GENDER AND PROMOTION IN THE ECONOMICS PROFESSION

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The authors use unique panel data on American Economic Association members to test for gender differences in promotion in a profession with a well-defined promotion and job hierarchy and in which men and women exhibit similar labor-market attachment. The results suggest that over the period from the 1960s through the early 1980s, female economists had lower levels of professional attainment and career advancement than did their male colleagues with similar attributes. These gender differences remain in evidence despite controls for unobserved heterogeneity and self-selection between academic and non-academic jobs. There is evidence, however, that promotion prospects for female economists significantly improved during the 1980s, not only at all ranks, but also within both Ph.D.-granting institutions and non-Ph.D.-granting institutions. In fact, the results reveal no unexplained gender-specific differences in promotion by the end of the 1980s.

A growing body of evidence indicates that women are less likely than men to be promoted in a wide range of professions, including business management (Cannings 1988), law (Spurr and Sueyoshi 1994), and school administration (Joy 1998). Although these results are consistent with gender discrimination in promotion, Lazear and Rosen (1990) demonstrated that gender differences in attitudes toward non–labor-market activities can lead men and women to sort into jobs with unequal promotion opportunities. Occupation-specific studies generally include limited controls for employee and employer heterogeneity, but recent empirical work comparing men and women across different occupations has found that gender differences in job and worker attributes affect promotion. For example, Groot and van den Brink (1996) found that significant promotion differences by gender present in the British Household Panel Survey for 1991–92 disappear after controls for job type are added. Winter-Ebmer and Zweimuller

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A data appendix with additional results, and copies of the computer programs used to generate the results presented in the paper, are available from Larry D. Singell at the Department of Economics, University of Oregon, Eugene, OR 97403-1285.

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(1997) found that controls for fertility and home time reduced, but did not eliminate, gender differences in the probability of promotion in 1990 Austrian Census data. Thus, prior occupation-specific studies that do not fully control for employee and employer heterogeneity may overstate possible gender differences in promotion.

This study builds on prior occupation-specific studies using a unique panel of American Economic Association (AEA) members to examine whether detailed controls for observed and unobserved productivity can account for possible gender differences in the promotion of Ph.D. economists. The labor market for academic economists is a rich context for studying gender differences in promotion. Whereas male and female Ph.D. economists likely exhibit relatively homogeneous labor-market attachment in comparison to the general population (Kahn 1995), the annual reports of the Committee on the Status of Women in the Economics Profession (CSWEP) over the past 25 years provide descriptive evidence that female economists have not progressed up the academic ranks as rapidly as might be expected based on a "standard" promotion profile (Blank 1996). This view is formally supported by Kahn (1993) and Broder (1993), who used National Science Foundation data for Ph.D. economists to, respectively, show that women took over 2 years longer than men to receive tenure and had a lower predicted academic rank than comparable male colleagues. Recent work has also found significant gender differences in the probability of choosing an academic job, the quality of job placement, and productivity (McMillen and Singell 1994; Kolpin and Singell 1996). Our paper examines whether gender differences in promotion are present for AEA economists after we include detailed controls for employer and employee heterogeneity and model the process of selection into academia.

Academic labor markets offer a unique opportunity to study possible gender differences in promotion, because departments can be ranked within the profession and because professors can be ranked within a department by a well-defined promotion hierarchy. Prior studies that have examined gender differences in promotion have not generally had a clear job ranking and have used strictly ordered proxies for job advancement, including access to vocational training (Duncan and Hoffman 1979), occupational indices (Leonard 1984), and skill intensities of jobs (Gronau 1988). The reliance on job-advancement indices, along with cross-sectional data, has made it difficult to distinguish between initial job assignment (that is, an initial placement in a good job) and job promotion (that is, a movement up the job ladder from an initial low-rung job). Such measurement error could confound aging versus cohort effects and may overstate the portion of the promotion differential that is unexplained. Our data, however, permit a precise identification of whether a promotion has occurred and provide controls for the quality of the promoting department that relates to the height of the promotion hurdle. In addition, empirical promotion studies generally do not have direct controls for productivity on the job and have instead relied on schooling and experience controls to measure productive differences among workers. Our focus on academic economists offers the additional advantage that on-the-job productivity can be measured directly by research output.

