THE EFFECTS OF RACE, SEX, AND EXPECTED RETURNS ON THE CHOICE OF COLLEGE MAJOR

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INTRODUCTION

Much attention has been directed lately at the underrepresentation of women and certain minority groups in the science and engineering fields. While there has been a significant decrease in the gender gap over the past several decades, women still receive less than 20 percent of bachelor's degrees in engineering and just over one-third of degrees in physical sciences, mathematical and computer sciences, and earth sciences, despite earning 55 percent of the total bachelor's degrees awarded [U.S. Department of Education, 2000]. Not surprisingly, the percentage of women receiving advanced degrees is even smaller. Among minority groups, the percentage of Asian science and engineering bachelor's degree recipients is much higher than their percentage of the U.S. population, while the reverse is true for both African-Americans and Hispanics.

This underrepresentation is of concern for two reasons. First, as women and the underrepresented minorities tend to earn less than white males, attracting more members of these groups into the relatively high-paying science and engineering fields could potentially narrow the sex and race wage gaps. Gill and Leigh [2000] have found that the increase in women choosing majors in relatively high-paying fields accounts for a significant portion of the decline in the male-female wage gap. Second, the demands of rapidly improving technology require a workforce strong in science and engineering not only to respond to, but also to develop, these advances in order to keep the nation at the forefront of the "new economy." The lower rate of women and certain minority groups entering the science and engineering fields may perhaps imply that we are not fully realizing our potential productivity in these areas.

This study examines the determinants of college major choice, with an emphasis on whether the choice of a major in a science or engineering discipline, and the factors affecting this choice, vary significantly by race or sex. Of particular interest is whether differences in major choice behavior across groups have any significant relationship with differences in expected labor market returns. That is, are women and the underrepresented minorities less responsive to the wage premium from choosing a major in the science and engineering fields? Or, perhaps, are the relative wage gains these groups realize from science and engineering majors less than those of their white and Asian male counterparts, thus, in part, explaining their lower propensity to choose these majors.

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PREVIOUS STUDIES OF MAJOR CHOICE

Several previous studies have investigated the college major decision. Polachek [1978] was the first to examine differences in major choice by sex. He found that, controlling for other individual and family characteristics, sex had a significant effect on the choice of all major fields except social sciences and fine arts. He also found that students with the greatest expectations for labor force participation over their lifetimes were more likely to choose majors with more on-the-job training, such as engineering and biology. Blakemore and Low [1984] also looked at differences in college major across sex and found, similarly to Polachek [1978], that women with higher expected fertility were more likely to choose majors that were less subject to obsolescence with significant time out of the workforce. Neither of these studies controlled for race or expected labor market returns.

Fiorito and Dauffenbach [1982] do consider market influences on major choice, but use aggregate data, so it is impossible to control for a variety of other individual characteristics that may affect a student's choice of major. In addition, their data was restricted to males only and results were not differentiated by race. Berger [1988] focused on the effects of expected future earnings on major choice, a potentially important determinant not included in the previous two studies. His analysis differentiated between whites and nonwhites, but again his sample was restricted to only men.

A major issue with extrapolating the findings of any of the above studies to current major choice behavior is that all were based on data from 1978 or earlier. Clearly, the career choices of young women have changed dramatically in the intervening three decades. During the same period, increases in, and changing patterns of, immigration have led to a significant increase in the Hispanic and Asian populations—subgroups not typically differentiated in earlier data sources. A study by the National Center for Education Statistics (NCES) [U.S. Department of Education, 2000] provides the most recent analysis of major choice, using data from the 1992 high school senior class. Their emphasis is specifically on women and minorities in science and engineering; however, they do not include expected returns as an explanatory variable. Also, the NCES study focuses on determining the factors that are significantly related to the number of women and minorities in science and engineering majors, without distinguishing whether the students not in science and engineering have chosen other majors, or have simply not enrolled in college at all.

