ***	0.077 ***	0.076 ***	-0.002	-0.002	-0.003	-0.004
	(0.006)	(0.006)	(0.006)	(0.006)	(0.019)	(0.019)	(0.020)	(0.020)	(0.017)	(0.017)	(0.018)	(0.018)	(0.015)	(0.015)	(0.015)	(0.015)
Percent female squared	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 **	-0.001 **	-0.001 **	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***	0	0	0	0
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Reference groups are [1] physical science, [2] 1970-74 , [3] east, [4] neither college educated, and [5] unpartnered. [a] Among students within STEM field and graduating cohort.

*p<.05; **p<.01; ***p<.001

Table 3. Logistic Regression Models of STEM Employment versus Non-STEM Employment among Men (cont'd)

	White Men				Black Men				Hispanic Men				Asian Men			
	model1	model2	model3	model4	model1	model2	model3	model4	model1	model2	model3	model4	model1	model2	model3	model4
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
Parental education[4]																
Father earned college degree		0.036	-0.003	-0.004		-0.079	-0.048	-0.053		0.055	-0.012	-0.022		-0.05	-0.059	-0.065
		(0.026)	(0.026)	(0.026)		(0.113)	(0.114)	(0.114)		(0.085)	(0.086)	(0.086)		(0.060)	(0.062)	(0.062)
Mother earned college degree		0.1 *	0.081	0.079		0.315 *	0.328 *	0.327 *		0.144	0.054	0.046		-0.272 *	-0.231	-0.234
		(0.042)	(0.043)	(0.043)		(0.129)	(0.131)	(0.132)		(0.128)	(0.129)	(0.129)		(0.132)	(0.134)	(0.133)
Both earned college degree		0.11 ***	0.031	0.029		0.294 **	0.258 **	0.25 **		0.153	0.075	0.065		-0.028	-0.029	-0.033
		(0.024)	(0.024)	(0.024)		(0.092)	(0.094)	(0.095)		(0.082)	(0.084)	(0.084)		(0.058)	(0.059)	(0.059)
Advanced degrees																
STEM Masters			0.538 ***	0.534 ***			0.644 ***	0.639 ***			0.612 ***	0.605 ***			0.638 ***	0.629 ***
			(0.024)	(0.024)			(0.091)	(0.091)			(0.076)	(0.076)			(0.052)	(0.052)
STEM PhD			0.664 ***	0.66 ***			0.85 ***	0.841 ***			0.82 ***	0.803 ***			0.477 ***	0.466 ***
			(0.031)	(0.031)			(0.125)	(0.125)			(0.107)	(0.107)			(0.059)	(0.059)
Non-STEM advanced degree			-0.384 ***	-0.383 ***			-0.204	-0.198			-0.116	-0.121			-0.83 ***	-0.84 ***
			(0.032)	(0.032)			(0.117)	(0.118)			(0.107)	(0.108)			(0.073)	(0.073)
Marriage and family[5]																
Married				0.078 **				0.067				0.033				0.085
				(0.025)				(0.090)				(0.080)				(0.066)
Cohabiting				0.071				0.037				0.094				0.239
				(0.082)				(0.327)				(0.207)				(0.310)
Any children<6				-0.005				-0.019				0.093				0.013
				(0.026)				(0.095)				(0.080)				(0.058)
Any children 6-17				-0.143 ***				-0.213 *				-0.208 **				-0.329 ***
				(0.025)				(0.091)				(0.080)				(0.059)
Constant	0.912 ***	0.918 ***	0.85 ***	0.845 ***	-0.181	-0.192	0.05	0.093	-0.132	-0.105	-0.324	-0.311	1.481 ***	1.522 ***	1.104 ***	1.121 ***
	(0.119)	(0.119)	(0.122)	(0.122)	(0.397)	(0.399)	(0.413)	(0.414)	(0.350)	(0.351)	(0.361)	(0.361)	(0.277)	(0.279)	(0.286)	(0.285)
N	65,234				4,649				6,453				15,751			
Likelihood Ratio	1,109	1,156	2,880	2,918	103	120	272	277	140	153	341	349	402	411	950	983
df	17	21	24	28	17	21	24	28	17	21	24	28	17	21	24	28

Reference groups are [1] physical science, [2] 1970-74 , [3] east, [4] neither college educated, and [5] unpartnered. [a] Among students within STEM field and graduating cohort.