We develop a static discrete-choice model of job assignment and job promotion, which is operationalized using a panel of postwar academic and non-academic economists belonging to the AEA. Specifically, we employ a cross-sectional ordered-probit model to examine whether there were gender differences in job assignment among academic economists, controlling for possible self-selection between academic and non-academic jobs. In addition, we examine gender differences in the career advancement process by estimating the probability of promotion from the assistant-to-associate level and the associate-to-full level using both standard bivariate and random-effects probit models. Finally, we explore the trend in gender differences over the three decades studied.

Empirical Model

We modify the static discrete-choice promotion formulation of Winter-Ebmer and Zweimuller (1997) to examine the promotion process of academic economists. Although we have access to repeated observations of the same individual, for expositional purposes we discuss a cross-sectional variant of the model. Specifically, we assume an aggregate measure of productivity (P_i) for academic i that depends linearly on a vector of attributes (X_i):

$$(1) \qquad P_i = X_i\beta + \varepsilon_i,$$

where β is a vector of unknown parameters and ε_i measures unobserved individual productivity differences that are assumed to be normally distributed.

Each department has a threshold productivity level (P_i^*), which represents the minimum necessary productivity to achieve promotion. The threshold productivity depends on department characteristics (Z_i) and measurement error in assessing productivity (v_i): $P_i^* = Z_i\gamma + v_i$. Thus, promotion occurs if the person's productivity level exceeds the threshold value of the faculty (that is, $P_i > P_i^*$). In other words, using (1), the promotion condition can be expressed as

$$(2) \qquad X_i\beta + \varepsilon_i > Z_i\gamma + v_i.$$

Equation (2) forms the basis for a discrete-choice model of promotion. Gender differences in promotion are modeled by including a gender dummy variable in Z_i to examine whether women's promotion requirements differ from those of comparable male colleagues.

Based on equation (2), we consider two empirically plausible manifestations of gender differences in promotion: job attainment and job advancement. For professional attainment, we examine the progress of an individual through the academic ranks from assistant professor ($R = 0$) to associate professor ($R = 1$) to full professor ($R = 2$). In this instance, promotion from assistant to associate professor and promotion from associate to full professor both involve surpassing a discrete, ordered productivity threshold. Thus, if ε_i and v_i are normally distributed, equation (2) forms the basis for an ordered-probit model of promotion up the academic hierarchy:

$$(3.1) \qquad R = 0 \text{ if } (Z_i\gamma - X_i\beta) + (v_i - \varepsilon_i) \leq 0$$

$$(3.2) \qquad R = 1 \text{ if } p > (Z_i\gamma - X_i\beta) + (v_i - \varepsilon_i) > 0$$

$$(3.3) \qquad R = 2 \text{ if } (Z_i\gamma - X_i\beta) + (v_i - \varepsilon_i) > p,$$

where 0 and p are the latent productivity thresholds for promotion from assistant to associate professor and associate to full professor, respectively. The ordered-probit model described in equations (3.1)–(3.3) is used to examine possible gender differences in the composition of the job hierarchy in economics.

Gender differences in the composition of the profession by academic rank can arise if the opportunities for promotion of female economists differ from those of their male colleagues at any rung of the job ladder. Thus, we also examine how careers advance within the profession by focusing on the promotion process from assistant to associate professor separately from the promotion process from associate to full professor. In the context of (2), advancement up a rung of the job ladder (A) is dichotomous, with $A = 1$ when a professor's productivity exceeds a department's productivity threshold for a given rank and $A = 0$ when not. Thus, using equation (2), assistant-to-associate or associate-to-full professor career advancement can be expressed as

$$(4.1) \qquad A_i = 1 \text{ if } \varepsilon_i - v_i > Z_i\gamma - X_i\beta$$

$$(4.2) \qquad A_i = 0 \text{ if } \varepsilon_i - v_i \leq Z_i\gamma - X\beta$$

Given that $\varepsilon_i - v_i$ is normally distributed, (4.1) and (4.2) form the basis for a probit model that is used to examine whether there are gender differences in the promotion process from assistant to associate professor or from associate to full professor.

