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THE UNDERREPRESENTATION OF WOMEN IN ECONOMICS: A STUDY OF UNDERGRADUATE ECONOMICS STUDENTS

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ABSTRACT

Although women are underrepresented in the field of economics, many people see little need for intervention, arguing that women are inherently less interested in economics, or are less willing or able to acquire the math skills needed to do well in the subject. At the same time, others support active efforts to increase the number of women in the field, pointing to other possible causes of their current underrepresentation. These people argue, for example, that women are deterred from entering the field because of a lack of female role models, or that women are discouraged by an unappealing classroom environment. This study attempts to assess these hypotheses. We examine the factors that influence undergraduate students' decisions to become economics majors by analyzing a survey of students in the introductory economics course at Harvard University as well as data on an entire class of students from Harvard's registrar.

We find that although women in the introductory economics course at Harvard tend to begin the course with a weaker math background than men, math background does not appear to explain much of the gender difference in students' decisions about whether to major in economics. The class environment and the presence or absence of role models also do not explain much of the gender gap. On the other hand, women do less well in economics relative to their other courses than men do, and controlling for this difference in relative performance significantly diminishes the estimated gender gap. An economically large, but statistically insignificant, difference between sexes in the probability of majoring in economics remains, however. This remaining gender gap may be due to differing tastes or information about the nature of economics. As evidence, we find that women who were considering majoring in economics when they began introductory economics were about as likely to choose economics as were men.

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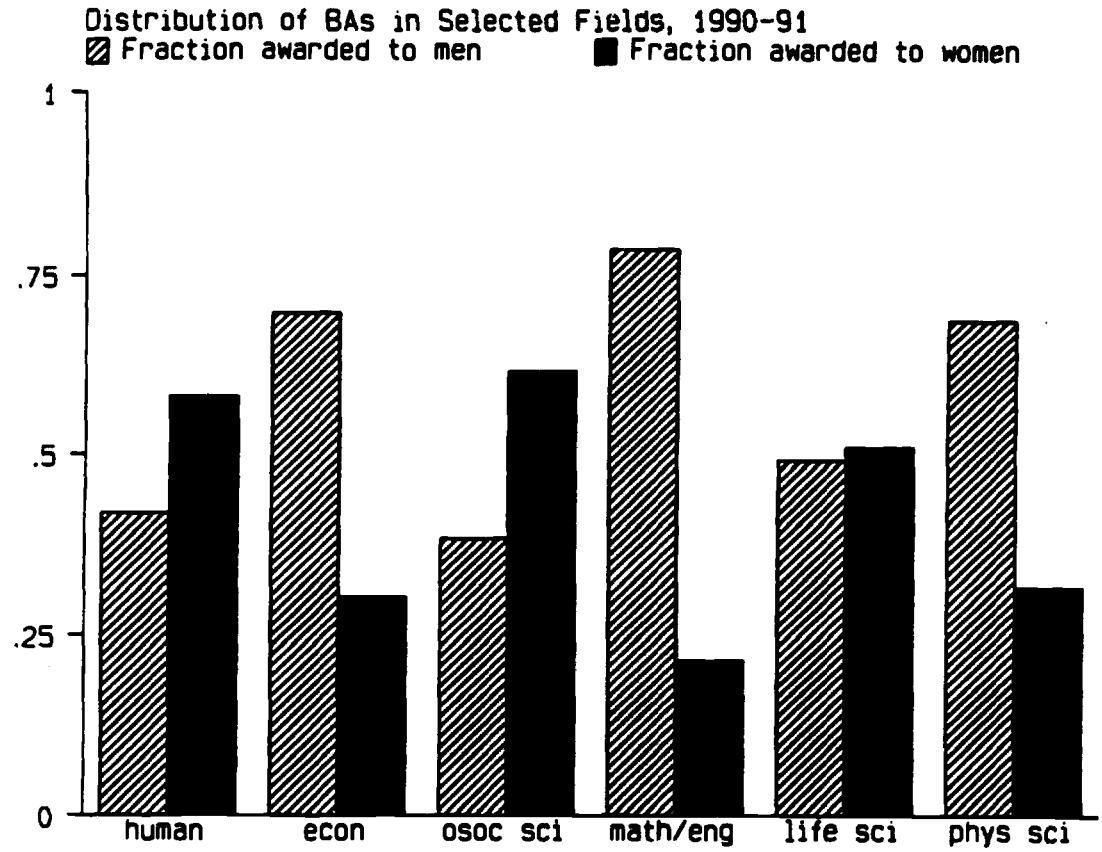
I. Introduction