*p<.05; **p<.01; ***p<.001

Chart 1. Women's Representation among Graduating Cohorts of STEM Majors by STEM Field

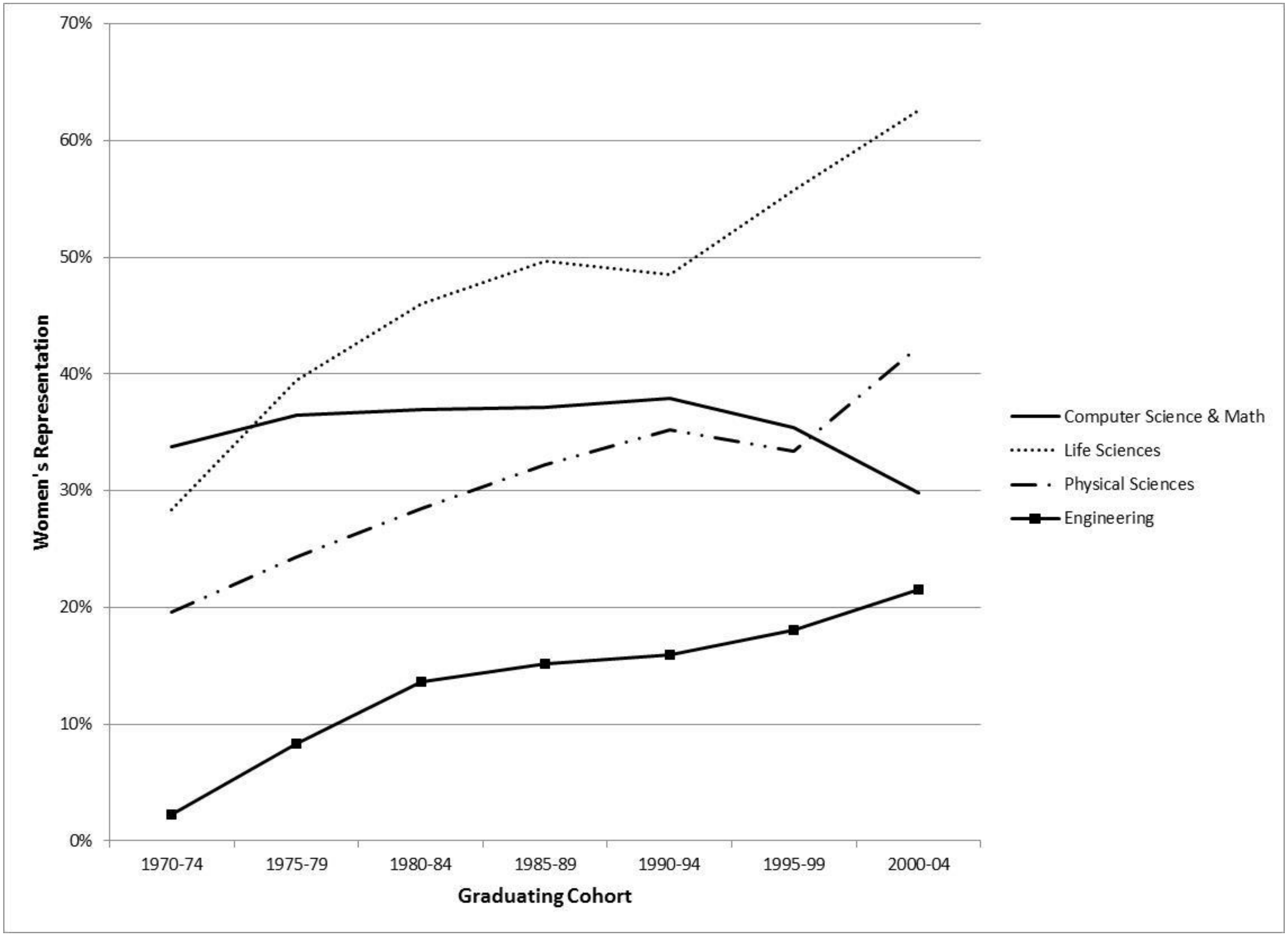

Chart 2. Predicted Probabilities of STEM Employment among Women across Graduating Cohorts