Importantly, we only observe academic attainment and promotion if the individual selects into academia. Thus, modeling selection is important to take account of the possibly non-random decision to select into or out of an academic job. For brevity, the description of the likelihood functions for equations (3) and (4) that model the selection process is included in the appendix. These selection models are used in the empirical analysis.

Data

The data used contain characteristics of American Economic Association (AEA) members. AEA members are likely to represent the most active Ph.D. economists in the profession. Given that professional activity is correlated with success, this suggests that AEA members are more likely to be promoted. Thus, if women are less likely to be promoted than are men, as prior evidence suggests, and are less active on average in the profession, only the best female economists would be observed in the AEA, and this would tend to understate the gender differences in promotion.

Both a pooled cross-section and a panel data set are used in the empirical analysis. The data are constructed in several steps. First, using the 1964 and 1974 AEA "Biographical Listing of Members" and the 1985 computer tape of AEA members, we select all female AEA members and a random sample of male AEA members within each cross-section (that is, 1964, 1974, and 1985). To be included in the sample the person must have a Ph.D., must be under age 66, and must work for an employer located in the United States.[1]

The initial cross-sectional data are supplemented by adding observations for the originally sampled persons in each of the cross-sections for which they are observed. For example, the name of an economist initially sampled in 1974 is cross-checked and observations added in other cross-sections if this person is observed in the 1964 AEA Directory, the 1985 AEA Directory, or both. Nearly 66% of male and female AEA members are observed in more than one directory. Thus, a third of the sample is lost through attrition in a given cross-section. The empirical analysis examines the sensitivity of the results to possible attrition bias by comparing the panel models that require at least two person years to cross-sectional specifications that include those AEA members who are observed only once.

The last data step involves adding the 1989 cross-section. The 1989 cross-section is constructed by including in the 1989 data all individuals who are in the 1985 cross-section and who otherwise meet the criteria for sample inclusion. Thus, no attempt is made to add "new" names in the 1989 cross-section. By adding the 1989 cross-section, we include in the data persons who received their Ph.D. after 1974, and we include the most recent year for which all the data necessary for the analysis are available. While the pooled cross-section data set includes all observations in the four cross-sections, the panel data are comprised of only those observations in which a particular individual is observed in more than one cross-section.

The data include academic and non-academic economists, but exclude instructors, lecturers, visiting professors, and adjunct professors because promotion is usually not considered for temporary faculty.[2] Faculty

[1]While the selection of the male sample within each cross-section is random, the number of men selected in each of the cross-sections is not random. Originally, we constructed the data set to analyze foreign-born members of the U.S. economics profession. In doing so, we randomly sampled a native-born control group at a 50% rate of the foreign-born AEA population within each of the 1964, 1974, and 1985 cross-section samples (see McDowell and Singell 1999). For the current analysis, all male foreign-born AEA members are excluded from the sample. Moreover, any previously unsampled female economists who met the criterion for sample selection have been added so that the current data include the entire population of female AEA economists and a randomly sampled native-born male control group.

[2]Data we collected for lecturers, visiting professors, and adjunct professors indicate that whereas women comprise approximately one-third of the total observations in the cross-sectional data, they are 57% of the 242 non-permanent faculty. Omission of these data could result in an understatement of gender differences in promotion to the extent that women are over-represented in temporary faculty positions because of a failure to be promoted.

who have joint appointments in academic and non-academic jobs are assumed to be in the academic sector. The promotion analysis focuses on academic rank rather than tenure for associate professors because tenure is unobserved. Although the focus on rank is a consistent treatment of the promotion to associate and full professor within a university, it may provide a different treatment between universities, because some departments are less likely to link promotion to associate with tenure. The subsequent analysis does control for departmental quality and also examines possible promotion differences between Ph.D.-granting and non-Ph.D.-granting institutions. Nonetheless, the likelihood of promotion at departments that do not link tenure and promotion may be overstated relative to their counterparts that do, because non-tenured promotions are easier to obtain, all else equal. If men are disproportionately at institutions that grant associate professorship without tenure, this relationship will work toward finding gender-specific differences in promotion.