The model in this paper also focuses on the factors affecting the choice of a major in science and engineering and, specifically, how these effects may differ by race or sex. The choice variable is defined, however, as choice of major by students who have already chosen to attend college. Clearly, the lower high school graduation and college attendance rates of certain minority groups will necessarily lower the percentage of these students ultimately choosing science and engineering majors in college. High school completion and college enrollment have been the focus of numerous other studies, however, many of which have specifically investigated the behavior of minority students.[1] This paper, therefore, examines the question of whether getting women and minorities into college is enough to assure their proportional representation among science and engineering majors or whether, even among students who have enrolled in college, there are still significant differences in their choice of majors.

DATA AND DEFINITION OF THE VARIABLES

The estimation uses data from the *National Education Longitudinal Study* of 1998 (NELS:88), which surveyed students who were in eighth grade in 1988, and followed them up every two years until 1994, two years after the cohort graduated from high school.[2] Of the 13,120 students who responded in the base year survey and each of the follow-ups, restricting the sample to only students who enrolled in postsecondary education sometime in their first two years after high school reduces the sample size to 9,700. Of these, 9,585 had nonmissing data for the survey questions regarding major at the student's first postsecondary institution, their most recent postsecondary institution, and the postsecondary institution they attended longest. Among the students for whom major choice data was available, 8,631 listed the same major in response to all three questions. For the 954 students who changed major sometime in their first two years of postsecondary education, the major variable was defined as their first major choice (questions of the persistence of women and minorities in the science and engineering majors are also of significant interest but are beyond the scope of this paper) at the institution they attended in the fall of 1992, or at their first institution if they matriculated after the fall of 1992. In the cases of students starting with an undeclared or exploratory major, if they eventually declared a major, then that declared major was used.

Majors were grouped into four broad categories. Three categories encompassed majors generally leading to a bachelor's degree, grouped broadly by field: science, engineering, and math (SEM); humanities and fine arts (HFA); and social science/other (including business, education, and undeclared majors.) The fourth category includes all programs generally leading to a vocational certificate or degree, regardless of field (for example, cosmetology, data entry, etc.). While the NELS:88 data would allow a more detailed breakdown of major choices, the definition of categories for the dependent variable was limited by the information available on expected returns, as explained at the end of this section.

The distribution of students across majors, broken down by race and sex, is given in Table 1. One somewhat surprising finding is that a smaller percentage of white students choose SEM majors than students in any other race category. This holds true for the group as a whole and when broken down by sex. Asian students have a much larger percentage of students in the SEM majors than any other race, while Blacks are more likely than other races to choose vocational programs and less likely to select majors in the fine arts and humanities. Hispanics, by contrast, choose majors in roughly the same distribution as the student population as a whole.

The numbers in Table 1 provide a snapshot of how enrollments are distributed, but they provide no information on what is driving these differences in major choice behavior. The multinomial logit model estimated in this paper examines the effects on major choice of a variety of individual student, parent, and high school characteristic variables (the mean values of which are presented in Table 2). Socioeconomic status is proxied by variables measuring family income in the student's senior year of high school, mother's and father's education, and whether or not the parents have professional occupations. Holding constant socioeconomic variables, many students make major choices based on the earnings potential. To capture this effect, the model includes a dummy variable indicating whether or not the student considers money to be very important in choice of occupation.

TABLE 1
Percent Choosing Each Major by Race and Sex

	SEM	Humanities/ Fine Arts	Vocational	Social Sci./other
All (N=9,487)	25.5	11.6	7.7	55.2
Females				
All (5,040)	23.6	11.5	6.9	58.0
White (3,395)	21.3	12.5	6.4	59.8
Asian (461)	31.5	12.6	3.5	52.5
Hispanic (621)	24.3	10.0	8.9	56.8
Black (514)	30.9	5.8	10.9	52.3
Males				
All (4,447)	27.7	11.7	8.5	52.1
White (3,043)	25.9	12.7	8.2	53.2
Asian (441)	37.6	10.7	4.3	47.4
Hispanic (532)	28.2	10.5	9.4	51.9
Black (399)	30.6	6.8	12.8	49.9

Note: Rows may not sum to 100 due to rounding.