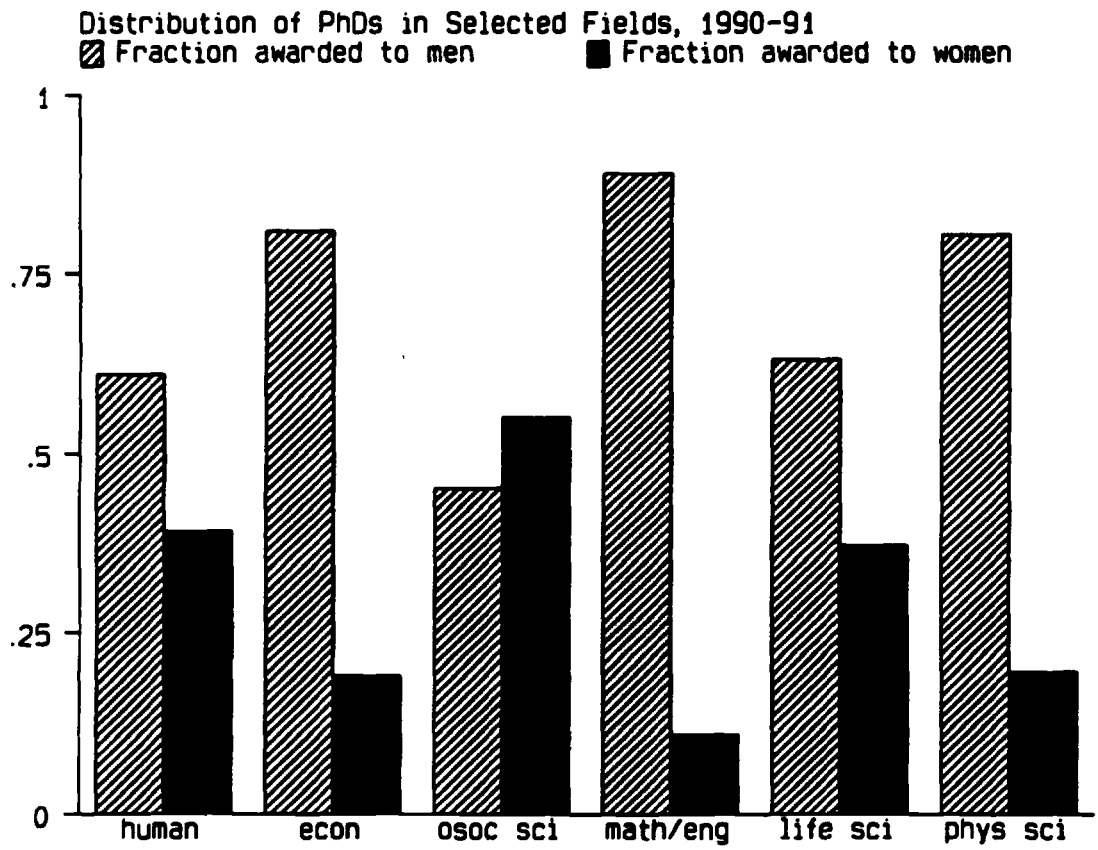
In 1990, women represented less than one-quarter of newly granted doctoral degrees in economics and of new assistant professors in economics departments. The share of women is even lower at the tenured ranks, as women represented less than 4 percent in the top thirty economics departments in 1992 (Uchitelle, 1993). This underrepresentation is also apparent at the undergraduate level where women received only 31 percent of the bachelor degrees in economics in 1990 as compared to just over half of bachelor degrees in all fields. As shown in the upper and lower panels of Figure 1, the fraction of economics bachelor and doctoral degrees granted to women in 1990-91 was considerably lower than the corresponding fractions for the other social sciences, the humanities, and the life sciences. The gender distribution of degrees in the physical sciences was similar to that in economics; only math and engineering had proportionally fewer women than economics.

Although the evidence indicates that women are underrepresented in the field of economics, it is not clear whether efforts to change the gender balance are justified. Many people see little need for intervention, arguing that women are inherently less interested in economics, or that women are less willing or able to acquire the math skills needed to do well in the subject. At the same time, some people support active efforts to increase the number of women in the field, pointing to other possible causes of their current underrepresentation. These people argue, for example, that women are deterred from entering the field because of a lack of female role models, or that women are discouraged by an unappealing classroom environment (Ferber (1990, 1995)).

This study sets out to identify some of the factors that influence undergraduate students' decisions to major in economics. Although having an undergraduate degree in economics is certainly not a prerequisite for earning a doctorate in the field or becoming a faculty member, most economics graduate students do have a BA in economics. Thus, understanding the

Figure 1


Distribution of BAs in Selected Fields, 1990-91
Fraction awarded to men
Fraction awarded to women
1
.75
.5
.25
0
human
econ
osoc sci
math/eng
life sci
phys sci


Distribution of PhDs in Selected Fields, 1990-91
Fraction awarded to men
Fraction awarded to women
1
.75
.5
.25
0
human
econ
osoc sci
math/eng
life sci
phys sci

decisions made by undergraduate women will likely improve our understanding of the underrepresentation of women in our profession as a whole.

We examine the results from a survey of students enrolled in the introductory economics course at Harvard University in 1991 and 1992. Many of the respondents had chosen their major just prior to the survey.[1] They were asked for information about their choice of major, personal characteristics, math background, as well as their performance and classroom experience in this course. We also obtained data from the Harvard registrar in order to assess the potential biases from reporting error and from sampling only students who were already enrolled in an economics course.

The next section of the paper describes the data sets used in the analysis. The third section discusses several hypotheses about why female students are less likely to major in economics than are men. The fourth section presents descriptive statistics, and the fifth section discusses regression results. The sixth section concludes.

II. Data

Survey of Introductory Economics Students

Our primary data are drawn from a survey of students, both male and female, in the introductory economics class at Harvard University. Roughly one-half of each class at Harvard enrolls in this course at some point in their undergraduate careers. The course is taught for the full academic year, focusing on microeconomics in the fall term and macroeconomics in the spring term. We sampled students in April 1991 and April 1992. In both years, about half of the

[1] Because we do not follow the students, we cannot test the hypothesis that women are more likely to change out of economics than men. See Misol and Ramachandran (1994) for a study of female economics majors at Duke University.

students sampled were in their first year at Harvard, and the survey was administered shortly after they were asked to declare their majors.

The survey asked about the students' characteristics, backgrounds, perceived performance in the course, and choice of major. It also asked students about their attitudes regarding different features of the course, particularly the classroom environment and the amount of math used.[2] In addition, the survey collected information about the sex of each student's instructor. Because most of the course's meetings are in small classes (sections) taught by different instructors, we are able to use variation in the instructor's gender to investigate the importance of role models in the choice of major.

It should be emphasized that this survey covers only students who had already chosen to study introductory economics. Thus, the estimates of the effect of gender on the probability of majoring in economics are *conditional* on taking an economics class; they should generally be interpreted as the effect of the class on the decision to major in economics. We nonetheless believe that valuable lessons can be learned from the decisions of women and men who already display some interest in economics.

