Pedagogy, Gender, and Interest in Economics

Elizabeth J. Jensen and Ann L. Owen

Abstract: Using a large multi-school sample, the authors examined how the characteristics and attitudes of students interact with the pedagogy and attributes of the instructor to influence students' decisions to study economics beyond the first semester. They found that students who have a predisposition to major in economics, who find economics relevant, who believe they understand economics as well as their classmates, and who expect higher grades in economics relative to their other classes are more likely to continue. They found evidence that teaching techniques and evaluation methods influence all of these factors except for the predisposition to major in economics. Some, but not all, of these techniques are particularly successful in influencing the decisions of female students.

Key words: economics major, gender, pedagogy, teaching
JEL codes: A22, J24, J16

The fact that women are underrepresented in economics classes is undisputed. Many hypotheses have been advanced to explain this phenomenon, but, as yet, no consensus has been reached. For example, Ashworth and Evans (1999) find support for the idea that a lack of female role models in the classroom adversely affects a female student's choice to study economics, whereas Dynan and Rouse (1997) point to inferior math preparation of female students in high school and poorer relative performance in economics. Others contend that female students have different career aspirations and are therefore less interested in economics, but some blame the lack of interest in a mainstream economics curriculum that excludes topics and methods that appeal to women (e.g., Feiner and Roberts 1995; Ferber 1995). Finally, some work suggests that instructors are largely responsible for this trend, either by creating a classroom environment that is unfriendly to women (e.g., Hall and Sandler 1982) or by adopting pedagogy and using evaluative instruments that favor male learning styles.[1] (See Becker [1997 and 2000] for a comprehensive discussion and critique of current practices in teaching economics.)

Although our work was motivated by this last hypothesis—that instructional practices can have different effects on men and women—the extensive data set

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we describe in this article allowed us to test all of the hypotheses mentioned above simultaneously, putting the importance of pedagogical practices in perspective. Because our large multi-school sample included information on both instructor and student attributes, we were able to investigate how students' characteristics and attitudes interact with the instructor's pedagogy and certain departmental and college-level characteristics to influence students' decisions about pursuing economics.[2] Although previous studies have focused on the decision to major in economics, we also examined the decision to continue in economics beyond the first course. Perhaps our most interesting results, however, related to the factors that encouraged students who did not expect to continue when they signed up for the first course to change their minds and the factors that discouraged students who initially expected to continue but later decided to stop. The two groups of students who changed their minds about taking more economics during their first economics course are particularly interesting from a teacher's perspective because these students were influenced by something that happened during the semester.

Not surprisingly, we found that attitudes formed prior to taking introductory economics affect students' decisions. In particular, those students who entered the first economics class considering economics as a possible major were more likely to pursue economics. We also found, however, that experiences in class mattered. Students who expected to receive higher grades in economics relative to their other classes, who believed they understand economics as well as their classmates, and who thought that economics considers the ideas and issues in which they were interested were more likely to continue to study economics.[3]

To gain more insight into these relatively straightforward conclusions, we examined the student and instructor characteristics that influence four key variables in students' decisions: (1) the students' predisposition to becoming an economics major, (2) their relative grades, (3) their confidence, and (4) their perception of relevance. Although there are many relevant factors that an introductory economics teacher cannot influence directly (e.g., the student's high school math preparation or GPA), we were able to identify specific factors that teachers of economics could affect. For example, including a warm-up activity at the beginning of the semester is associated with higher relative grades, particularly for women.[4] Grades in economics relative to other classes decreased slightly for women as the percentage of the final grade determined by exam scores increased, but this effect was not present for men. Devoting more class time to group problem solving increased an individual student's perception of relevance, but only if the gender balance in the class did not put that student in the minority.

Overall, our results provide support for several hypotheses that have been suggested to explain the relatively low percentage of female economics majors. Specifically, we found that differences in initial interest levels in economics, in math ability, and in relative grades can partially explain the discrepancy between male and female enrollments. In addition, as mentioned above, some teaching techniques can have differential effects on male and female students. However, we found only limited support for a role model effect—female teachers are more likely to increase a female student's interest in taking another economics class,

but they are not associated with higher probabilities of women majoring in economics or lower probabilities of women becoming discouraged from taking more economics. Finally, we found no evidence that covering topics traditionally considered to be of interest to women differentially affects the decisions of male and female students. These results are discussed in more detail in the following three sections.

DATA AND SAMPLE CHARACTERISTICS

Our sample consisted of 1,776 students from 93 different sections of introductory economics taught by 67 different instructors at 34 co-ed liberal arts colleges during the spring of 1999.[5] To collect this data, we started with the top 25 liberal arts colleges as ranked in *U.S. News and World Report*.[6] We added peer institutions used by our college, Hamilton College, in assessing competitiveness of academic salaries, increasing the number to 36 colleges on our initial contact list. We received responses from 72 percent of the introductory sections offered in the spring semester at 34 colleges, and we had full participation at 19 colleges. Most of the instructors in our sample asked students to complete the surveys at the same time they completed course evaluations at the end of the term; in all cases, surveys were completed in class during the second half of the semester. This is a particularly relevant time to elicit student opinion because of its proximity to preregistration for the next semester. Instructors who did not participate in our survey were unanimous about the reason: they did not want to relinquish class time. Instructors who are more interested in the issue of female enrollments in economics were probably more likely to participate in our survey; however, because we were primarily interested in examining students' choices about studying economics beyond the first semester rather than teachers' decisions, this aspect of our sample selection technique should not affect our main results. Nevertheless, to the extent that nonparticipation of instructors produced a nonrepresentative sample of students, our results may be affected by sampling bias.[7]

We focused on co-ed liberal arts colleges for a number of reasons. First, this strategy gave us the opportunity to study students in relatively homogeneous environments, allowing us to focus on the impact of events that were actually occurring within the classroom. Second, we chose not to include women's colleges in our survey because of the possibility that the environments and students at these colleges might be substantially different, in which case including them would invalidate our econometric methods.[8] Third, based on findings in Becker and Watts (1996), we believed that liberal arts colleges might be the most fertile ground for finding economics professors who used a variety of teaching techniques. Finally, the colleges in our sample are an important source of economics graduate students; these colleges send a disproportionate share of their students on to graduate school.[9]

Even though students at liberal arts colleges may have an academic experience different from undergraduates at larger research universities, the gender differences in economics majors are comparable: Data collected by the Committee on the Status of Women in the Economics Profession (CSWEP) on undergraduate

economics majors at liberal arts colleges puts the percentage of female majors at approximately 36 percent for 1998–99, which is comparable to the percentage of female majors at all colleges and universities. Thus, our findings from this sample may be relevant to a larger population.