TABLE 2
Sample Means of Independent Variables

variable name	mean	std. deviation
Income (in 000's)	53.43	24.05
test quintiles (1–5 w/1 high):		
reading test quintile	2.81	.545
math test quintile	2.87	.532
science test quintile	2.78	.545
0–1 categorical variables:		
female	.518	.291
Asian/Pacific Islander	.050	.128
Hispanic	.094	.170
Black	.115	.186
money very important	.314	.271
father hs graduate or less	.332	.275
father college graduate	.324	.273
mother hs graduate or less	.393	.285
mother college graduate	.264	.257
mother single household head	.144	.205
language minority in 8th grade	.096	.172
more than 75% hs class taking AP classes	.223	.243
more than 75% hs class college prep	.157	.212
N= 9,487		

Student characteristic variables include: student ability, as measured by scores on NELS-administered tests in reading, math, and science, and a dummy variable for whether or not the student is a "language minority," based primarily on whether English is the student's home language. In addition, high school variables—measuring whether 75 percent or more of students in the school are on a college preparatory track and whether 75 percent or more have taken advanced placement classes—are included to capture peer effects and the availability of college prep coursework.

In addition to the effects of current student income, ability, and schooling variables, one might expect that the choice of college major would be influenced to some extent by the differences in labor market returns students expect to realize from different major choices. Human capital theory would suggest that schooling choices be based on how they affect the present value of future lifetime earnings streams. As Betts [1996] finds, however, students typically have the most accurate knowledge of earnings of younger, less experienced workers, perhaps due to discounting. Given their lack of information regarding lifetime earnings profiles, students are more likely to base the education decisions on relative salaries of recent graduates.

Differences in returns by major were based on data from the *Baccalaureate and Beyond Survey* (B&B), which follows students who received their bachelor's degrees in the 1992-93 academic year, the year the NELS students were starting college. Thus, the early labor market earnings of the B&B students roughly represent the information set facing the NELS students when making their choice of major. Specifically, returns to major were estimated based on the average salary, by sex and race earned by 1992-93 graduates in 1996. Due to small numbers, averages could only be calculated for fairly broadly defined major categories—science, engineering, and math; humanities and fine arts; and social sciences. Estimates of average income for these major categories by race and sex are presented in Table 3. From these averages, relative returns to SEM and humanities/fine arts majors were defined for each race and sex combination as the average earnings for students with those majors relative to the average earnings of students in that demographic group with social science majors.

TABLE 3
Estimated Earnings for Recent College Graduates[a]
(by sex, race, and college major)

	SEM	Humanities/Fine Arts	Social Sci./other
Females			
White	$28,601	$23,128	$24,035
Asian	$28,689	$22,052	$30,873
Hispanic	$27,047	$25,694	$23,333
Black	$31,086	$24,828	$26,379
Males			
White	$35,565	$27,477	$30,658
Asian	$39,249	$29,864	$30,691
Hispanic	$34,309	$23,165	$30,661
Black	$32,303	$36,093	$32,626

a. Source: Author's calculations from the NCES *Baccalaureate and Beyond Survey*. Earnings in 1996 of graduates in the 1992–93 academic year.

METHOD OF ESTIMATION

The student's choice of college major is modeled as the choice of the major that yields the highest utility, given the student's individual, family, and high school characteristics. Student i chooses major j if

(1) $$U_{ij} = \max\left(U_{i1},\ldots,U_{ij},\ldots,U_{im}\right)\forall j = 1..m,$$

where $U_{ij} = \boldsymbol{\beta}'_j\mathbf{X}_i + \varepsilon_{ij}$, and where $\mathbf{X}_i$ is a vector of student characteristics for the ith student, $\boldsymbol{\beta}_j$ represents the effects of that characteristic on the utility of choosing the jth alternative, and ε_{ij} is a random error term.