Data from the Registrar

We also obtained data from the Harvard registrar on 1,475 students in the class of 1989. This data set includes information on whether and when each student took the introductory economics course, as well as each student's major, grade in the course, sex, math SAT score, and overall grade-point-average (GPA) at the time of graduation. We cannot properly correct for the sample selection in our estimates based on the introductory course sample, and the registrar data enables us to gauge the extent to which our introductory course estimates would differ from

[2] The survey instrument is available from the authors upon request.

estimates based on all students. Further, the registrar data help us to evaluate the role of reporting error, as it includes information about actual (not first declared) major, actual (not recalled) math SAT score, and actual (not mid-year) grade in introductory economics.

Comparability with National Data

An obvious concern is that students at Harvard University may not be representative of college students nationwide. The registrar data indicate that 5.3 percent of the women in the Harvard class of 1989 majored in economics, compared to 13.6 percent of the men. These percentages are high compared to the national numbers on BAs awarded in economics: according to the *Digest of Education Statistics* (1993), 1.2 percent of women who graduated during the academic year 1990-91 majored in economics as compared to 3.3 percent of men.[3] The difference may largely be explained by Harvard's limited selection of majors as a liberal arts college; some students selecting economics as a major at Harvard might have chosen business or accounting at universities offering a wider range of fields. Both nationally and at Harvard, however, men are almost three times as likely as women to major in economics.[4] Thus, we believe that our results on the gender gap are likely to generalize to other schools.

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[3] The variation across institutions is large. For example, Phillip Levine of Wellesley College informs us that about 14 percent of the all-female class at Wellesley typically chooses to major in economics. See Misol and Ramachandran (1994) for a comparison of the experiences of economics students at Duke University and Wellesley College.

[4] The same point can be made by noting the following facts. In 1991 nationwide, 30 percent of economics BAs were awarded to women while 54 percent of all BAs were received by women. In the Harvard class of 1989, 20 percent of the economics majors were female, compared to 39 percent of the student class. (In a typical year at Harvard, approximately 24 percent of the economics majors are women; thus, the share of women in 1989 was a little lower than average.)

III. Hypotheses

One of the most commonly asserted hypotheses about why women are less likely to major in economics than men is that women are less proficient or less comfortable using the math needed to do economics.[5] Measuring "math aptitude" or "comfort using math" is difficult, however. For example, students with sophisticated mathematics backgrounds may find it difficult to apply their skills to a new context. In our survey, we attempted to measure math ability in three ways. First, we asked the students for their math SAT scores. Second, we asked about the highest level of math that they had taken before starting introductory economics. Finally, because introductory economics does not typically require high levels of math but does require skill at interpreting graphs, we asked students to complete the following sentence:

When my teacher uses graphs,

1. they make sense immediately.
2. they don't always make sense, but I easily figure them out.
3. they don't always make sense, but after some work I figure them out.
4. there are some that are very difficult to figure out.

Perceived aptitude for economics may also influence the choice of major because students are presumably more likely to choose a subject in which they expect to do well.[6] More precisely, an individual may respond to how well she does in economics relative to her other classes, rather than how well she does in an absolute sense.[7] Our data set from the introductory class survey contains "absolute" aptitude, as measured by the grade that the student received for the first

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[5] It is not clear whether women may be uncomfortable because of "math anxiety" or because of a weak background in math. See Ware, Steckler, and Leserman (1984) for references.

[6] For a study of the influence of grades on course selection, see Sabot and Wakeman-Linn (1991).

[7] Maxwell and Lopus (1994) find no significant differences between sexes in the misreporting of grades. If such differences do exist, they could distort the comparison of men's and women's perceived absolute performance in economics. They are not likely to distort the comparison of perceived relative performance, however.

semester of introductory economics, and "relative" aptitude, as measured by whether the student reported that she was doing better in introductory economics than in her other courses.

A student's choice of major may also depend on whether she believes she will "fit in" or be comfortable in the field. Thus, another determinant of a student's choice of major might be the presence or absence of role models. Students uncertain about whether they will do well in economics or whether they will enjoy the subject may be reassured if they observe someone with similar characteristics who is accomplished in the field.[8] Our data set allows us to test this hypothesis because we know the sex of the instructor in the introductory course sample.

A related hypothesis is that the classroom environment influences a student's choice of major. The introductory class data set includes two variables that may indicate how appealing (or unappealing) the classroom environment is.[9] First, we asked students how comfortable they feel asking questions in class and participating in class discussion. Second, we calculated the fraction of women in each student's introductory economics section. The fraction of women in the section might alter a student's likelihood of majoring in economics by changing the dynamic in the classroom or by providing more (or fewer) peer role models.[10]

Of course, the underrepresentation of women among economics majors may simply be a matter of taste or of the information they have about the nature of economics before arriving at college. Although it is difficult to gauge taste and information, we tried to assess a student's predisposition for majoring in economics by asking whether he or she was considering majoring

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[8] For arguments that role models are likely to be important, see Ehrhart and Sandler (1987) and Blau and Ferber (1986).

[9] Others also argue that the content and pedagogy in introductory classes deter women from majoring in economics (Bartlett (1995), Ferber (1995)). Since our data come from a class with fairly standardized course material, we could not readily test this hypothesis.

[10] To calculate the fraction of women in each individual's section, we used all students in the section *except* for that individual.

in economics at the beginning of the academic year. We also attempted to learn about tastes by asking the students their principal reason for taking introductory economics.