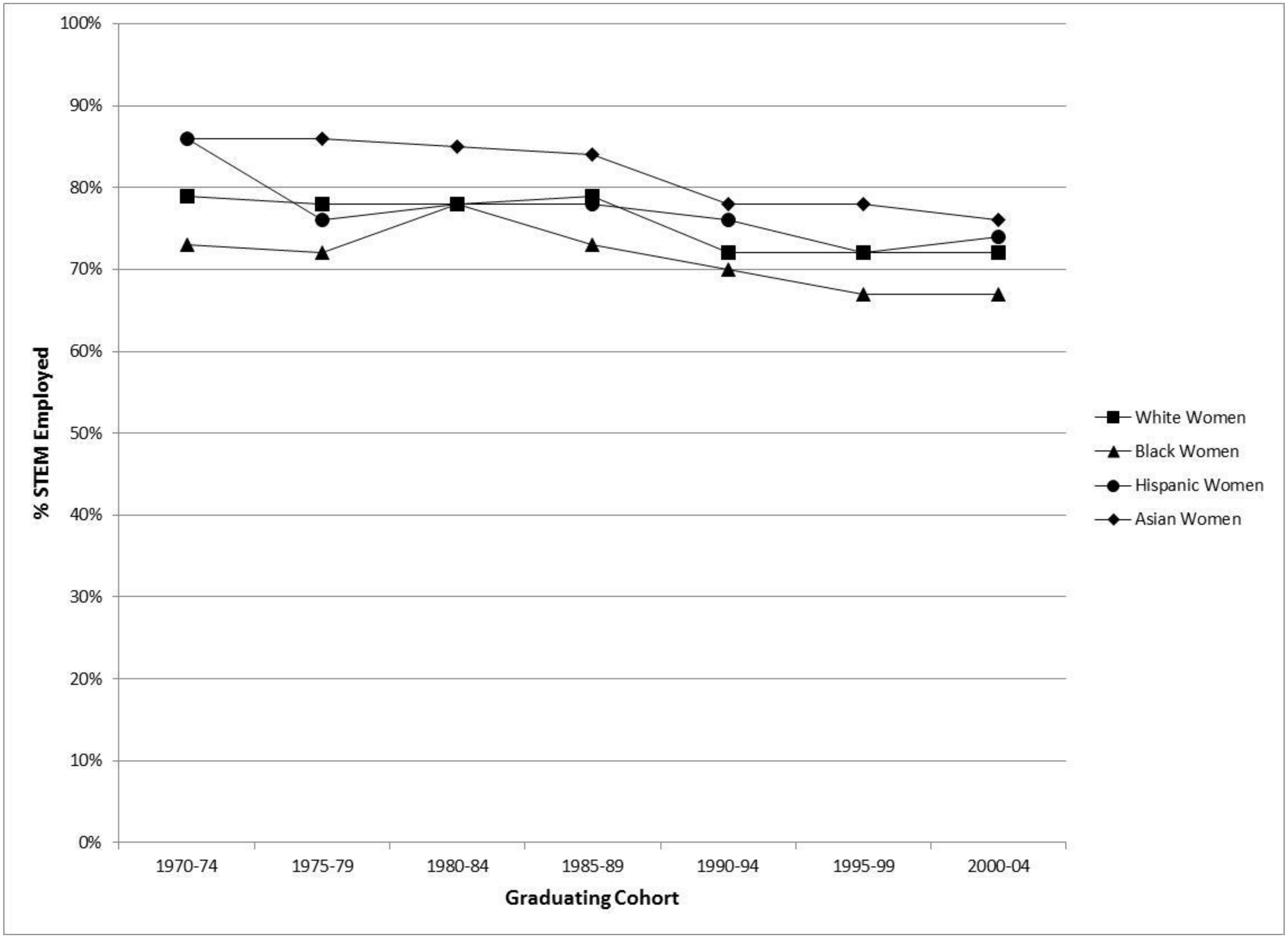

Chart 3. Predicted Probabilities of STEM Employment among Men across Graduating Cohorts