The probability of individual i choosing major j can be expressed as

(2) $$\mathrm{P}_{ij} = e^{\boldsymbol{\beta}'_j\mathbf{X}_i} \Big/ \sum_{k=1}^{m} e^{\boldsymbol{\beta}'_k\mathbf{X}_i}$$

and is estimated using a multinomial logit model.[3] For identification of the model, one of the major choices must be chosen as the "reference" major, and its vector of coefficients is normalized to zero. Then the estimation of the multinomial logit model will yield coefficients expressing the effect of the independent variable on the log-odds ratio, or the log of the probability of choosing major j relative to the probability of choosing major r, the "reference" major.

Specifically, for every major j, except major r, estimation of the model yields a vector of coefficients, $\boldsymbol{\beta}_j$, such that $\log \mathrm{P}_{ij}/\mathrm{P}_{ir} = \mathbf{X}_i(\boldsymbol{\beta}'_j - \boldsymbol{\beta}_r)$, where the elements of the vector $\boldsymbol{\beta}_r$ are normalized to zero. In this model of major choice, the "social science/other" major is chosen to be r. As there is a much wider variation in types of majors across the social sciences than within any of the other major categories, there are no real priors on how certain explanatory variables might be expected to affect the probability of choosing a major in that category.

Given the nature of the multinomial logit coefficients, the estimated parameters do not lend themselves to intuitive interpretation, nor can their values be meaningfully compared across alternatives. To determine the direct marginal effect of a continuous explanatory variable on the probability of each category of major choice, one can evaluate the partial derivative of the probability function with respect to each of the independent variables. Thus, the marginal effect of the ith explanatory variable on the probability of choosing the jth choice category is

(3) $$\partial \mathrm{P}_j / \partial x_i = \mathrm{P}_j\boldsymbol{\beta}_{ij}\left(1 - \mathrm{P}_j\right) - \mathrm{P}_j \sum_{k \neq j} \mathrm{P}_k\boldsymbol{\beta}_{ik}.$$

For 0–1 categorical variables, marginal effects are best estimated by evaluating the predicted probability with the variable of interest set equal to zero and then again with it set equal to one (with the remaining explanatory variables typically set to their mean values) and then calculating the change in predicted probability as the variable of interest changes value.

RESULTS

The multinomial logit model was first estimated without the inclusion of the relative returns variables (Table 4.) As explained in the previous section, the estimated coefficients do not have a clear intuitive interpretation; however, they are useful for providing insight into the significance and direction of the explanatory variables on the probability of choosing each major category (relative to the choice of social science

TABLE 4
Effects of Individual Characteristics on Major Choice multinomial logit coefficients (std. errors in parentheses)

	SEM	Humanities/Fine Arts	Vocational
Female	**–.078***	–.059	**–.199*****
	(.045)	(.060)	**(.071)**
Asian/Pacific Islander	**.184***	–.057	–.344
	(.100)	(.143)	(.237)
Hispanic	.113	–.041	–.052
	(.088)	(.121)	(.134)
Black	**.353*****	**–.344*****	.074
	(.071)	**(.126)**	(.101)
income (in 000s)	–.0015	.0010	**–.0056***
	(.0013)	(.0015)	**(.0029)**
money v. impt.	**–.081***	**–.123***	.104
	(.049)	**(.068)**	(.071)
father <= hs grad	**.122***	.108	**.188***
	(.067)	(.091)	**(.097)**
father college grad	.039	.075	**–.371*****
	(.071)	(.093)	**(.137)**
mother <= hs grad	.003	**–.163****	–.019
	(.063)	**(.083)**	(.095)
mother college grad	.033	.025	.035
	(.067)	(.083)	(.125)
mother prof/tech occup.	.035	.072	.122
	(.073)	(.088)	(.122)
father prof/tech occup.	.068	.092	–.203
	(.064)	(.080)	(.153)
single mom household	**–.125***	**.221*****	.001
	(.070)	**(.085)**	(.010)
language minority	.076	.045	–.111
	(.088)	(.124)	(.143)
reading test quintile	–.067	**.252*****	**–.229****
	(.067)	**(.093)**	**(.107)**
math test quintile	**.176****	**–.239****	**–.427*****
	(.074)	**(.098)**	**(.115)**
science test quintile	**.199*****	.080	.182
	(.073)	(.099)	(.116)
75%+ hs students AP	–.057	.103	**–.272*****
	(.053)	(.067)	**(.104)**
75%+ hs students col prep	–.101	.030	–.141
	(.064)	(.079)	(.130)