In order to test the various hypotheses, we estimate binary probit models of choosing economics as a college major. The basic equation is:

$$Econ_i = \beta_0 + \beta_1 Fem_i + \beta_2 Math_i + \beta_3 RelAdv_i + \beta_4 RMod_i + \beta_5 Class_i + \epsilon_i, \quad (1)$$

where $Econ_i$ takes the value of 1 if student i intends to major in economics and 0 otherwise. Fem_i indicates whether student i is female, $Math_i$ measures student i's math ability, $RelAdv_i$ is student i's performance in introductory economics relative to other classes, $RMod_i$ is a dummy variable indicating whether student i's instructor was female (we also try interacting the sex of the instructor with the sex of the student), $Class_i$ represents variables related to student i's perception of his or her classroom environment, and ϵ_i is a normally distributed error term. If adding one or more of these variables to the regression reduces the magnitude and eliminates the significance of the coefficient on Fem_i, it suggests that the corresponding hypotheses explain some or all of the gender difference in choice of economics as a major. On the other hand, if the coefficient on Fem_i remains large and significant after all additional variables are included, systematic gender differences in tastes or other unobserved factors may be at least partly responsible for the underrepresentation of women in economics.

IV. Descriptive Statistics

Table 1 presents descriptive statistics on first-year students from the survey of the

TABLE 1

DESCRIPTIVE STATISTICS:
SURVEY OF FIRST-YEAR INTRODUCTORY ECONOMICS STUDENTS
(Percentage of Gender)

	Women	Men	χ^2 Test of Independence (p-value)
Major			0.03[a]
Economics	28.0	35.6	0.05
Other Social Science	36.5	30.3	0.10
Humanities	19.9	14.4	0.06
Science	10.9	16.1	0.07
Other	4.7	3.6	0.49
Grade in Introductory Economics			0.19[a]
A	13.3	20.7	0.02
A-	20.4	19.0	0.66
B+	17.5	19.7	0.49
B	20.4	16.7	0.26
B-	17.1	15.5	0.61
C+ or below	10.9	8.1	0.22
Pass	0.5	0.2	0.51
Performance Relative to Other Courses			0.00[a]
Better	11.9	24.3	0.00
About the Same	46.9	49.0	0.60
Worse in Introductory Economics	41.2	26.6	0.00
Math SAT Score[b]	723	733	-10.01 (4.30)
Highest Level Math Class Taken Prior to Intro. Economics			0.04[a]
Precalculus	9.5	12.8	0.20
First Semester Calculus	37.4	29.3	0.03
Second Semester Calculus	42.7	42.1	0.90
Multivariate Calculus	8.1	9.0	0.68
Linear Algebra or Higher	2.4	6.7	0.02
Percentage of Other Students in Class Who are Female[b]	30.5	29.6	0.92 (0.76)

[a] The p-value of χ^2 test of independence of all characteristics in the set together.
[b] Means for women and men, and coefficient and standard error from a regression of Percent Female/SAT on female.

(Table continues...)

TABLE 1 (cont.)

DESCRIPTIVE STATISTICS:
SURVEY OF FIRST-YEAR INTRODUCTORY ECONOMICS STUDENTS
(Percentage of Gender)

	Women	Men	χ^2 Test of Independence (p-value)
Ease in Interpreting Graphs			0.11[a]
Graphs Make Sense Immediately	25.6	34.1	0.03
They Don't Always Make Sense, but I Easily Figure Them Out	46.5	43.9	0.53
They Don't Always Make Sense, but After Some Work, I Figure Them Out	25.6	19.7	0.08
There are Some That Are Very Difficult to Figure Out	2.4	2.3	0.95
Female Section Leader	38.4	33.3	.19
Comfort Asking Questions/Participating in Class			0.45[a]
Very Comfortable	37.0	42.3	0.18
Fairly Comfortable	42.7	40.6	0.61
Uncomfortable	17.1	13.4	0.20
So Uncomfortable, I Do Not Participate	3.3	3.6	0.83
Principal Reason for Taking Economics			0.24[a]
Interested in Subject	61.1	68.4	0.06
Thought it Would Help Get Job or Get Into Business School	5.7	6.1	0.82
A Requirement for Major	22.3	18.8	0.28
Satisfies a Distribution Requirement	4.3	2.5	0.20
Other	6.6	4.2	0.17
Considering Majoring in Economics When Began Introductory Economics	69.2	77.8	0.01
Number of Observations	211	512	

[a] The p-value of χ^2 test of independence of all characteristics in the set together.

introductory economics class.[11] We pool data from the two years of the survey as there is no discernible difference between the years. The first two columns show percentages of students with various characteristics by gender. The third column presents the p-values from χ^2 tests of independence for each characteristic within a set and for each set of characteristics together, unless otherwise noted.

Approximately 28 percent of the first-year women in the introductory class chose to major in economics compared to 36 percent of the men. The p-value of 0.05 indicates that this difference is statistically significant. Women are more likely than men to major in the humanities and other social sciences, and less likely to major in the sciences. These findings are consistent with the national statistics shown in Figure 1.

The distribution of first-semester grades in introductory economics reveals that men tended to do better than women. The mean grade for men was about a B+, while the mean grade for women was just below a B. This difference is statistically significant, but does not seem very large in practical terms.[12] The gender differences in the responses to the question about performance in introductory economics relative to performance in other courses seem consistent with the distribution of grades. Men were twice as likely as women to report that they did better in introductory economics than in their other courses, and only two-thirds as likely to report that they did worse.

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[11] Although it is possible for students to major in economics at Harvard if they take introductory economics in their second (or even third) year, about 85 percent of economics majors take the course when they are in their first year and choose to major in the field at that time. Thus, we base our descriptive statistics on the first-year students in the introductory economics class. In general, the statistics are similar for first-year students and for all students; exceptions are noted below.

[12] Durden and Ellis (1995) find no gender-related differences in student performance after controlling for a variety of factors. They point out, however, that most of the previous evidence on this topic suggests significant gender differences.