Descriptive Statistics

Our approach was two pronged: Students completed a short questionnaire about their characteristics and attitudes, while instructors completed a questionnaire giving detailed information about how they taught the class. Summary statistics for the variables used in our analysis are provided in Tables 1 and 2.[10] The typical class in our sample was taught by a male instructor and had 35 students, about half of whom were women. The most frequently used teaching technique was lecturing, followed by class discussion, then group problem solving. Although there was considerable variation, on average, instructors did not strongly agree that they made a special effort to include topics of interest to female students (*FINTEREST*), and only 22 percent of the students had instructors who covered at least three topics traditionally considered to be gender-related in class (*FEMTOPIC*).[11]

We used the data collected on the student questionnaires to construct a variable that captured some unobserved qualities of the teacher. Specifically, we asked students to rate the importance of the professor's reputation in their decision to take the class on a scale of 1 to 5 (1 being the lowest and 5 the highest). We then averaged the responses of all students in the class for each professor. The resulting variable, *AVGREP*, was a rough measure of teacher popularity as communicated through the student grapevine. The mean of *AVGREP* was 2.5, indicating that, on average, students did not consider the professor's reputation to be an important factor when signing up for the class; some instructors, however, had much higher ratings, with a maximum of 4.2.[12]

The characteristics of the students in our sample are summarized in Table 2. We used three measures of math ability in our estimations: the student's math SAT score relative to the class average (*RELSATM*), the ratio of the student's math SAT to verbal SAT (*SATMV*), and the response to a question eliciting student discomfort with graphs.[13] Math SAT scores were almost 2 percent higher than verbal SAT scores for the average student in the class, perhaps indicating a small comparative advantage in quantitative skills for students enrolled in introductory economics.

Slightly more than half of the students in our sample intended to take more economics courses (*CONTINUE* = 1), and 10 percent told us that economics was their intended major (*ECONMAJ* = 1). In addition, 58 percent of the undecided majors indicated a strong interest in majoring in economics (*POSMAJOR* = 4 or 5) when they signed up for the class. However, 21 percent of the students who indicated at least some interest in taking another economics course when they signed up for their first class became discouraged during the semester, and they did not intend to take more economics (*DISCOURAGED* = 1). On the other hand, 42 percent of the students who had little initial interest in another economics class became

TABLE 1
Instructor/Class Characteristics

Variable	Mean	*SD*	Min.	Max.	Definition
ACTIVITY	0.087	0.282	0	1	1 if econ dept. has extracurricular activity for females
ANALYT[1]	4.526	0.748	2	5	Instructor's opinion–importance of learning to think analytically in intro econ
AVGREP[1]	2.471	0.645	1.385	4.244	Average professor's reputation
BUSINESS	0.123	0.328	0	1	1 if college has business major
CALCULUS	0.438	0.496	0	1	1 if major requires calculus
CEDISCUSS[1]	4.178	0.982	1	5	Instructor's opinion–importance of current events discussion
CLASSIZE	34.911	17.518	5	93	Class size
COLLAB	10.655	12.293	0	60	% of grade for which collaborative work accepted
COMBINED	0.471	0.499	0	1	1 if course covers both micro and macro topics
COMPLAB	1.077	4.893	0	40	Computer labs–% of grade
CURVE	0.683	0.465	0	1	1 if grade on curve
DISC	13.499	11.524	0	60	% of class time spent in discussion
ECONBUS	0.141	0.348	0	1	1 if econ major can count 3 or more "business" courses toward major
ESSAY	21.609	24.126	0	100	Essay–% of exams
EXAM	71.974	13.385	30	100	Exams–% of grade
FEMTOPIC	0.218	0.413	0	1	1 if cover 3 or more gender-related topics
FINTEREST[1]	2.780	1.141	1	5	Instructor's opinion–makes special effort to include topics of interest to women
GAMEXPT	3.173	5.831	0	30	% of class time spent on games or experiments
GRPPROB	4.496	7.042	0	30	% of class time spent in group problem solving
IGENDER	0.711	0.453	0	1	1 if instructor male
LECTURE	65.056	21.573	15	95	% of class time spent lecturing
MACRO	0.211	0.408	0	1	1 if intro macro
MC	16.323	19.521	0	60	Multiple-choice questions–% of exams
MICRO	0.274	0.446	0	1	1 if intro micro
PART	2.890	4.413	0	15	Participation–% of grade
PERCFEM	0.484	0.121	0.143	0.830	% females in section
PFEMFAC	0.231	0.120	0	0.75	% female econ faculty
PRES	1.146	3.946	0	30	Presentations–% of grade
PS	8.256	8.018	0	30	Problem sets–% of grade
QUIZ	6.342	9.209	0	45	Quizzes–% of grade
SHORTA	60.341	28.641	0	100	Short answer–% of exams
TCHEXP	13.755	10.733	1	40	Years teaching experience
WARMUP	0.348	0.476	0	1	1 if do warmup
WRITING	8.104	9.783	0	40	Writing assgn–% of grade

Notes: Total number of observations is 1,776 (excludes seniors and those not taking first college-level economics course). Note that characteristics of smaller classes receive less weight in the calculation of instructor and class characteristics because averages are weighted by number of student respondents.
[1]Variable is measured on a scale of 1 to 5, 1 being the lowest and 5 the highest.