N = 9,487 Likelihood ratio = 6439

*statistically significant at the .10 level; ** at the .05 level; ***at the .01 level.

major.) As might be expected from the raw data in Table 1, female students are, in fact, significantly less likely than males to enroll in SEM majors, while Asian students are significantly more likely to choose such a major. Perhaps surprisingly, one of the largest and most highly significant effects in the entire estimation shows that, controlling for other factors, being black increases a student's probability of enrolling in SEM fields relative to the probability of choosing a social science/other major. Black students also have a significantly lower likelihood of choosing humanities or fine arts. Hispanics, by contrast, have major choice behavior not significantly different from that of their white counterparts.

While family income has no significant effect on the choice of SEM major, higher income does decrease the likelihood of a student enrolling in a vocational major. As might be expected, students who consider money a very important aspect of their future career have a lower probability of choosing a major in the humanities or fine arts, relative to the probability of choosing a social science/other major. Less expected is the result that these students are also less likely to select SEM majors. Among other variables designed to capture socioeconomic status, parental occupation has no significant effect and the effects of parental education are fairly limited, apart from the unsurprising impact of the father's education on choice of vocational major. The most significant family variable was the dummy for whether a student lived in a single female-headed household. Even after controlling for income and mother's education level, students from these households were less likely to major in SEM, and significantly more likely to major in the humanities and fine arts. This result may be attributable to the historically lower probability of females selecting SEM majors, so that most of the students in single female-headed households lack role models in the home for pursuing more technical majors.

The effects of ability as measured by test quintiles are as expected. Students who are good at math and science are significantly more likely to choose SEM majors relative to the probability of choosing social science/other majors. Meanwhile, higher math scores decrease the likelihood of selecting a humanities/fine arts major while higher scores in reading ability increase the probability of such a choice.

While race and sex both clearly have significant effects on major choice, these results naturally raise the question of whether the race effects vary by sex. That is, given that females are less likely to choose SEM majors, but Asians are more likely to choose SEM, what is the effect of being Asian for females? Table 5 provides results of the same model as in Table 4, estimated separately over males and females. As Table 5 shows, Asian female students are significantly more likely to enroll in SEM than in social sciences, while Asian males are actually no more likely to choose SEM than are white students. The greater likelihood of SEM choice among blacks, however, shows up for both males and females. Therefore, it appears that after controlling for other factors that affect major choice, neither all females nor all minorities are, in fact, underrepresented.

Among other explanatory variables, it appears that ability plays a larger role in major choice for male than for female students, with seven of the nine ability test coefficients attaining significance in the male estimation, versus only three in the female regression. Parental educational variables, however, have no significance at all in male major choice, while both father's and mother's education have some impact on females' choice probabilities. Interestingly, the two significant effects associated in the main regression with a student coming from a one-parent female-headed household appears to be split between the sexes; the probability of a female student choosing an SEM major decreases, while the likelihood a male student will select a major in the humanities or fine arts increases.