The various measures of math aptitude also show a difference between the sexes, with female students having more limited math backgrounds and less comfort using graphs. Men are roughly twice as likely as women to have completed a course in linear algebra before starting college, and less likely to have completed only the first semester of calculus or less. In addition, the mean math SAT score among male students was roughly 10 points higher than the mean score for female students. This difference is statistically significant, although small. Finally, the results for the survey question regarding ease in interpreting the graphs used in class show that first-year male students were significantly more likely to report that the graphs used in class "make sense immediately."[13]

Perhaps surprisingly, although first-year women were somewhat less comfortable participating in class than first-year men were, the difference is not statistically significant. Further, first-year women's comfort in class is not significantly affected by the presence of a female section leader, or the proportion of the class that is female.[14]

The final questions on the survey of the introductory course were designed to shed some light on the role of tastes and, to some extent, knowledge about economics before arriving at college. Women were less likely than men to take the course principally because they were interested in the field, and marginally more likely to take the course because it satisfied a curricular requirement. Further, first-year women were significantly less likely to have been considering majoring in economics when they began the course than were first-year men.

Table 2 presents the descriptive statistics from the registrar data on the class of 1989, for

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[13] This result differed for the full sample of students in the introductory course, where men and women reported roughly equal ease in interpreting the graphs used in class.

[14] In the full sample of students, the statistical significance of the gender differences in comfort levels is somewhat larger, and female students were significantly more comfortable asking questions in classes that had a higher percentage of women.

TABLE 2

DESCRIPTIVE STATISTICS:
REGISTRAR DATA
(Percentage of Gender)

	Sample					
	Students Who Took Intro. Econ. First year			Entire Class		
	Women	Men	χ^2 Test of Independence (p-value)	Women	Men	χ^2 Test of Independence (p-value)
Major[a]			0.03[b]			0.00[b]
Economics	22.3	36.5	0.01	5.0	13.2	0.00
Other Social Science	56.3	44.0	0.03	49.1	42.5	0.01
Humanities	14.6	10.1	0.23	29.1	17.7	0.00
Science	6.8	9.4	0.43	16.9	26.6	0.00
Grade in Introductory Economics			0.01[b]			
A	4.9	12.4	0.03			
A-	6.8	13.5	0.07			
B+	27.2	18.1	0.05			
B	23.3	17.7	0.22			
B-	16.5	24.4	0.10			
C+ or below	21.4	13.9	0.08			
Cumulative GPA			0.05[b]			0.00[b]
A/A-	10.7	18.1	0.08	12.2	16.0	0.04
B+/B/B-	48.5	32.7	0.01	48.0	40.7	0.01
C+/C/C-	33.0	38.0	0.37	33.4	33.0	0.88
D or Lower	7.8	11.3	0.32	6.4	10.3	0.01
Grade in Intro. Econ. Greater than graduating GPA	10.7	24.8	0.00			
SAT Math Score[c]	697	715	-17.65 (7.24)	695	721	-26.27 (3.33)
Number of Observations	103	266		581	894	

[a] The registrar assigned each student's major to one of these four groups, whereas the survey allowed students to classify their majors as "other."

[b] The p-value of χ^2 test of independence of all characteristics in the set together.

[c] Means for women and men, and coefficient and standard error from a regression of Percent Female/SAT on female.

comparison with the class surveys for the spring semesters of 1991 and 1992. The first three columns show statistics on members of the class of 1989 who took introductory economics in their first year at Harvard. The proportion of women in the class of 1989 who took introductory economics and majored in economics is slightly lower than the proportion of women in the introductory economics course in 1991 and 1992 who majored in the field, and the difference between sexes is statistically significant. As in Table 1, men tended to receive higher grades in introductory economics than women did, and twice as likely to receive a grade in introductory economics that was higher than their (overall) average grade at Harvard.[15]

The final three columns of Table 2 show statistics for the entire Harvard class of 1989. Women in this class were more likely than men to major in the humanities or social sciences other than economics; they were underrepresented in the sciences. As in the subsample who took introductory economics in their first year, women graduated with lower overall GPAs, although the difference is smaller than in the subsample. Women's scores on the math SAT averaged 26 points lower than men's scores, a statistically significant difference which is somewhat larger than for students who took the introductory course. On balance, however, the statistics for the entire class seem roughly similar to those for the subsample who took introductory economics.

V. Regression Results

The Effect of Grades and Math Background

Table 3 presents binary probit estimates of the effect of math background and grades on

[15] Ideally, we would like to compare the grade in introductory economics to other first-year grades, but we do not have such information.

TABLE 3

PROBIT ESTIMATES OF THE DECISION TO MAJOR IN ECONOMICS: EFFECTS OF MATH ABILITY AND GRADES
(Evidence from Students in Introductory Economics Class)

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female	-0.216 (0.108) [-0.078]	-0.212 (0.108) [-0.077]	-0.230 (0.108) [-0.084]	-0.195 (0.108) [-0.071]	-0.201 (0.109) [-0.073]	-0.199 (0.110) [-0.072]	-0.166 (0.111) [-0.060]
SAT Math Score (÷100)		0.038 (0.091) [0.014]			0.115 (0.100) [0.042]	-0.044 (0.111) [-0.016]	-0.057 (0.112) [-0.020]
Completed at Least Two Semesters of Calculus			-0.245 (0.097) [-0.089]		-0.354 (0.107) [-0.128]	-0.371 (0.108) [-0.134]	-0.367 (0.108) [-0.132]
Interprets Graphs Easily				0.249 (0.102) [0.091]	0.305 (0.106) [0.111]	0.251 (0.109) [0.091]	0.230 (0.109) [0.083]
Grade in Intro. Economics*						0.071 (0.024) [0.026]	0.052 (0.025) [0.019]
Did Better in Intro. Econ. than in Other Courses							0.326 (0.128) [0.118]
Pseudo R^2	0.004	0.005	0.011	0.011	0.023	0.035	0.041

Notes: The dependent variable is 1 = Plans to Major in Economics and 0 = Does Not Plan to Major in Economics. Asymptotic standard errors are in parentheses. The derivatives of the probabilities evaluated at the means are in brackets. All probits also include a constant. Sample size is 733.