The empirical model predicts that both professional attainment and career advancement depend on attributes of the individual and the department. In addition to a binary variable that equals one for female economists, personal attributes include measures of research productivity, Ph.D. quality, life-cycle attributes, and fields of specialization. The demographic and career-related data (except publishing productivity) are collected from the biographical listings in the various AEA directories. The analysis focuses on discrete gender differences in promotion because given the relatively small number of female economists in the data, some structure needs to be placed on the model in order to identify possible differences by gender. However, we examine the sensitivity of the base case results to possible gender differences in the slope coefficients.

A control for the quality of the Ph.D. institution is constructed from Graves et al. (1982), which is a publication ranking of the top 240 economics departments from 1979 to 1981. Because of the measurement error associated with any qualitative ranking of departments, we construct a binary variable that equals one for "top" departments. In the analysis we use a Ph.D. from a top–35 department as the cut-off point. On average, an economist who has a top–35 Ph.D. is expected to be of higher ability than a counterpart who is not from a top program because of better initial endowments and superior training.

Publishing productivity is measured by one of four possible publication measures. In particular, the number of published articles in the year of the cross-section and the subsequent year (that is, 1964–65, 1974–75, 1985–86, or 1989–90) is used directly or, alternatively, weighted either by the number of co-authors, a journal quality index, or both. Publication data are gathered from various issues of the AEA *Index of Economic Articles*.[3] While publications prior to the promotion decision directly affect professional attainment, this variable tests whether contemporaneous qualitative differences in faculty performance predict professional attainment.

We control for life-cycle effects by including the economist's post-Ph.D. experience and age, which, respectively, capture possible human-capital accumulation and depreciation over a career. The square and cubic of age and experience are included to control for possible nonlinear life-cycle effects that have been documented in prior work (Oster and Hamermesh 1997). In addition, 13 binary field-of-specialization variables are included to measure possible differences in attributes among specialists in different fields.

Departmental differences are measured by two variables constructed using the Graves et al. (1982) ranking. Specifically, a binary variable that equals one if the econo-

[3]Only journal articles are enumerated in the publication counts (that is, books and articles in books of collected works are excluded). Co-authors are weighted by the simple 1/n rule. Article quality is accounted for using the SSCI Journal Citation Reports "impact factor" as a weight.

mist places in a top–50 department is used to measure current-job placement in a research-oriented department, while the log rank within the top–50 is used to measure relative placement among research-oriented departments. The greater breadth of the current-job category in comparison to that used for Ph.D. institution reflects the possibly greater imprecision in measuring job quality than in measuring Ph.D. quality. The log rank is used for rank within top–50 jobs because, while institution quality is likely to be inversely related to rank, a linear ranking is likely to overstate the differences among departments (for example, 1 is not necessarily twice a good as 2). To account for possible promotion differences across different disciplines, we also include two dummy variables indicating if the individual is not in an economics department (including agricultural economics) but is a faculty member in a business department (for example, finance) or other department (for example, political science).[4] Finally, time differences are measured by three binary variables for the 1974, 1985, and 1989 cross-sections that compare possible period effects relative to the 1964 cross-section.

Descriptive statistics for the 1,878 sampled AEA members, 633 women and 1,245 men, are presented in Table 1. There are 4,611 person-year observations, of which 1,578 are for female economists and 3,033 are for their male counterparts. These data include all observations in each cross-section. Thus, there are between 1 and 4 observations for each person, and the average male and female AEA members contribute 2.5 observations. Women were generally more likely to be working in non-academic occupations, especially in the "other" category (for example, a non-profit or non-academic research institution). It also is clear that, among the sampled AEA members employed by an academic institution, women were over-represented at the assistant professor rank and under-represented at the full professor rank. This is perhaps partially due to the women in the sample being younger and less experienced than the men.