TABLE 5
Effects of Individual Characteristics on Major Choice by Sex (standard errors in parentheses)

	male			female		
	SEM	Hum./F.A.	vocational	SEM	Hum./F.A.	vocational
Asian/Pacific Islander	.118	–.011	–.460	**.243***	–.104	–.331
	(.143)	(.205)	(.306)	**(.143)**	(.207)	(.385)
Hispanic	.083	–.181	–.258	.121	.073	.159
	(.126)	(.182)	(.195)	(.126)	(.166)	(.187)
Black	**.271****	**–.381****	.040	**.414*****	**–.356****	.087
	(.108)	**(.179)**	(.140)	**(.096)**	**(.180)**	(.150)
income (in 000s)	–.0012	–.0004	–.0044	–.0019	.0028	–.0068
	(.0017)	(.0023)	(.0040)	(.0019)	(.0020)	(.0044)
money v. impt.	–.106	**–.191****	.085	–.053	–.048	.140
	(.068)	**(.094)**	(.097)	(.072)	(.099)	(.107)
father <= hs grad	.146	–.021	.201	.086	**.219***	.194
	(.099)	(.132)	(.134)	(.092)	**(.130)**	(.145)
father college grad	.090	.026	–.298	–.009	.112	**–.416****
	(.103)	(.134)	(.185)	(.099)	(.132)	**(.205)**
mother <= hs grad	–.022	–.066	–.054	.018	**–.242****	.036
	(.093)	(.123)	(.132)	(.085)	**(.114)**	(.142)
mother college grad	.045	.021	–.278	–.009	.020	.238
	(.095)	(.124)	(.179)	(.098)	(.115)	(.179)
father occupation prof.	.088	.010	**–.387***	.041	.162	.040
	(.089)	(.119)	**(.235)**	(.094)	(.110)	(.204)
mother occupation prof.	–.031	.040	.050	.121	.085	.211
	(.105)	(.130)	(.183)	(.102)	(.125)	(.168)
single mom household	-.032	**.344*****	.152	**–.208****	.124	–.145
	(.102)	**(.121)**	(.139)	**(.099)**	(.123)	(.148)
language minority	.150	.077	.054	.023	.008	–.305
	(.128)	(.181)	(.196)	(.124)	(.175)	(.214)
reading test quintile	–.032	**.326****	**–.341****	–.129	**.239***	–.136
	(.092)	**(.128)**	**(.150)**	(.100)	**(.141)**	(.160)
math test quintile	**.258****	**–.335****	**–.447*****	.097	–.145	**–.448****
	(.106)	**(.136)**	**(.155)**	(.106)	(.145)	**(.176)**
science test quintile	**.211***	.018	**.340****	**.207****	.082	.047
	(.108)	(.142)	**(.161)**	**(.103)**	(.141)	(.176)
75%+ hs stud AP	–.109	.121	**–.363****	–.008	.090	–.186
	(.076)	(.096)	**(.148)**	(.075)	(.097)	(.147)
75%+ hs stud col. prep	**–.172***	–.095	–.072	–.037	.175	–.200
	(.090)	(.117)	(.175)	(.092)	(.108)	(.201)
	N = 4,447	Likelihood ratio= 3132		N = 5,040	Likelihood ratio = 3228	

*statistically significant at the .10 level; ** at the .05 level; *** at the .01 level.

TABLE 6
Effects of Individual Characteristics and Expected Returns on Major Choice multinomial logit coefficients (std. errors in parentheses)