* Probits with "Grade in Introductory Economics" also include a dummy variable indicating that the grade is missing. Grade based on first semester performance only.

the decision to major in economics using the survey of all first-year students in the introductory economics course.[16] Column (1) shows that women were 7.8 percentage points less likely to major in economics than men, and the difference is statistically significant at the 5 percent level.

Columns (2) through (5) show the effect of including variables related to math aptitude or comfort using graphs. Adding the math SAT score lowered the gender difference in the probability of majoring in economics by only about 1 percentage point, which is 1 percent of the original gap estimated in column (1). Controlling for whether the student had completed at least two semesters of calculus *increased* the gender gap slightly, while controlling for ease in interpreting graphs lowered the gap by roughly 9 percent, and produced a p-value on the female coefficient of 0.07. Altogether, the math-related variables appear to be significant determinants of the decision to major in economics, although they explain little (approximately 6 percent) of the gender difference.[17]

Results in columns (6) and (7) are based on probits which include the grade attained in the first semester of introductory economics and a dummy variable indicating whether the student reported doing better in economics than in other classes. Adding the grade attained in introductory economics explained about 1 percent of the gender gap. Controlling for the student's perceived relative advantage in economics makes a big difference, however, as the coefficient on the female dummy decreased 17 percent further and became insignificant with a p-value of 0.13. Thus, the results suggest that part of the reason that women are less likely to major in economics is that they have more aptitude for other subjects, or at least perceive that they do.

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[16] We report probit results without a year dummy. The results including a year dummy are very similar and are available from the authors upon request.

[17] We also interacted the female dummy variable with the math variables. While the results suggest that women with higher math SAT scores and greater facility with math are more likely to major in economics than men, the interactions were never (independently or jointly) significantly different from zero.

We now turn to the registrar data, which yields information on the gender gap for the entire student population, rather than the gender gap conditional on taking the introductory course. First, we model the decision to take introductory economics, and then the decision to major in economics conditional on taking the introductory course in the first year and among the entire class.

The probit results for the decision to take introductory economics are shown in Table 4. As shown in column (1), women were 13 percentage points less likely to take introductory economics in their first year than were men, a difference that is substantively and statistically significant. Conditioning on the math SAT score changed the coefficient on gender only slightly. However, an interaction term between female and math SAT score has a positive coefficient, albeit an insignificant one with a p-value of 0.12, suggesting that the effect of math preparation may differ by sex. Women with better math backgrounds appear more likely to take introductory economics, while the reverse was true for men.

Table 5 presents probit results based on the registrar data for the decision to major in economics. The first five columns analyze the decisions of students who took introductory economics in their first year; columns (6) and (7) use the entire class. Among those who took introductory economics in their first year, the gender difference in the likelihood of majoring in economics was 15 percentage points. Further, as with the survey data, controlling for math SAT score closes the gender gap by about 5 percent.[18]

The next columns explore the importance of performance in introductory economics. The student's grade in introductory economics had a positive and significant effect on majoring in

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[18] On the other hand, the data suggest that "math ability" may explain a large portion of the gender difference in the likelihood of choosing science as a major. Regressing (using a linear probability model) whether the person is a science major on a female dummy yielded a coefficient of -0.103 with a t-statistic of -4.83; when the regression controlled for math SAT score, the female coefficient dropped to -0.037 with a t-statistic of -1.73.

TABLE 4

PROBIT ESTIMATES OF WHO TAKES INTRODUCTORY ECONOMICS IN FIRST YEAR

Independent Variables	(1)	(2)	(3)
Female	-0.397	-0.412	-1.721
	(0.075)	(0.076)	(0.851)
	[-0.126]	[-0.131]	[-0.547]
Math SAT Score (÷ 100)		-0.060	-0.125
		(0.057)	(0.071)
		[-0.019]	[-0.040]
Female*Math SAT Score			0.186
(÷ 100)			(0.120)
			[0.059]
Pseudo R^2	0.017	0.018	0.019

Note: The dependent variable is 1 = Took introductory economics in first year and 0 = Did not take introductory economics in first year. Asymptotic standard errors are in parentheses. The derivatives of the probabilities evaluated at the means are in brackets. All probits also include a constant. Results based on 1475 observations.

TABLE 5

PROBIT ESTIMATES OF THE DECISION TO MAJOR IN ECONOMICS: EVIDENCE FROM THE CLASS OF 1989

	Sample						
	Students Who Took Introductory Economics in Their First Year					Entire Class	
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female	-0.415 (0.158) [-0.149]	-0.397 (0.159) [-0.142]	-0.380 (0.160) [-0.136]	-0.383 (0.160) [-0.137]	-0.342 (0.162) [-0.122]	-0.529 (0.102) [-0.088]	-0.531 (0.104) [-0.088]
SAT Math Score (÷100)		0.108 (0.112) [0.039]		-0.027 (0.127) [-0.010]	-0.012 (0.128) [-0.004]		-0.010 (0.074) [-0.002]
Grade in Introductory Economics			0.071 (0.029) [0.025]	0.074 (0.033) [0.027]	0.048 (0.035) [0.017]		
Intro. Econ. Grade Higher than Graduating GPA					0.362 (0.179) [0.129]		
Pseudo R^2	0.015	0.017	0.028	0.028	0.037	0.030	0.030
Number of Obs.	369					1475	

Notes: The dependent variable is 1 = Economics Major and 0 = Not an Economics Major. Asymptotic standard errors are in parentheses. The derivatives of the probabilities evaluated at the means are in brackets. All probits also included a constant.