Women also were less likely than men to be employed at a top–50 department. Among other possible reasons, this finding may reflect the fact that, regardless of which measure of publication productivity is used, the descriptive statistics indicate that women produced less research than men. Some of this productivity difference may perhaps be explained by differences in fields of specialization: women tended to be less concentrated than men in theory and quantitative methods and more concentrated in labor.[5] Finally, consistent with their growing numbers in recent years, women appear to have relatively higher representation in the more recent cross-sections. The descriptive evidence for the panel data, which exclude those persons who are observed only once in an AEA Directory, is not presented because it yields the same qualitative conclusions.

Professional Attainment

The descriptive evidence indicating that women were under-represented at the senior ranks may show that female economists progressed up through the academic ranks relatively slowly in comparison to their male counterparts. However, because economics has historically been a male-dominated profession and the entry of female economists into the profession has increased over time, this under-representation may simply have been the result of the relatively shorter tenure of women in the profession. In addition, McMillen and

[4]Sensitivity checks that replicate the empirical analysis excluding business and other departments yield the same qualitative conclusions as those presented. Thus, we include all members of the AEA, including those not in economics departments.

[5]Fields of specialization do not sum to 100% because both first and second fields are used to designate a field of specialization.

Table 1. Descriptive Statistics for All AEA Members in the Sample.

Characteristic	*Full Sample* *Mean*	*Full Sample* *St. Dev.*	*Women* *Mean*	*Women* *St. Dev.*	*Men* *Mean*	*Men* *St. Dev*
Occupation						
Assistant Professor	0.172	0.378	0.253	0.435	0.130	0.337
Associate Professor	0.197	0.398	0.212	0.409	0.189	0.392
Full Professor	0.343	0.475	0.222	0.416	0.406	0.491
Government Occupation	0.099	0.298	0.106	0.309	0.095	0.293
Business Occupation	0.100	0.300	0.093	0.290	0.104	0.306
Other Occupation	0.089	0.285	0.114	0.318	0.076	0.266
Publications						
Articles Published	0.700	1.382	0.575	1.141	0.765	1.488
Articles Wtd. by Co-Authors	0.566	1.096	0.468	0.903	0.617	1.180
Articles Wtd. by Quality	0.521	1.362	0.365	0.943	0.602	1.529
Art's Wtd. by Co-Authors/Quality	0.389	1.062	0.270	0.712	0.451	1.200
Personal Attributes						
Age	43.756	9.321	42.390	9.602	44.467	9.092
Experience	12.988	8.490	11.205	8.386	13.915	8.396
Top 35 Ph.D.	0.725	0.446	0.691	0.462	0.743	0.437
Top 50 Current Job	0.263	0.440	0.219	0.413	0.287	0.452
Business Department	0.092	0.289	0.050	0.218	0.113	0.317
Other Department	0.052	0.221	0.068	0.251	0.043	0.203
Cross-Section: 1974	0.257	0.437	0.218	0.413	0.277	0.448
Cross-Section: 1985	0.361	0.480	0.411	0.492	0.335	0.472
Cross-Section: 1989	0.263	0.440	0.282	0.450	0.253	0.435
Fields of Specialization						
Theory	0.151	0.358	0.081	0.273	0.187	0.390
History	0.057	0.232	0.041	0.199	0.065	0.246
Economic Systems	0.027	0.162	0.023	0.149	0.029	0.168
Growth	0.145	0.352	0.061	0.240	0.189	0.392
Quantitative Methods	0.125	0.331	0.036	0.187	0.171	0.377
Monetary	0.172	0.378	0.148	0.355	0.185	0.388
Fiscal	0.133	0.339	0.094	0.293	0.152	0.359
International	0.096	0.294	0.074	0.261	0.107	0.310
Business	0.101	0.301	0.018	0.132	0.144	0.351
Industrial Organization	0.137	0.344	0.040	0.196	0.188	0.391
Agricultural	0.031	0.175	0.011	0.106	0.042	0.200
Natural Resources	0.053	0.225	0.031	0.174	0.065	0.246
Labor	0.226	0.418	0.285	0.452	0.196	0.397
Urban and Regional	0.075	0.264	0.047	0.211	0.090	0.286
Individual Observations	1,878		633		1,245	
Person-Year Observations	4,611		1,578		3,033	