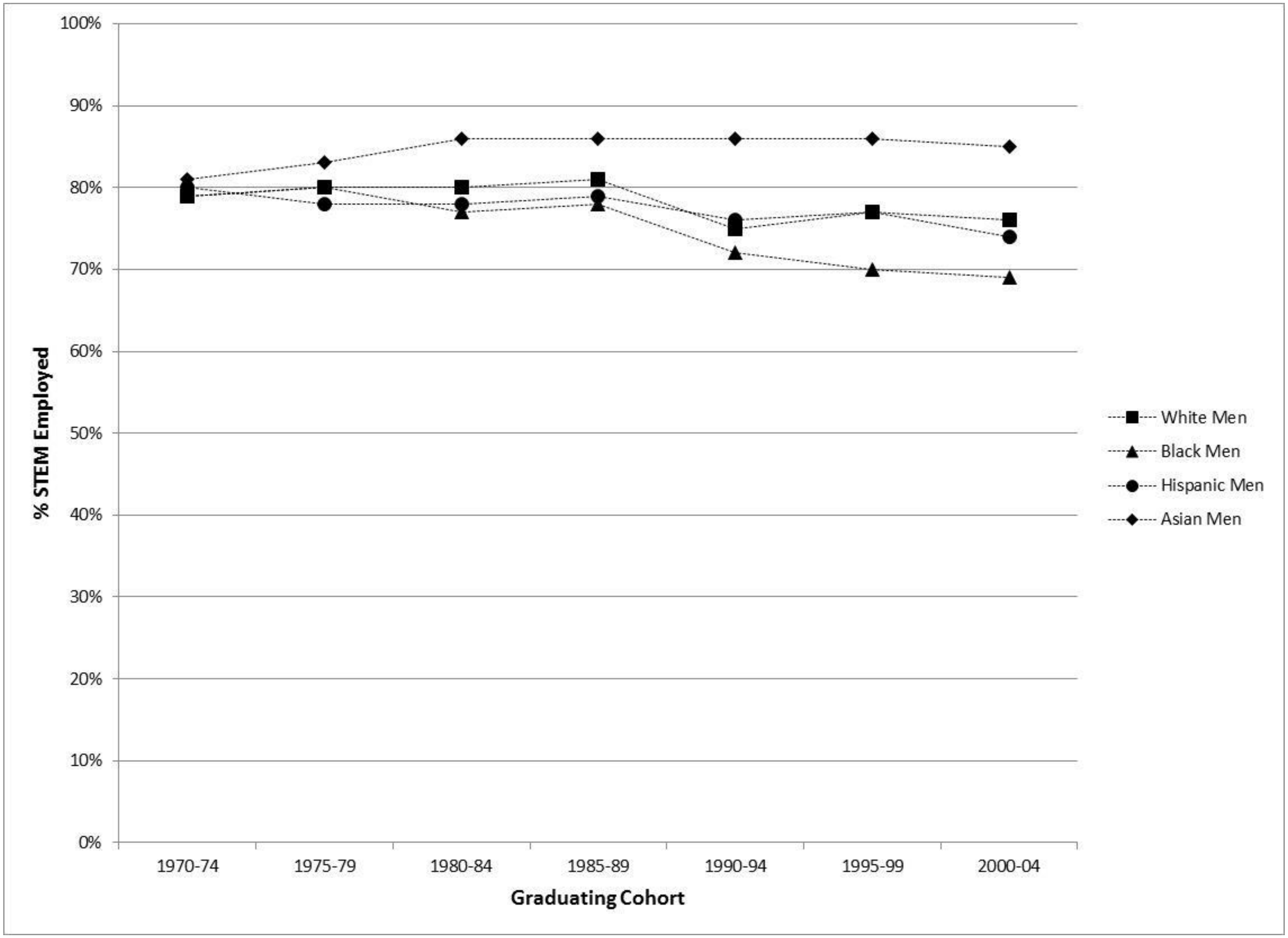

Chart 4. Predicted Probabilities of Women's STEM Employment (Broadly Defined) across Levels of Women's Representation among STEM College Majors