economics, and it explained a small portion of the gender difference. Including a student's math SAT score has little effect on the results. Again, however, having "relative advantage" in economics, as measured by whether a student's grade in introductory economics was greater than his or her graduating GPA, had a positive and significant effect on majoring in economics. This effect was substantively large as well, explaining about 11 percent of the gender difference.[19]

The final two columns of Table 5 show results based on the entire class of 1989. Column (6) shows that women in the class of 1989 were about 9 percentage points less likely to major in economics than were men, a smaller gap than that estimated using only students who had taken the introductory class in their first year. In addition, we find in column (7), again using the entire class, that conditioning on the math SAT score does not change the gender gap.[20]

Our results on the effect of math background in both the registrar data and the introductory course data warrant further discussion. One possible reason for the insignificance of math background is that a student who did not major in economics may have chosen either a humanities major or a science major. Students with strong math backgrounds may have been more likely to major in economics than in the humanities, but less likely to major in economics than in the sciences. Thus, estimates of the effect of math in a binary choice model may show

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[19] Measuring relative advantage as receiving a grade in introductory economics that is greater than *or equal to* the graduating GPA decreased the gender gap by 12 percent in these data.

[20] This result is unsurprising since the fact that the conditional gender gap (in columns (1) and (2)) is larger than the unconditional gender gap (in columns (6) and (7)) does not necessarily affect inferences about the determinants of the gap. In particular, only those factors that affect the gender gap in both the probability of taking the introductory course and the decision to major in economics will bias the conditional estimates of determinants of the gap. Since the SAT math score has only a small effect on the gender gap among students in the introductory class and is not significantly related to who chooses to take introductory economics, our estimate of the importance of the SAT math score on the conditional gap is similar to that on the unconditional gap.

no effect. In results not presented, we estimated multinomial logits of choice of major using data from the entire class of 1989. Our results were virtually identical to the binary estimates reported in Table 5: conditioning on math SAT score does not appear to significantly affect the gender difference in the probability of majoring in economics.

On the other hand, math background (as proxied by the math SAT score) is a fairly good predictor of the grade in introductory economics, with a correlation coefficient of 0.46.[21] In fact, controlling for SAT math score explains most of the gender gap in the introductory economics course grade in the registrar data, and explains almost one-half of the gender gap in the introductory economics course grade in the class survey.[22] Yet, before conditioning on the grade in introductory economics, our three measures of math background did not explain a large portion of the coefficient on female in Table 3. These results likely reflect our finding that relative performance is much more important than absolute performance in determining the choice of major.[23]

In summary, the results in Tables 3 through 5 suggest that math background, as proxied by math SAT score, the highest level of math attained, the ease in interpreting graphs, and grade in introductory economics, explains only a small portion of the gender gap in the decision to major

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[21] Our results on the determinants of the grade in economics are consistent with those of Brasfield et al (1992) who find that students with some calculus background do better in introductory economics courses than students without that background, and Cohn and Cohn (1994) who report a significant positive relationship between graph skills and success in introductory economics.

[22] We also find that ease with interpreting graphs explains about 20% of the gender gap in the grade in introductory economics. However, having a female instructor or more female classmates did not affect the gender gap in economics grades (contrary to the findings of research reported by Ferber (1995)).

[23] Because the grade in introductory economics could be endogenous in the sense that those who know they want to major in economics work harder, we tried instrumenting the grade with the SAT math score. The results did not change.

in economics. On the other hand, an individual's performance in introductory economics relative to that in other courses is a significant determinant of the choice of major, going part of the way toward explaining why women are less likely to major in economics than are men.[24]

Other Hypotheses

In Table 6 we use the sample from the survey of first-year students in the introductory economics class to consider additional hypotheses about the gender gap in choosing to major in economics. In all cases, we first present the unconditional effect of the additional variable and then consider the effect of the additional variable while controlling for math background, grade in introductory economics, and relative advantage in economics.

In the first three columns, we study the effect of having a female section leader, which we interpret as having a potential role model for women. We find that controlling for having a female teacher explains only a small portion of the gender gap, and that while the interaction between whether the student was female and whether the student had a female section leader was positive, it was not significantly different from zero. These results are consistent with those of Canes and Rosen (1995) who study female undergraduates' choices of majors at several institutions and find that the fraction of faculty in a discipline who are female does not appear to influence the proportion of students majoring in that discipline who are female.

Columns (4) and (5) show that a student's comfort in asking questions in class is not significantly correlated with the probability of majoring in economics. Further, including this variable has little effect on the magnitude of the gender difference, although the coefficient is no longer significant at the 5% level. This result is not surprising since there were no significant

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[24] It is also possible that the individual's performance in introductory economics relative to that in other courses is a better measure of absolute math skills than the more direct measures.

TABLE 6

PROBIT ESTIMATES OF THE DECISION TO MAJOR IN ECONOMICS: OTHER HYPOTHESES
(Evidence from First-year Students in Introductory Economics Class)

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female	-0.212 (0.108) [-0.077]	-0.162 (0.111) [-0.059]	-0.215 (0.139) [-0.077]	-0.211 (0.108) [-0.077]	-0.166 (0.111) [-0.060]	-0.224 (0.108) [-0.081]	-0.175 (0.111) [-0.063]	-0.171 (0.111) [-0.061]	-0.090 (0.116) [-0.031]
Female Teacher	-0.077 (0.101) [-0.028]	-0.051 (0.112) [-0.025]	-0.110 (0.122) [-0.039]					-0.077 (0.104)	-0.138 (0.108) [-0.048]
Female Teacher*Female			0.146 (0.229) [0.053]						
Comfort Asking Questions During Class {p-value}*				{0.709}	{0.971}			{0.965}	{0.915}
Percentage of Other Students in Class Who are Female						0.692 (0.523) [0.252]	0.619 (0.529) [0.223]	0.659 (0.531) [0.238]	0.751 (0.550) [0.263]
Considering Majoring in Econ. When Started Intro. Econ.									1.086 (0.144) [0.380]
Includes Math and Econ. Grade**		X	X		X		X	X	X
Pseudo R^2	0.005	0.042	0.042	0.006	0.042	0.006	0.043	0.044	0.116

Notes: The dependent variable is 1 = Plans to Major in Economics and 0 = Does Not Plan to Major in Economics. Asymptotic standard errors are in parentheses. The derivatives of the probabilities evaluated at the means are in parentheses. All probits also included a constant. Sample size is 733. Probits with "Grade in Introductory Economics" also include a dummy variable indicating that the grade is missing.