TABLE 2
Student Characteristics

Variable	Mean	*SD*	Min.	Max.	Female mean—male mean	Definition
ADVICE[1]	2.816	1.322	1	5	0.158*	Reason for taking class—advice of family or friends
CAREER[1]	3.540	1.257	1	5	–0.069	Reason for taking class—importance to career
CONFIDENCE[1]	3.683	1.010	1	5	–0.314*	Student attitude—I understand the material as well as most of the other people in the class
CONTINUE	0.515	0.500	0	1	–0.137*	Intend to take another economics class
CUREVENT[1]	3.374	1.161	1	5	0.109*	Reason for taking class, interest in current events
DISCOURAGED	0.205	0.404	0	1	0.114*	Decreased interest in taking another economics class (excludes students with negative prior)
DOJOB[1]	3.392	1.080	1	5	–0.041	Student opinion—economics helps do job
ECONMAJ	0.103	0.303	0	1	–0.051*	Major or intended major is econ
ENCOURAGED	0.423	0.494	0	1	–0.056**	Increased interest in taking another economics class (excludes students with positive prior)
EXPECT	86.677	5.935	55	98	–0.730*	Expected grade (on 100 point scale)
EXPRESS[1]	4.012	0.939	1	5	–0.007	Student attitude—likes classes in which can express ideas and opinions

FINANCE[1]	3.646	1.116	1	5	–0.255*	Reason for taking class—interest in finance
FIRSTYEAR	0.656	0.475	0	1	–0.016	1 if student a first year
FREEZEUP[1]	2.805	1.299	1	5	0.391*	Student attitude—often afraid will freeze–up on exams
GETJOB[1]	3.030	1.122	1	5	–0.172*	Student opinion—economics helps get job
GPA	87.074	4.368	68	98	0.897*	GPA
GRADSCHOOL[1]	2.950	1.068	1	5	–0.478	Student opinion—economics helps get into grad school
GRAPHS	2.332	0.802	1	4	0.200*	Discomfort with graphs
JUNIOR	0.090	0.287	0	1	–0.002	1 if student a junior
MALE	0.483	0.500	0	1	–1*	1 if student male
POSMAJOR[1]	2.580	1.534	1	5	–0.341*	Reason for taking class—considering econ as major
PUBPOL[1]	3.270	1.153	1	5	–0.102**	Reason for taking class—interest in public policy
RELEVANT[1]	3.476	1.011	1	5	–0.126*	Student attitude—economics helps understand issues in which I am interested
RELEXPECT	0.998	0.064	0.645	1.174	–0.008*	Expected grade/average expected grade for class
RELGRADE	0.996	0.062	0.671	1.237	–0.018*	Expected grade/GPA
RELSATM	0.999	0.098	0.591	1.270	–0.024*	Math SAT/class average math SAT
REQD[1]	2.723	1.582	1	5	–0.131	Reason for taking class—required
SATMV	1.016	0.131	0.513	2	–0.037*	Math SAT/verbal SAT
SOPHOMORE	0.254	0.435	0	1	0.018	1 if student a sophomore

Notes: *Difference significant at the .05 level;**difference significant at the .10 level.
[1]Variable measured on a scale of 1 to 5. Total number of observations is 1,776 (excludes seniors and those not taking first college-level economics course).

encouraged during the semester. These students did not initially intend to take more economics but later changed their minds (*ENCOURAGED* = 1).[14]

Our four measures of interest in economics varied considerably by section, suggesting that events in the classroom were affecting student decisions. For example, the percentage of students who declared an interest in majoring in economics when surveyed toward the end of their first economics class varied from a low of 0 in one section to a high of 67 percent in another. The percentage of discouraged students in a section ranged from 0 to 50 percent, and the percentage of encouraged students had an even wider range—from 0 to 100 percent.

The fifth column of Table 2 reports the difference in the mean response for female and male students. These results show that male and female students enter their first economics class with some different interests. For example, women were less likely to indicate that an interest in finance (*FINANCE*), an interest in public policy (*PUBPOL*), or the possibility of majoring in economics (*POSMAJOR*) was important in deciding to take economics. On the other hand, the average male and female student believed that taking economics was equally important to their career (*CAREER*). Women entered economics with lower relative levels of math ability and lower overall self-confidence, as measured by their rating of their fear of freezing up on exams (*FREEZEUP*). Overall, male students were more likely to continue in economics, to become encouraged during the first semester of economics, and to major in economics. Men were also less likely to become discouraged. In the next section, we explore the determinants of these four measures of student interest in economics.

ESTIMATION RESULTS

Determinants of Further Interest in Economics

We were interested in knowing what factors influenced the probability of a student falling into each of four groups after one semester of economics: (1) students who reported they intended to major in economics (*ECONMAJ* = 1), (2) students who intended to take more economics classes (*CONTINUE* = 1), (3) discouraged students (*DISCOURAGED* = 1), and (4) encouraged students (*ENCOURAGED* = 1). We estimated four different binary probit models, using student and instructor characteristics as the explanatory variables.[15] The *ENCOURAGED* and *DISCOURAGED* estimations gave us the "cleanest" look at students who had been influenced by something that happened during the semester, whereas the *ECONMAJ* and *CONTINUE* results were more comparable to those of other studies.

Existing hypotheses from the literature on the underrepresetation of women in economics guided our choice of specification.[16] The five hypotheses being tested and the variables included in our estimations to test each hypothesis are summarized in Table 3. The first two hypotheses postulate that a student's characteristics are important factors in the decision to continue in economics, focusing on a student's interests and career aspirations and on math ability and performance

TABLE 3
Probit Specification

Hypothesis	Variable included to test hypothesis
1. Women have different interests and career aspirations.	*POSMAJOR, RELEVANT, CAREER*
2. Women have lower math ability or performance in economics classes.	*GRAPHS, EXPECT, RELGRADE*
3. Women role models are important to female students.	*IGENDER*[a], *PFEMFAC*[a]
4. Economics topics/methodology are not of interest to women.	*FEMTOPIC*[a]
5. Teaching techniques and classroom environment in economics classes are not compatible with female learning styles.	*CONFIDENCE, CLASSIZE*[a], *LECTURE*[a], *DISC*[a], *GRPPROB*[a], *GRPPROB*PERCFEM*[a], *EXAM*[a], *PERCFEM*[a]

[a]Variables are also interacted with student gender.
Note: Additional control variables relevant to decision to study economics: *ADVICE, REQD, MACRO, COMBINED, BUSINESS, TCHEXP, TCHEXP*^{2}, *AVGREP.*

in economics classes. The third hypothesis suggests that a lack of female role models discourages female students from continuing in economics. The final two hypotheses state that decisions made by the instructor about topics that are discussed, pedagogy, and forms of evaluation and characteristics of the class, such as class size and percentage that is female, affect students' decisions about continuing to study economics.[17] Variables that were hypothesized to have differential effects on male and female students were interacted with student gender (Table 3).[17] Additional variables relevant to the students' decisions to study economics were included as control variables.