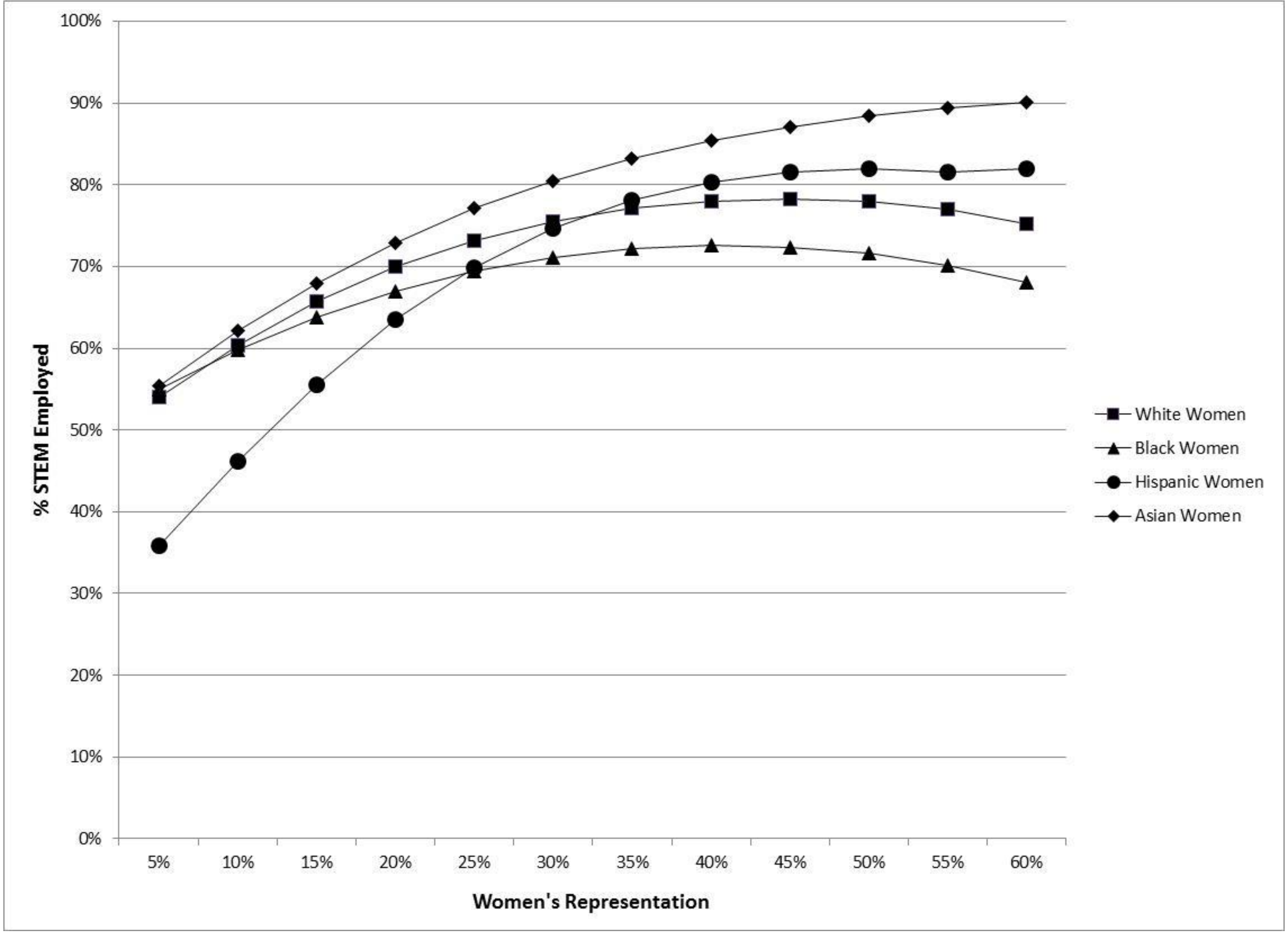

Chart 5. Predicted Probabilities of Men's STEM Employment (Broadly Defined) across Levels of Women's Representation among STEM College Majors