* Measured as dummy variables: "Fairly comfortable", "Uncomfortable", "So Uncomfortable Does Not Participate".

** Includes SAT math score, grade in introductory economics, and dummies for whether completed at least two semesters of calculus, interprets graphs easily, did better in introductory economics relative to other classes, and whether grade in introductory economics is missing.

differences in the distribution of answers between the men and women in Table 1. Columns (6) and (7) include the percentage of the individual's class that is female, another proxy for the student's classroom environment. The coefficient on the percent female in the class is positive, although statistically insignificant. Note also that including the measure increases the gender gap slightly.

As further evidence that the introductory economics course, per se, is not a significant deterrent to women majoring in economics, column (9) shows that the gender gap decreases significantly when we control for whether the student was considering majoring in economics when she started introductory economics. The coefficient on female is now insignificantly different from zero at the 5 percent level, and its magnitude has dropped by one-half.[25]

VI. Conclusion

There is a significant difference between the fraction of female students who choose to major in economics and the fraction of male students who do the same. Although women in the introductory economics course at Harvard tend to begin the course with a weaker math background, math background does not appear to affect students' decisions about whether to major in economics. The class environment and the presence or absence of role models also do not explain much of the gender gap. At the same time, women do less well in economics relative to their other courses than men do, and controlling for this difference in relative performance significantly diminishes the estimated gender gap. Thus, to some extent women may not major in economics because they have a comparative advantage in other fields.

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[25] Unfortunately, we cannot judge the extent of recall error in the student responses to whether they had been considering majoring in economics at the beginning of the course. Our concern is that the responses tell us more about the student's actual decision than about her intentions seven months earlier.

After controlling for performance, math background, role models, and classroom environment, the estimated gender gap in the introductory course data is 6.1 percentage points, 22 percent smaller than the original gap. While the coefficient is not statistically different from zero, its magnitude indicates that some difference in the probability of majoring in economics across sexes remains. This remaining gap may arise from differences in tastes or other unmeasured characteristics such as knowledge about the nature of economics upon entering college. As evidence, we find that women who were considering majoring in economics when they began introductory economics were about as likely to choose economics as were men.

We do not know whether women perform less well in economics relative to other classes because of differences in aptitude for economics, differences in work effort in economics, or differences related to the other courses they take. We also do not know what determines the taste for economics that students bring to college. Women may arrive at college with preconceptions about the nature of the field, having already decided not to major in it. It is worth noting that when upperclass students were asked why they did not take introductory economics in their first year, women were over twice as likely as men to respond that they "did not think that economics was interesting."

REFERENCES

Bartlett, Robin L. "Attracting 'Otherwise Bright Students' to Economics 101." *American Economic Review*, May 1995, 362-366.

Blau, Francine D. and Marianne A. Ferber. *The Economics of Women, Men and Work*, Englewood Cliffs, N.J.: Prentice-Hall, 1986.

Brasfield, David, James McCoy, and Martin Milkman. "The Effect of University Math on Student Performance in Principles of Economics." *Journal of Research and Development in Education*, Summer 1992, 240-247.

Canes, Brandice J. and Harvey S. Rosen. "Following in Her Footsteps? Faculty Gender Composition and Women's Choices of College Majors." *Industrial and Labor Relations Review*, April 1995, 486-504.

Cohn, Elchanan and Sharon Cohn. "Graphs and Learning in Principles of Economics." *American Economic Review*, May 1994, 197-200.

Digest of Education Statistics. Washington, D.C.: U.S. Department of Health, Education, and Welfare, Education Division, National Center for Education Statistics, 1970, 1973, 1975, 1976, 1978, 1979, 1984, 1986, 1987, 1988, 1989, 1992, 1993.

Durden, Garey C. and Larry V. Ellis. "The Effects of Attendance on Student Learning in Principles of Economics." *American Economic Review*, May 1995, 343-346.

Ehrhart, J.K. and B.R. Sandler. *Looking for More than a Few Good Women in Traditionally Male Fields*, Project on the Status and Education of Women, Washington, D.C.: Association for American Colleges, 1987.

Ferber, Marianne A. "Gender and the Study of Economics." *The Principles of Economics Course: A Handbook for Instructors*, 1990, 44-59.

Ferber, Marianne A. "The Study of Economics: A Feminist Critique." *American Economic Review*, May 1995, 357-362.

Maxwell, Nan L. and Jane S. Lopus. "The Lake Wobegon Effect in Student Self-Reported Data." *American Economic Review*, May 1994, 201-205.

Misol, Elizabeth and Vijaya Ramachandran. "The Decline in Female Enrollment in Economics at Duke, 1986-1993." Duke University mimeo, February, 1994.

Sabot, Richard and John Wakeman-Linn. "Grade Inflation and Course Choice." *Journal of Economic Perspectives*, Winter 1991, 159-170.

Uchitelle, Louis. "In Economics, a Subtle Exclusion," *New York Times*, January 11, 1993, reprinted in American Economic Association 1993 Committee on the Status of Women in the Economics Profession Newsletter, Winter (1993).

Ware, Norma, Nicole Steckler, and Jane Leserman. "The Choice of a Science Major Among Undergraduate Women." *Journal of Higher Education*, Fall 1984.