In Table 4, we report a subset of the probit coefficients from the estimations.[19] Of the five hypotheses laid out in Table 3, we found some evidence for four of them. The significance of *CAREER*, *RELEVANT*, and *POSMAJOR* provides evidence for the first hypothesis—that different career aspirations and interests can explain some of the difference between male and female interest in pursuing further study in economics. As shown in Table 2, the difference in means between male and female students was statistically significant for all of these variables except for *CAREER*, suggesting an indirect way in which student gender affects the decision to continue studying or to major in economics. The importance of a student's relative grade in estimating these probabilities indicated that performance in class matters—female students may be choosing not to study economics because their comparative advantage lies in studying other subjects. The evidence for a role-model effect was weaker—only when looking at the probability of being encouraged did we find that instructor gender had a differential effect on male and female students. Finally, a student's confidence, something that may be affected by teaching techniques and classroom environment, was important, providing some support for the fifth hypothesis in Table 3.[20] However, these results do not provide support for the idea that covering topics traditionally thought to be of interest to women has any effect on student decisions.

The effects on probabilities of many of the variables that were statistically sig-

TABLE 4
Selected Probit Results

Independent variable	DISCOURAGED	ENCOURAGED	*ECONMAJ*	*CONTINUE*
MALE	−1.66	−2.90*	−.056	−.939
	(1.44)	(2.46)	(0.03)	(1.09)
IGENDER	.064	−.472*	−.332	−.366*
	(0.30)	(2.21)	(0.82)	(2.23)
*IGENDER*MALE*	.246	.524**	.106	.108
	(0.88)	(1.83)	(0.22)	(0.50)
GRAPHS	.009	−.023	−.142	.008
	(0.13)	(0.30)	(1.39)	(0.14)
RELGRADE	−4.57*	3.43*	3.42*	1.42
	(3.62)	(2.74)	(2.03)	(1.55)
CONFIDENCE	−.367*	.194*	.200*	.187*
	(5.68)	(2.72)	(1.97)	(3.66)
RELEVANT	−.369*	.273*	.217*	.233*
	(6.51)	(4.65)	(2.57)	(5.34)
ADVICE	.107*	−.087*	−.116*	−.141*
	(2.70)	(2.16)	(1.98)	(4.72)
POSMAJOR	.025	.261*	1.13*	.305*
	(0.65)	(6.36)	(9.92)	(10.61)
REQD	−.147*	.011	.111*	.067*
	(3.85)	(0.32)	(2.14)	(2.54)
CAREER	−.160*	.196*	.241*	.268*
	(3.33)	(4.32)	(2.87)	(7.56)
PERCFEM	−.854	−1.15	.254	−.978**
	(1.09)	(1.58)	(.218)	(1.63)
*PERCFEM*MALE*	.296	.669	1.62	.807
	(0.26)	(0.60)	(1.05)	(0.97)
AVGREP	−.128	.171**	.119	.035
	(1.22)	(1.81)	(0.83)	(0.47)
LECTURE	.002	−.015*	−.005	−.009*
	(0.46)	(2.884)	(0.58)	(2.14)
*LECTURE*MALE*	.003	.025*	−.017	.011*
	(0.33)	(3.22)	(1.58)	(1.95)
FEMTOPIC	−.022	−.212	.329	.110
	(.012)	(1.15)	(1.10)	(0.75)
*FEMTOPIC*MALE*	.121	.373	−0.50	−.048
	(.046)	(1.31)	(1.32)	(0.24)
Observations	1,100	819	1,318	1,458

*Significant at the .05 level; **significant at the .10 level. Absolute value of z statistics are in parentheses. See Table 3 for a list of variables included. Variables not reported were not consistently significant at the .10 level across all four estimations. The *ECONMAJ* probit excludes juniors and seniors. All other estimations exclude only seniors.

nificant were notable, but moderate, with the largest effect on probabilities being that of instructor gender on the probability of being encouraged. Holding all other variables constant at their means, the probability that a female student becomes encouraged was 18 percentage points lower if the instructor was male rather than female. The next most important variable in explaining students' decisions was *POSMAJOR*.[21] Increasing *POSMAJOR* from its mean of 2.58 by one standard deviation (1.53), while holding all other variables constant at their means, increased the probability of continuing in economics by 17.5 percentage points and the probability of becoming encouraged by 15.3 percentage points.[22]

Supplementary Estimations

Although Table 4 allows some interesting conclusions, what we did not find is equally interesting. We found no evidence that instructors who spend more time on topics traditionally considered to be of interest to female students elicited greater enthusiasm for economics among the women in their classes. Also, the results in Table 4 do not support a direct link between math ability and student interest in economics.[23] Finally, many variables included to measure teaching methods or classroom environment did not enter our estimations in a consistent and statistically significant way.[24] Concluding that these teaching techniques or environmental factors do not influence students' decisions would, however, be premature; the coefficients on these variables are reported (Table 4), holding all other factors constant. Teaching techniques and classroom environment may have an indirect effect on students' decisions through their influence on the other factors in our estimation. We examined this possibility with the estimations reported in Table 5. Here, again using instructor, class, and student characteristics, we attempted to predict four key variables: (1) students' confidence, (2) their perception of relevance, (3) their relative grade, and (4) their predisposition to becoming an economics major.[25]

The results in Table 5 provide some evidence for three of the five hypotheses outlined in Table 3. Broadly speaking, these estimations revealed that interests and career aspirations, math ability or overall performance in economics classes, and teaching techniques or general classroom environment may influence female students' decisions to continue in economics. These results do not support the hypotheses that either female instructors or the inclusion of topics traditionally considered to be of interest to women are particularly important in influencing the confidence, the perception of relevance, or the relative grade of female students.[26] Also, most of the effects of individual variables were modest, suggesting that a wide range of experiences and characteristics may in fact affect individual students. A final general comment about the findings in Table 5 is that, although each of our four dependent variables was correlated with being male, adding additional control variables accounted for the differences between women and men. There was no unexplained component of these four student characteristics that is associated with student gender. We now briefly discuss each of the four estimations in turn.