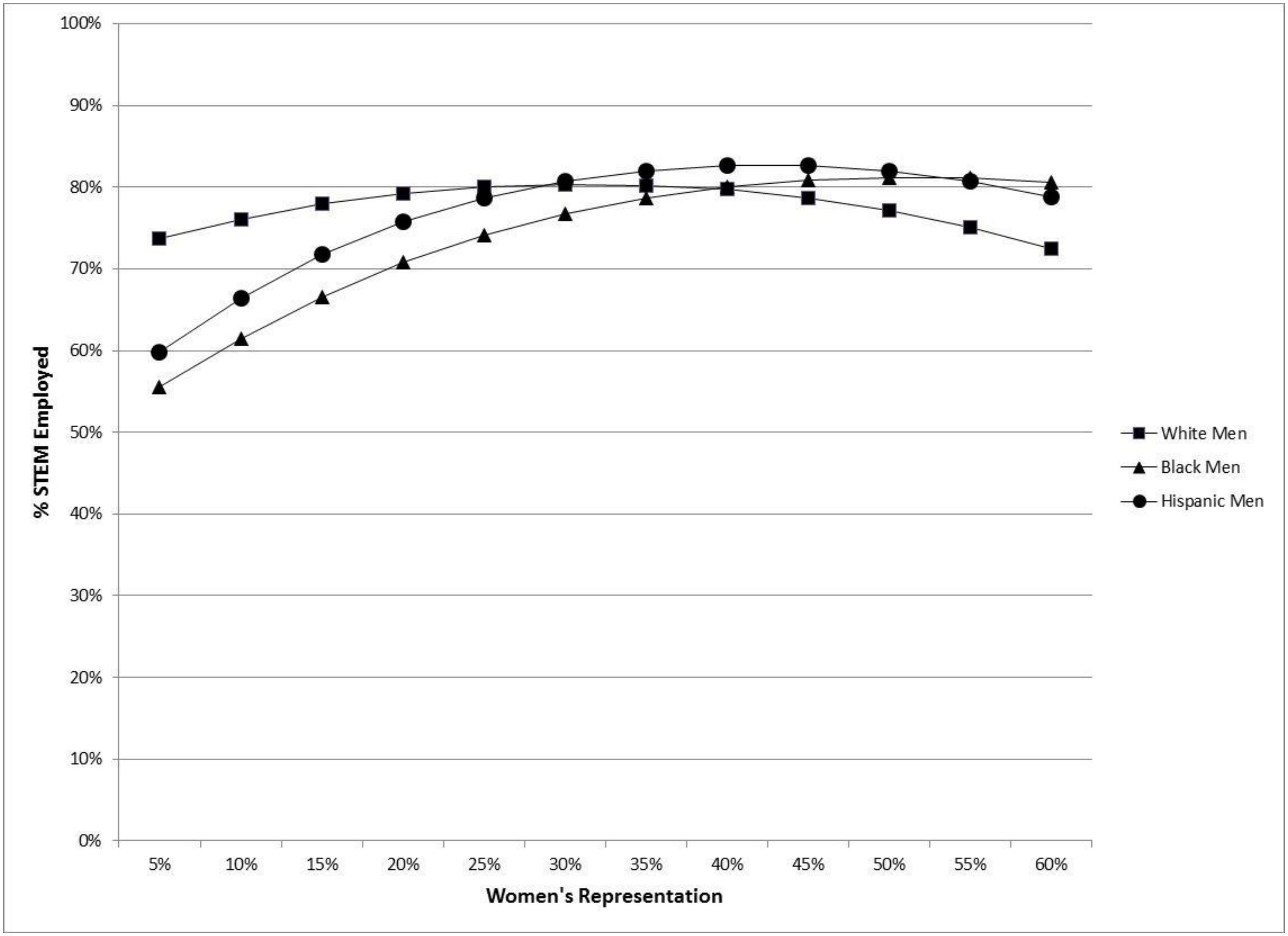

Chart 6. Predicted Probabilities of Women's STEM Employment (Narrowly Defined) across Levels of Women's Representation among STEM College Majors