Singell (1994) found that academic economists differ from non-academic economists in various attributes, including gender composition, suggesting possible non-random selection of Ph.D. economists into academia. Thus, to determine whether there were gender differences in Ph.D. vintage, in opportunities, or both, and to control for possible self-selection into academia, we estimate the bivariate ordered-probit model in equation (A2) (Appendix).

Identification of the bivariate model is obtained through two exclusion restrictions. First, current-job rank is excluded from the probit model for an academic versus non-academic job because publication rankings do not exist for non-academic institutions. Second, the probit model for academic jobs excludes age and instead includes five-year Ph.D. cohort dummies starting with those prior to 1956 (the excluded period) and ending in 1985–89, which measure possible cohort effects for sector placement in the profession, which have been documented in prior work (Breneman 1975; Cartter 1976). In this case, the three time measures (experience, period, and cohort effects) are linearly related and cannot be separately identified with the two sources of sample variation (individual and time). Thus, we exclude the period effects in favor of cohort effects in the selection equation.

The ordered-probit results that are presented in Table 2 focus on the possible gender differences in the promotion process, and the selection estimates are included in the first two columns of Appendix Table A1 for reference. The estimates indicate that most of the explanatory variables are statistically significant at traditional levels. In addition, the coefficient on the correlation between the ordered-probit model and the probit selection model is negative and statistically significant, which indicates that non-academics are predicted to have had lower professional attainment than persons who selected academia. It could be that Ph.D. economists simply sorted based on their comparative advantage, or, alternatively, that persons who fell short of the promotion threshold frequently moved into non-academic jobs. This issue is not examined here but deserves future exploration, because the selection results presented in columns (1) and (2) in Appendix Table A1 indicate that women were less likely to select academic jobs.

Table 2 includes the results for the number of articles weighted by journal quality as the measure of contemporaneous publishing tendency. These findings are presented because the coefficients on the alternative publication measures, while qualitatively equivalent, generally have less explanatory power. The greater explanatory power of the quality-adjusted number of articles supports prior work that finds that economics departments evaluate the number of lines on the vitae discounted by journal quality for the purposes of promotion (McDowell and Smith 1992). The coefficient on the publishing productivity variable is positive and statistically significant, which indicates that economists with a higher contemporaneous tendency to publish had higher professional attainment.

The coefficient on current job in the top 50 is positive and statistically significant, which may reflect the fact that many top departments, rather than hire and promote younger faculty, hired proven senior faculty. Indeed, controlling for a top–50 placement, the coefficient on the log rank of top–50 departments is negative and statistically significant, suggesting that it was harder to move up through the job hierarchy of top departments. The coefficients on age and post-Ph.D. experience variables are statistically significant and indicate nonlinear life-cycle effects on promotion. Jointly, their coefficients suggest that, for the average Ph.D. who received a Ph.D. at age 30, the probability of moving up in academic rank increased at a decreasing rate between approximately the ages of 30 and 50 and declined thereafter. Thus, there appears to have been a standard promotion profile whereby most faculty achieved the rank of full professor by their mid- to late forties, and those who did not reach the full professor rank "on schedule" became increasingly likely to stay at the rank of associate. In addition, the binary variables controlling for each of the cross-sections suggest that placement in the senior ranks became significantly more difficult in the 1980s relative to the earlier periods. This is not surprising, given the recent history of the academic labor market for economists. The number of academic jobs in the profession grew at an unprecedented rate during the 1960s, creating ample opportunities for promotion well into the early 1970s, but this process had slowed or even reversed for academics hired later and promoted in the 1980s (Cartter 1976).