Confidence. The first estimation in Table 5 reports results from our equation predicting student confidence.[27] These results provided support for the idea that math ability influences student confidence, with a one standard deviation increase in *RELSATM* producing an increase in *CONFIDENCE* of .164.[28] Teaching techniques associated with students who were more likely to give their economics abilities higher relative ratings included group problem solving when the class had more female students, grading on a curve, and discussion of topics traditionally considered to be of interest to women by female instructors. These results suggest that group activities may take on a different character when the gender composition of the class changes: a higher percentage of female students may be associated with a less-threatening or competitive environment. In

TABLE 5
Supplementary OLS Estimations, Selected Results

Ind. var.	*CONFIDENCE*	Ind. var.	*RELEVANT*	Ind. var.	*RELGRADE*	Ind. var.	*POSMAJOR*
MALE	−1.15	*MALE*	.295	*MALE*	−.011	*MALE*	−.409
	(1.09)		(0.44)		(0.52)		(1.54)
RELSATM	1.68*	*GRAPHS*	−.116*	*GRAPHS*	−.025*	*SATMV*	1.16*
	(6.36)		(3.90)		(13.40)		(4.33)
FREEZEUP	−.176*	*CAREER*	.052*	*WARMUP*	.020*	*CAREER*	.268*
	(8.80)		(2.37)		(4.19)		(5.70)
AVGREP	.142*	*CUREVENT*	.146*	*WARMUP**	−.013**	*CUREVENT*	−.161*
	(2.87)		(6.19)	*MALE*	(1.86)		(4.24)
CURVE	.159*	*FINANCE*	.091*	*EXAM*	−.0004*	*FINANCE*	.260*
	(2.25)		(3.79)	*E*	(2.60)		(6.67)
TCHEXP	.040*	*PUBPOL*	.134*	*XAM*MALE*	.0004**	*PUBPOL*	.064**
	(2.89)		(5.89)		(1.73)		(1.68)
TCHEXP2	−.001*	*TCHEXP*	.019*	*POSMAJOR*	.006*	*GPA*	−.025*
	(4.09)		(2.14)		(5.49)		(2.78)

GRPPROB	.080**	*TCHEXP2*	−.0005*	*PART*	−.0009**	*EXPRESS*	−.112*
**PERCFEM*	(1.68)	*GRPPROB*	(1.99)	*GETJOB*	(1.78)	*GETJOB*	(2.87)
GPA	.022*	**PERCFEM*	.078**		.005*	*CALCULUS*	.324*
	(2.54)	*GRPPROB*PERC*	(2.01)	*CALCULUS*	(3.72)		(5.23)
FEMTOPIC	.533*	*FEM*MALE*	−.177*		−.010*	*BUSINESS*	−.124**
	(3.31)	*GRPPROB*	(2.98)	*SOPHOMORE*	(2.93)		(1.65)
*FEMTOPIC**	−.390*		−.037**		.020*	*ECONBUS*	−.538*
IGENDER	(2.37)	*GRPPROB**	(1.92)	*JUNIOR*	(5.53)		(4.64)
		MALE	.079*		.014*	*ECONBUS**	.441*
		DISC	(2.80)		(2.53)	*MALE*	(3.00)
			.005*				−.451*
		DOJOB	(2.20)				(2.20)
			.238*				
		GRADSCHOOL	(8.76)				
			.054*				
		EXPECT	(2.08)				
			.026*				
		SOPHOMORE	(4.40)				
			.171*				
		JUNIOR	(3.37)				
			.162*				
Adjusted R^2	.19		.36		.21		.33
Observations	1,364		1,452		1,516		1,321

Notes: Variables not reported had p values > .10. *denotes significance at .05 level; **denotes significance at the .10 level. Absolute value of t statistics are in parentheses. See the text for a discussion of other variables included, but not reported above. *POSMAJOR* estimations exclude juniors and seniors. All other estimations exclude only seniors.

addition, grading on a curve may partially accomplish the task of disseminating information about relative standing in class, helping to overcome the perception that "Everybody else understands better than I do." Overall, these results support the hypothesis that math ability matters, but they do not support the other hypotheses advanced earlier to explain the underrepresentation of women in economics. Although some teaching techniques may affect students' confidence in general, we did not find a differential effect on male and female students. In fact, the estimated effect of the variable *FREEZEUP* suggested that lower overall self-confidence, rather than what was happening in the economics class in particular, was at least as important as the other variables in explaining the lower confidence of female economics students.[29]

Relevance. The second estimation in Table 5 examines the determinants of students' perception of the relevance of economics. Whereas math ability and performance in the class matter here as well, the most important determinant of relevance was the students' interests prior to entering the class, with career interests being particularly influential. A one standard deviation increase in *DOJOB* increased students' ranking of relevance by .257, and students' prior interests in finance, public policy, and current events had similar but slightly smaller impacts. These results also indicated that some teaching techniques are associated with a greater perception of relevance (e.g., more class discussion is associated with a small increase in perceived relevance) and support the finding discussed above that the dynamics of group problem solving in class change as the gender composition of the class changes. The net effect of all the coefficients involving group problem solving was that devoting class time to group problem solving was associated with women rating economics as more relevant when the percentage of women in the class was relatively high (about 47 percent or higher). For male students, the opposite was true: when the percentage of women in the class was relatively low (less than about 42 percent), more group problem solving increased male students' perception of the relevance of economics. Overall, the *RELEVANT* estimation provided evidence for three of the five hypotheses: interests and career aspirations, performance and math ability, and teaching techniques and classroom environment matter. The magnitudes of the marginal effects of these variables indicated that career aspirations and interests were the most important determinant of relevance.

Relative Grade. Estimation of the determinants of relative grade supported these same three hypotheses, although the support for the career interests and math ability hypotheses was somewhat limited.[30] This regression provided the strongest evidence for the hypotheses that teaching techniques affect students' choices to study economics and that these techniques may have differential effects on male and female students. Doing a warm-up activity at the beginning of the semester increased a student's predicted relative grade by .02, an increase equal in magnitude to that achieved by a one standard deviation increase in math ability.[31] (The average for *RELGRADE* was .996; thus, a .02 increase was a little more than 2 percentage points.) When exams had a larger weight in the determination of the course grade, women had slightly lower relative grades. The point estimates in Table 5 indicate that a one standard deviation increase in *EXAM* low-

ered a woman's relative grade by .006 but did not affect the relative grade of men.[32] The positive coefficients on *POSMAJOR* (which we show below to be related to career interests) and *GETJOB* provided some evidence that students who take economics because of career interests may also do slightly better, although the magnitude of these effects was relatively small. (A one standard deviation increase in *POSMAJOR* or *GETJOB* produced an increase in *RELGRADE* of less than .01.)[33]

Predisposition to Major in Economics. Finally, we investigated the determinants of the predisposition to major in economics, the fourth estimation reported in Table 5. Because the *POSMAJOR* variable was constructed from a student's ranking of the importance of considering economics as a possible major prior to taking the class, we focused only on student characteristics that were likely to be present when the student was registering for the class. Given that *POSMAJOR* was one of the most important explanatory variables in our initial estimations (Table 4), this estimation shed further light on the decision to continue in economics. We cannot use these results to comment on any of the hypotheses concerning experiences in the class, however. Even so, these results are interesting, providing further support for the idea that career interests are important to students' decisions.