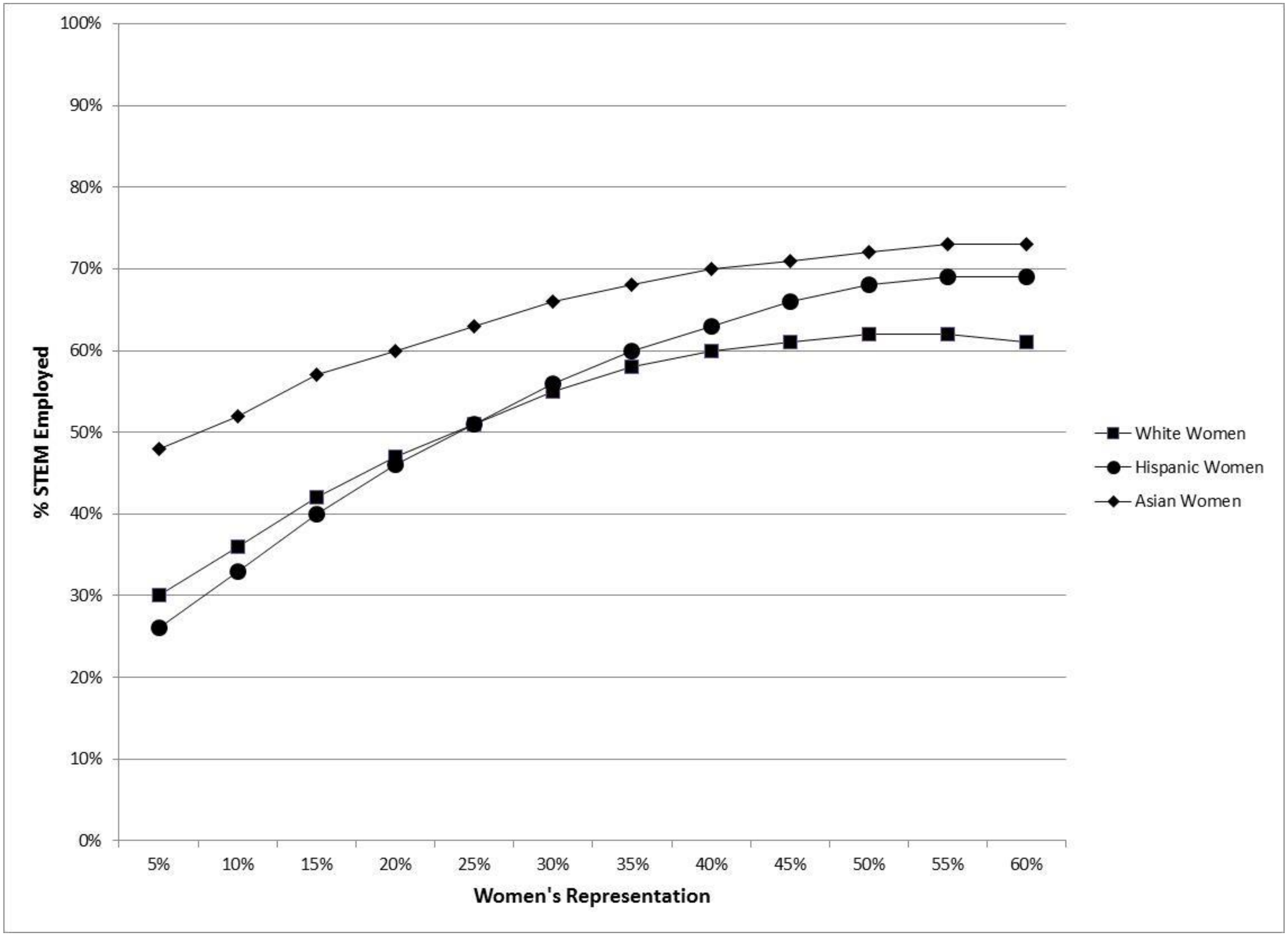

Chart 7. Predicted Probabilities of Men’s STEM Employment (Narrowly Defined) across Levels of Women’s Representation among STEM College Majors