The coefficient on the female dummy variable is negative and statistically significant, suggesting that women were less likely than men to be at senior ranks. Although supportive of descriptive evidence suggest-

Table 2. Ordered-Probit Model for Assistant-Associate-Full Professor with Sample Selection.[a]

	Ordered Probit Estimates	*Marginal Effects*		
Independent Variable	*Coefficient (Standard Error)*	*Assistant*	*Associate*	*Full*
Constant	–20.250** (2.849)	2.888	5.187	–8.075
Female	–0.298** (0.065)	0.042	0.076	–0.118
Articles Wtd. by Quality	0.080** (0.022)	–0.011	–0.020	0.031
Current Job in Top 50[b]	0.364** (0.141)	–0.052	–0.093	0.145
Log Rank in Top 50[b]	–0.096** (0.045)	0.014	0.024	–0.038
Top 35 Ph.D.[b]	–0.022 (0.052)	0.003	0.006	–0.009
Age[c]	120.156** (18.799)	–17.137	–30.779	47.916
Age^2	–240.274** (40.866)	34.268	61.548	–95.816
Age^3	15.897** (2.914)	–2.267	–4.072	6.339
Experience[c]	23.504** (1.575)	–3.352	–6.021	9.373
$Experience^2$	–38.259** (4.507)	5.457	9.801	–15.257
$Experience^3$	–1.327** (0.634)	0.189	0.340	–0.529
Cross-Section: 1974	0.273** (0.076)	–0.039	–0.070	0.109
Cross-Section: 1985	–0.232** (0.085)	0.033	0.060	–0.093
Cross-Section: 1989	–0.242** (0.087)	0.035	0.062	–0.097
Business Department	0.067 (0.075)	–0.010	–0.017	0.027
Other Department	0.135 (0.086)	–0.019	–0.035	0.054
MU(1)	1.406** (0.062)			
Rho(1,2)	–0.610** (0.097)			
Log-Likelihood	–4,512.026			
Number of Observations	4,611			

[a]Explanatory variables also include 13 field-of-specialization variables.
[b]Department ranking based on publication rankings in Graves et al. (1982).
[c]Age and experience are divided by 10 and their square and cubic terms are divided by 100 and 1,000, respectively.
**Statistically significant at the 5% level.

ing that women ascended through the ranks of the profession more slowly than their comparably skilled male colleagues, this finding does not necessarily indicate gender discrimination in promotion. Prior work suggests that female economists have lower publishing profiles than men throughout their careers (McDowell and Singell

1999) and that female academics experience a drop in productivity in the "childbearing" years (McDowell 1982). Thus, while the analysis controls for contemporaneous publishing tendencies, the statistically significant negative coefficient on the female dummy variable may reflect the cumulative effect of gender differences in publishing tendencies over a career.[6]

Career Advancement

To get a better sense of the factors that contribute to the apparent gender differences in the promotion profile of economists, we estimate two variants of probit models for each step up the academic job ladder. The first type, given in equation (A3) (Appendix), is cross-sectional and controls for possible sample selection between academic and non-academic jobs. To make the samples of non-academics and academics similar in distribution, we restrict non-academics used in the assistant-associate selection analysis to those having ten or fewer years of post-Ph.D. experience, while the associate-full selection analysis includes those non-academics with more than 10 years of post-Ph.D. experience.[7] Under the null of no unobserved heterogeneity, the pooled cross-section model in equation (A3) provides consistent estimates of model parameters.

The second model variant, a random-effects probit model, provides estimates that make use of the panel data to control for the possibility that unobserved heterogeneity is present. In the presence of random unobserved heterogeneity, the random-effects probit model can address the concern that men and women who are otherwise identical in their observed characteristics are heterogeneous in their probability of promotion.

Either of the two models, if used alone, could yield misleading results—the pooled cross-section model, because of possible unobserved heterogeneity; the random-effects probit model, because attrition bias is a potential problem in using panel data in this case, since some economists are not observed in consecutive AEA directories.[8] As detailed below, the two estimation procedures jointly indicate that the qualitative conclusions are not sensitive to the various potential sources of bias.