Math ability played a consistent but modest role. A one standard deviation increase in *CAREER*, *GETJOB*, or *FINANCE* increased *POSMAJOR* by a little more than .3, whereas a one standard deviation increase in *SATMV* produced an increase of only about half that much. Consistent with the career interest hypothesis, the presence of a business major lowered *POSMAJOR* by .538, whereas the offering of business classes within the economics major (*ECONBUS*) increased it by .441.[34] Interestingly, that effect was present only for female students. With this one exception, we found no evidence that the effects of any of these variables differed depending on the sex of the student, but the differences in means between women and men for both *SATMV* and *FINANCE* were statistically significant, providing some explanation as to why men may enter an economics class with a greater disposition to major in economics.[35]

Further Discussion

In our results, what did not help to explain student behavior was almost as important as what did help.[36] Previous work has suggested that instructor gender, collaborative work experiences, the proportion of female students, and the inclusion of topics specifically of interest to women matter in the decision of women to continue in economics. We did not find strong support for these hypotheses.[37]

Although our evidence narrows the influence of instructor gender to one specific circumstance (instructors are more likely to encourage students of the same gender), this circumstance is noteworthy. Given that female students are more likely to enter introductory economics without intentions to continue, the fact that female students are more likely to be encouraged when they have a female instructor is an important finding.[38] Our work also suggests that when identifying the effects of instructor gender, it is important to control for instructor age or

experience. Because of hiring patterns in the recent past, younger instructors are much more likely to be women than are older instructors. In addition, our findings support the idea that collaborative work can help women but only under the right circumstances. In-class group problem solving increases the relevance of economics to women, but not if the class is dominated by men. Furthermore, we did not find that increasing the percentage of the grade for which collaborative work was accepted (*COLLAB*) affected females' decisions to study economics in a statistically significant way. Finally, we show that the percentage of women in the class is related to student decisions in a fairly complex way. In classes in which teaching techniques encourage more interaction among students, the percentage of female students in the class does matter. However, in less interactive classes, that externality does not exist.

CONCLUSION

Various hypotheses have been advanced to explain the fact that female undergraduates are less likely than male undergraduates to continue in economics beyond the first course and to major in economics. We used a two-step approach to investigate these hypotheses. In the first step, we examined the factors that influence the following four probabilities: continuing in economics after the introductory course, majoring in economics, becoming encouraged during the semester, and becoming discouraged during the semester. We found evidence in these estimations that women and men pursue further study in economics at different rates because of different interests and career aspirations and because women perform less well in economics relative to other courses than do men. We also found that a student's perception of whether he or she understands the material as well as other students in the class is an important factor and that female students are more likely to become encouraged if they have a female instructor.

In the second step, we examined the determinants of four factors that were important in students' decisions about pursuing further study in economics: their confidence, their perception that economics is relevant, their relative grade, and their predisposition to becoming an economics major. In these estimations we found evidence that career aspirations and interests, math ability and overall performance in economics classes, and teaching techniques and classroom environment influence the determination of these four factors, with a few of the teaching techniques having differential effects on men and women. Having a female instructor or covering topics targeted at women were not particularly important determinants of the four factors for female students, however. Finally, most of the effects of statistically significant variables were modest, and one conclusion that emerged from our work was that students are individuals who are influenced by a wide range of experiences and characteristics. In the end, we concluded that economics instructors do make pedagogical decisions that help to shape part of these experiences, and these decisions can have a moderate impact on student choices.

NOTES

1. For example, Becker and Watts (1996) found that over 50 percent of economics instructors use multiple-choice exams at least half the time. Earlier, Lumsden and Scott (1986) found that female economics students perform worse than male economics students on multiple-choice exams but better than men on essay exams. Becker and Johnston (1999) also found that essay and multiple-choice exams measure different dimensions of student understanding of economics, with women performing better than men on essay exams. In addition, Bartlett (1996) argued strongly for alternative pedagogy that appeals to women, and Jensen and Owen (2000) provided preliminary evidence that some teaching techniques have differential effects on men and women taking their first economics class.
2. As will become clear when we describe our data, we observed students' *intentions* to take more economics at the end of the first semester. Surveys were filled out during or after preregistration for the following semester so, in most cases, intentions were reasonably good measures of actual choices.
3. See Becker (1997) for a discussion of the effect of relative grades in economics on students' persistence in the discipline.
4. Warm-up activities are exercises intended to help students get to know each other in the first few days of the semester and to get them accustomed to participating in class. For example, a class might play a short game that requires students to learn each other's name or to interact in smaller groups. Other examples include having students find something that they have in common with other another student in the class or having students tell the class something they have learned about another student.
5. We collected data from over 2,200 students but dropped seniors and students who were not taking college-level economics for the first time from our sample. However, we kept students in the sample who said that fulfilling a requirement was a consideration in taking economics. The liberal arts environment provides a wide choice to most students in fulfilling requirements and a good deal of flexibility in changing courses of study during the first few years. Therefore, it is legitimate to analyze the choices of these students alongside those who did not think fulfilling a requirement was important in their decision to take a first economics course.
6. The colleges in our sample were: Albion, Amherst, Bates, Bowdoin, Calvin, Carleton College, Claremont, Colby, Colgate, Colorado College, Connecticut College, Davidson, Denison, Grinnell, Hamilton, Hartwick, Hobart & William Smith, Kenyon, Macalaster, Middlebury, Oberlin, Pomona, Reed, Skidmore, St. Lawrence, St. Olaf, Swarthmore, Trinity, Union, Ursinus, Vassar, Wesleyan, William & Mary, and Williams.
7. For example, if instructors who did not participate had characteristics that attracted students of a certain type, our sample of students may not be representative. One might expect that female instructors would be more interested in this topic and more likely to participate; however, the percentage of male instructors responding to our survey, 71 percent, corresponds well to CSWEP data on the number of male instructors at liberal arts colleges in 1999, 73 percent (Bartlett 2000). In addition, our response rate, 72 percent, was very high for this type of survey. (The Becker and Watts' 1996 study was based on a response rate of 20.5 percent.)
8. Adding women's colleges to the sample and examining the differences between students and instructors at women's colleges versus the students and instructors at co-ed colleges could lead to some interesting insights into why women's colleges are successful in recruiting female economics majors. This area remains fruitful for further research.
9. Kasper et al. (1991) show that during 1980 and 1988, top-tier liberal arts colleges contributed 9 percent of the students who received economics Ph.D.s.
10. The questionnaires and a codebook are available at http://academics.hamilton.edu/economics/aowen. The data used in this analysis as well as some additional data not used here are also available at this site.
11. These topics were suggested by Bartlett (1994), Feiner (1993), and Lage and Treglia (1996). They included labor market discrimination, labor supply decisions of women with children, occupational segregation, comparable worth, affirmative action, comparative advantage applied to the family, housework and the measurement of GDP, increased labor force participation of women, unemployment rates broken down by gender, and the inflation/unemployment tradeoff by demographic group.
12. *AVGREP* and expected grade in the class had a small negative and statistically insignificant correlation, indicating that our measure of teacher quality—reputation—was not based solely on easy grading standards. Ideally, we would have liked to assess more directly the quality of teaching by asking students to rate the teacher's overall effectiveness. However, we chose not to ask