	SEM	Humanities/Fine Arts	Vocational
Female	–.073	–.075	**–.200****
	(.047)	(.065)	**(.087)**
Asian/Pacific Isl.	.170	–.038	–.321
	(.105)	(.151)	(.240)
Hispanic	.110	–.049	–.028
	(.095)	(.131)	(.153)
Black	**.393*****	**–.392****	.048
	(.084)	**(.155)**	(.134)
returns to SEM major	.0029	–.0043	.0019
	.0091	.0147	.0196
returns to Hum/FA maj.	–.0053	.0067	.0055
	.0056	.0095	.0082
income (in 000s)	–.0014	.0011	**–.0054***
	(.0013)	(.0015)	**(.0030)**
money v. impt.	**–.091***	**–.133***	.093
	(.049)	**(.068)**	(.072)
father <= hs grad	**.117***	.109	**.175***
	(.067)	(.092)	**(.098)**
father college grad	.045	.085	**–.379*****
	(.071)	(.093)	**(.139)**
mother <= hs grad	.005	**–.155***	–.000
	(.063)	**(.083)**	(.097)
single mom hshld	**–.124***	**.226*****	.008
	(.071)	**(.085)**	(.100)
language minority	.089	.049	–.120
	(.090)	(.126)	(.149)
reading test quintile	–.071	**.241*****	**–.234****
	(.067)	**(.093)**	**(.108)**
math test quintile	**.174****	**–.237****	**–.423*****
	(.075)	**(.099)**	**(.116)**
science test quintile	**.198*****	.080	.187
	(.073)	(.099)	(.117)
75%+ hs stud AP	–.059	.106	**–.267*****
	(.053)	(.068)	**(.104)**
75%+ hs stud col prep	–.103	.030	–.133
	(.064)	(.079)	(.131)

N = 9,406 Likelihood ratio = 6379

Note: To conserve space, parental occupation and education variables with no significant coefficients were not reported
*statistically significant at the .10 level; ** at the .05 level; *** at the .01 level.

One might hypothesize that, in addition to all of the individual characteristic variables, students' major choice might also be influenced by the differences in expected labor market returns across majors. Including relative returns to major in the equation allows us to determine whether the effects of race and sex on major choice are altered by controlling for differences in expected labor market outcomes across groups. As the results in Table 6 illustrate, the returns variables have no significant effect on the probability of choosing any of the three major categories relative to the probability of choosing a social science major. This lack of significance could be attributable to the broad classifications of major: variations in returns within SEM or humanities/ fine arts that would significantly affect major choice may be masked when the majors are grouped together. Or perhaps relative earnings, as defined here, whether or not they are an accurate earnings prediction, may not correlate closely with students' own expectations. Alternatively, it could be that while earning more money may motivate the college enrollment decision of students, it may have much less of an impact on their course of study once enrolled.

It should be noted, however, that inclusion of the returns variables does affect the significance of two other explanatory variables in the model. Neither the Asian nor the female variables have a significant effect on the choice of SEM major once the estimation controls for relative returns to major—Asians are no longer more likely to choose an SEM major while females are no longer less likely to choose a major in these fields. It would appear, therefore, that the major choices of these students are not directly affected by their race or sex, but are perhaps to some extent affected by the impact of their race and sex on their expected labor market returns. Unfortunately, that data on returns is insufficient for a closer examination of that question in this paper.

TABLE 7
Marginal Effects of Independent Variables on Major Choice[a]

variable name	SEM	Hum./F.A.	Vocational	Soc. Sci./other
Income (in 000's)	–.0002	.0002	–.0004	.0004
SEM returns	.0006	–.0005	.0001	–.0002
Humanities/fine arts returns	–.0013	.0008	.0004	.0001
test quintiles (1–5 w/1 high):				
reading test quintile	–.0161	.0289	–.0171	.0044
math test quintile	.0483	–.0257	–.0309	.0083
science test quintile	.0317	.0007	.0086	–.0409
0–1 categorical variables:				
female	–.0130	–.0027	–.0041	.0198
Asian/Pacific Islander	.0465	–.0087	–.0080	–.0298
Hispanic	.0292	–.0077	–.0017	–.0198
Black	.1101	–.0389	–.0026	–.0686
Money very important	–.0183	–.0072	.0035	.0220
father hs graduate or less	.0228	.0038	.0027	–.0293
father college graduate	.0116	.0058	–.0091	–.0083
mother hs graduate or less	.0105	–.0011	–.0056	–.0038
mother college graduate	.0075	.0005	–.0012	–.0069
mother single household head	–.0391	.0243	.0009	.0139
language minority in 8^{th} grade	.0213	.0007	–.0037	–.0183
more than 75% hs class taking AP classes	–.0158	.0114	–.0056	.0100
more than 75% hs class college prep	–.0251	.0066	–.0021	.0205
N = 9,406				

a. The marginal effects are calculated using Equation (3).