students to evaluate teachers directly because this type of question might reduce the response rate. Unlike mandatory end-of-semester evaluations that routinely ask questions like these, participation in our survey was completely voluntary; adding questions that might be considered sensitive by some instructors would likely reduce participation and exacerbate sampling bias.

13. GRAPHS was the response to: "Please check the statement below that best matches your understanding when your instructor uses graphs in this class: (1) They make sense to me 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." This question was adapted from the survey conducted by Dynan and Rouse (1997).

    About 10 percent of the students in our sample either did not take the SATs or could not remember their scores. These responses were coded as missing data and dropped from the analysis when SAT scores were used as independent variables.
14. Students who were not sure if they would take another economics class when they signed up for the first one were classified as discouraged if, at the time we surveyed them, they indicated they would not take more economics. If they indicated they would now take more economics, we considered them encouraged.
15. Students who did not intend to take more economics when they signed up for the course were not included in the discouraged estimation, and students who intended to take more economics initially were not considered in the encouraged estimation.
16. The studies cited in the first paragraph provide a good introduction to this literature.
17. Hypothesis 4 is closely related to hypothesis 1. However, we chose to list it separately to identify a specific reason why women may have different interests—some have suggested that economics is not of interest to women because, as traditionally taught, it does not adequately deal with the problems and issues faced specifically by women.
18. For example, one hypothesis states that teaching techniques affect men and women differently. Therefore, we allowed the effect of these specific techniques (e.g., *LECTURE*, *DISC*, or *EXAM*) to vary with student gender. Another hypothesis states that women have less interest in economics because they have lower math ability. In this case, because a given level of math ability is not hypothesized to have differential effects, we did not interact *GRAPHS* with student gender.
19. Many of our independent variables are student or instructor opinions reported on a scale of 1 to 5. By not entering these variables as a set of dummy variables, we essentially imposed restrictions on the relationship between the coefficients on the dummy variables. *F* tests do not reject these restrictions at the 10 percent significance level with two exceptions: (1) we rejected these restrictions for *CAREER* in all four estimations in Table 4, and (2) we rejected these restrictions for *POSMAJOR* in the *ECONMAJ* probit. However, none of our qualitiative conclusions were changed when we relaxed the restrictions; therefore, we report only the results from the restricted model. None of the restrictions were rejected for the estimations presented in Table 5.
20. Table 3 also indicates that women are less likely to be encouraged or to continue studying economics when a larger percentage of class time is devoted to lecture, whereas the opposite is true for men. However, as we discuss later, after correcting for the endogeneity present in these estimations, this variable lost statistical significance.
21. In the *ECONMAJ* probit, the effect of the predisposition to major in economics was particularly strong. In fact, very few students who did not rate "considering economics as a possible major" as a 5 in importance in the reasons for taking introductory economics were prepared to declare economics as their major after the first class. When we estimated the *ECONMAJ* probit only on those students for whom *POSMAJOR* equaled 5 (i.e., those students for whom the possibility of majoring in economics was a very important reason for taking the first economics class), the coefficients reported in Table 4 did not change materially with two exceptions: (1) *RELGRADE* lost its statistical significance but was similar in magnitude and sign, and (2) *FEMTOPIC*MALE* had a statistically significant negative coefficient (i.e., spending 30 or more minutes on topics traditionally considered to be of interest to females made it less likely that males who were strongly considering majoring in economics declared economics as their major).
22. Similar calculations revealed that an increase of one standard deviation in *RELEVANT* increased the probability of continuing by 9.2 percentage points and the probability of being encouraged by 16 percentage points; a one standard deviation increase in *RELGRADE* increased the probability of becoming encouraged by 7.9 percentage points; and a one standard deviation increase in *CONFIDENCE* increased the probability of continuing or becoming encouraged by about 7.5 percentage points.
23. Neither the effect of covering topics of interest to women nor math ability became statistically significant in these estimations when we measured them with alternative means (*FINTEREST*, *RELSATM*, *SATMV*).

24. Teacher popularity as measured by *AVGREP* was associated with a higher probability of encouraged students, giving us a suggestion that "better" teachers can ignite a student's interest in economics even though we did not find significant effects of various teaching techniques. Our failure to find significant effects of teaching techniques may be related to the fact that, although we included between 800 and 1,500 students in each estimation, we had only 67 different instructors in our sample.
25. Results reported in Table 5 were generated using ordinary least squares (OLS). Because *CONFIDENCE*, *RELEVANT*, and a *POSMAJOR* were all responses to a student ranking of importance on a scale of 1 to 5, we also estimated these three equations using an ordered probit model and obtained qualitatively similar results.

    In Table 5, we report only a subset of the coefficients in each estimation. The final specification was also selected based on our desire to test the 5 hypotheses listed in Table 3. Coefficients not reported in Table 5 were not statistically significant. The *CONFIDENCE* regression also included: *IGENDER*[a], *WARMUP*[a], *FEMTOPIC*[a], *PART*[a], *CLASS*, *GRPPROB*PERCFEM*[a], *GRPPROB*[a], and *PERCFEM*[a]. The *RELEVANT* regression also included: *IGENDER*[a], *COMBINED*, *MACRO*, *FEMTOPIC*[a], *GETJOB*, *PERCFEM*[a], *GPA*, and *EXPECT*[a]. The *RELGRADE* equation also included: *IGENDER*[a], *LECTURE*[a], *GRPPROB*, *PART*[a], *PERCFEM*[a], *FEMTOPIC*[a], *TCHEXP*, and *TCHEXP2*. The *POSMAJOR* equation also included: *ACTIVITY*[a], *CAREER*[a], *GETJOB*[a], and *DOJOB*[a]. (Superscript a denotes variable also interacted with *MALE*.)
26. We did not find a statistically significant effect of instructor gender on student confidence for either men or women in the results reported in Table 5. However, when we did not control for teaching experience, instructor gender became negatively and significantly related to confidence, suggesting that instructor gender effects picked up in previous studies may partly result from instructor age.
27. Our confidence variable was constructed from a question that asked students if they understood the material in the class as well as most of the other students. An alternative method of measuring student confidence would be to ask students directly how confident they are in their absolute ability to understand or use economics, irrespective of their classmates' abilities. Because we asked students if their understanding *was as good as* most of the others in the class, our question only identifies students with low confidence, not students with high confidence. (We could identify very confident students by asking if they understood the material *better* than most of the other students.) To the extent that we found that a particular variable improved the confidence of both sexes, the correct interpretation was not that all students in the class thought they were better than the average, but that these techniques were less likely to generate many students who thought they were worse than average. Although everybody in the class cannot be doing worse than the average in reality, many students in a class can perceive themselves to be below average. In fact, the section average for this variable varied from a minimum of 2.8 to a high of 4.46, suggesting that some classes were dominated by low-confidence students whereas others were not.
28. In this regression, we chose to measure math ability with the SAT score of the student relative to everybody else in the class because the confidence of students was expressed in terms of their ability to understand in relation to everybody else in the class. Similarly, in the *POSMAJOR* regression, we used *SATMV* (math SAT/verbal SAT) because that most closely resembled the information students had about their math ability at the time they signed up for the class.
29. A one standard deviation increase in *FREEZEUP* lowered *CONFIDENCE* by 0.238. To the extent that the introductory economics class was part of a college experience that gave female students lower overall confidence, activities in the economics classroom may be a contributing factor, but our results did not support the idea that it is economics in particular that generates lower confidence.
30. Because the survey was conducted before the end of the semester, *RELGRADE* relied on student expectations of the course grade. It is possible that students of a particular sex would systematically over or underestimate final grades. However, most of the surveys were done close to the end of the semester when students would have a good deal of information about their grade in the class. Furthermore, the raw correlations between *RELGRADE* and *MALE* were consistent with the observations made in Dynan and Rouse (1997). Overall, our data indicated that economics instructors give grades consistent with instructors in other disciplines—the average of the average relative grade earned by students of each instructor was 1.00.
31. About one-third of the instructors in our sample did a warm-up activity. It is possible that instructors who do warm-up activities share an unobserved characteristic that contributes to higher relative grades, and, therefore, it is not the warm-up activity *per se* that causes better

grades. However, the fact that several instructors in our sample adopted this practice makes this possibility less likely.

32. When we added the type of exams given to this specification (i.e., multiple choice, short answer, essay), the coefficients on these variables were not statistically significant.
33. One might think that a student's perception of relevance would affect relative grade: students who find the material relevant might do better in class. However, when we estimated the relative grade equation and included the measure of relevance (*RELEVANT*) using two-stage least squares, we found that *RELEVANT* did not enter significantly into the equation predicting relative grade. Because this estimation examined only the relative grade and not the absolute grade, this did not necessarily invalidate the idea that students who find the material relevant have higher grades. In fact, our estimation of the *RELEVANT* equation suggests a positive correlation between expected grade and *RELEVANT*.
34. *ECONBUS* = 1 if a college allows three or more business classes to count as part of the economics major (e.g., accounting, marketing, organizational behavior, etc.).
35. We have estimated our probits in Table 4 and our supplementary regressions in Table 5 as if there were no simultaneity. However, *POSMAJOR* is the only variable that we can argue, on theoretical grounds, is predetermined. We tested for exogeneity in a simultaneous probit model using a test developed by Rivers and Vuong (1988) and found that we did not reject exogeneity of *CONFIDENCE*, *RELEVANT*, and *RELGRADE* in each of our four probit equations at the .05 significance level, except in two cases. We rejected exogeneity of *RELEVANT* in the *ENCOURAGED* and *CONTINUE* probits. However, when we re-estimated these probits using the two-step method of Rivers and Vuong (1988), none of our major conclusions was affected. (Except, as noted above, *LECTURE* and its interaction with student gender lost significance after allowing for endogeneity in the two probits.)
36. Of course, our results examined the decision to study economics beyond one semester, conditional on the student having shown up in an introductory class. We could not directly address an equally interesting question—the decision by many female students not to enroll in economics. As we noted earlier, however, the percentage of students who were women in the 93 sections of introductory economics in our sample varied considerably, from a low of 14 percent to a high of 83 percent. We attempted to predict the percentage of female students in a class using those college, departmental, or instructor characteristics that would be likely to be known by the students during preregistration. Unfortunately, our efforts to predict the percentage of female students in a class were remarkably unsuccessful, and we do not report detailed results here.
37. Our inability to find this evidence did not conclusively show that these factors are unimportant. One possible reason why we did not find a robust correlation between discussion of female-related topics and female students' interest in economics was that our measure of this aspect of classroom dynamics was simply too crude. We used a dummy variable that indicated that more than 30 minutes of class time was spent on these topics. Although we experimented with different cutoffs, it is possible that the one we chose may have been too high or too low. We also experimented with the instructor's attitude toward making a special effort to include these topics (*FINTEREST*) but were not able to generate statistically significant results with this variable.
38. In a related article, Canes and Rosen (1995) found no evidence that an increase in the share of women on a department's faculty led to an increase in its share of female majors.

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