The significance, or lack thereof, of all the other explanatory variables remains unchanged with the inclusion of the returns variable. For ease of interpretation, these results are presented as marginal effects in Table 7. Notably, despite the lack of significance of other demographic characteristics once the relative returns variables were added to the equation, the impact of being black on the likelihood of choosing an SEM major remains large and highly significant—the marginal effect is easily the largest in the entire table. The result can be interpreted as saying that, all else constant, being black increases a student's probability of selecting an SEM major by just over 11 percentage points. At the same time, the probability that that student will choose a major in the humanities or fine arts is 3.9 percentage points lower than that of a comparable white student.

The second largest effect on choice of an SEM major is a student's math test quintile. An increase by one quintile in the math score is associated with a 4.8 percentage point increase in SEM choice probability. Science test score has a similar, though somewhat smaller (3.2 percentage points), effect. Of all the other significant variables, the one notable for the size of its marginal effect is the dummy for single female household head. Students from such homes are nearly 4 percentage points less likely to enroll in SEM majors, while being 2.4 percentage points more likely to major in the humanities or fine arts.

CONCLUSION

To a large extent the sex and race differences in major choice evidenced by raw percentages (Table 1) are still significant even when controlling for other factors that might affect the decision. Asian students as a whole have a higher probability of majoring in SEM relative to the probability of choosing a social science major. Therefore, this difference in enrollment probability cannot be explained by greater math and science ability or differences in family characteristics. However, the significance of the difference disappears once returns are included in the estimation, implying that it is the promise of greater relative rewards in the labor market that attract Asian students to SEM majors.

The effect of being female on the choice of SEM major also loses its significance once the returns variables are added. Controlling for ability and other individual, family, and school characteristics, females are still significantly less likely than males to select an SEM major. Once the returns variables are added, this difference between male and female major choice is no longer significant. One could infer from this result that a significant reason why women are less likely than men to choose SEM majors is that women's expected returns to SEM, relative to majoring in other fields, are lower than those for men. Thus, it may be that success in attracting females to SEM majors may depend less on boosting the math abilities and "science self-esteem" of young women and more on increasing their labor market returns to these majors relative to alternative majors.

Unlike the other significant race and sex effects, the impact of being black on the probability of SEM and humanities/fine arts major choices is essentially unchanged with the inclusion of returns variables. Therefore, there are some factors beyond ability, income, parental variables, and even expected return that are causing Blacks to be strongly and highly significantly more likely to choose an SEM major than their white counterparts. One possible explanation is that recent efforts to attract minorities into the sciences have been successful in meeting their goals. Attracting minorities to these fields where they have been traditionally underrepresented is just the first step, however. Studies have shown that retaining and graduating minority students in these majors is as much of a challenge, if not a greater one, than attracting them in the first place [U.S. Department of Education, 2000; Maple and Stage, 1991]. The recent release of the latest follow-up to the NELS:88 study will allow future study of the persistence, educational, and labor market outcomes of the women and minorities who have chosen science and engineering majors.

NOTES

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1. Including, but certainly not limited to Manski and Wise [1983], Fligstein and Fernandez [1985], Ganderton and Santos [1995], White and Kaufman [1997], and Hagy and Staniec [2002].
2. After being suspended for six years, a fourth follow-up was finally completed in 2000, and results should be released in Spring 2002.
3. See Maddala [1983] and Greene [2002] for a more detailed description of the multinomial logit model and the interpretation of its results.

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