Promotion from Assistant to Associate Professor

For promotion between assistant and associate professor, Table 3 includes the estimates for probit models that use the pooled cross-sections and correct for sample selection (models 1 and 2) and that use the panel and control for random effects (models 3 and 4). The qualitative effects of the explanatory variables in the probit specifications that control for sample selection are similar to those in the ordered-probit analysis. However, the coefficients are generally less statistically significant, which may reflect the fewer degrees of freedom in the

[6]To approximate the cumulative differences in publishing over a career, the panel models are estimated cumulating the contemporaneous publications over each successive cross-section. The coefficient on cumulative publication measure is positive in each of the models, but the gender-specific results are unchanged. The publication measure is also interacted with experience in both the bivariate and random-effects models because the cumulative effect of publications may be expected to be more precisely measured by the contemporaneous publication measure early in a career. However, this interaction is statistically insignificant in each specification, and statistically significant gender differences remain.

[7]The selection model is also estimated using the full sample of non-academic economists. In this case, the promotion results, while qualitatively equivalent to those presented, indicate no statistically significant selection between the academic and non-academic sectors.

[8]The random-effects probit analysis will tend to overstate the likelihood of promotion if the non-promoted tend to drop out of the AEA. However, if there is a "glass ceiling" such that women are less likely to be promoted, then female economists will be more likely to drop out, and the probability of their promotion will appear to be greater than it would be if there were no attrition. Thus, if there is attrition bias, it will tend to work against finding a gender difference in promotion prospects.

assistant and associate professor data set. Consistent with the ordered-probit model, the coefficient on the selection variable (rho) in the probit models of (1) and (2) indicates statistically significant negative self-selection. Thus, young Ph.D. economists do appear to have sorted by sector such that those who chose a non-academic job were less likely to be promoted in an academic job than those who actually chose academia. Unlike the ordered-probit model results, the selection results presented in columns (3) and (4) of Appendix Table A1 do not suggest statistically significant gender differences in the selection process into or out of academia.

The random-effects specifications yield the same qualitative conclusions as those that control for selection. However, the significance level of the coefficients is generally smaller, because the panel is half the size of the cross-sections. In addition, the qualitative variables (for example, the publication measure) are less statistically significant in the random-effects model, because their marginal effects are smaller in magnitude. This suggests that the statistically significant random heterogeneity (that is, rho in models 3 and 4) captures some qualitative differences among academic economists. Nonetheless, because the results for the explanatory variables in the probit specifications (when statistically significant) are the same as those found in the ordered-probit model, the subsequent discussion focuses on the gender differences in promotion.

The coefficient on the gender dummy is negative and statistically significant in both the probit model correcting for sample selection and the random-effects probit (models 1 and 3). Thus, the probability of holding the rank of associate professor was lower for a female economist than for her male colleague with comparable age, experience, and productive attributes. In other words, we find evidence that women were less likely to be promoted to associate professor after we control for possible self-selection into academia and the presence of observed and unobserved heterogeneity. Again, while this is consistent with gender discrimination in the promotion process, other non-discriminatory processes could lead to such an outcome. For example, if female economists were collectively more likely to stop the tenure clock because of family responsibilities, they would have had a lower probability of obtaining the rank of associate professor than their similarly situated male counterparts who were at a similar stage in their career. A gender differential would remain even in the presence of random effects, because its source would be a group effect, not an individual effect. A subsequent sensitivity analysis examines the impact of effective versus observed experience on gender differences in promotion. Nonetheless, without evidence to the contrary, the discrimination hypothesis is certainly as compelling as possible alternatives.[9]

While models 1 and 3 indicate that female economists were generally less likely than their male counterparts to be promoted from assistant to associate professor, the dramatic increase in the relative supply of female economists after 1960 and the possible increase in the relative demand for female economists as a result of policy changes, such as Title VII of the Civil Rights Act, suggest that the promotion prospects of women may have changed over time. Thus, in models 2 and 4 in Table 3 we include interactions of the gender variable with the cross-sectional dummy variables to determine whether there was any change in the promotion process over time.[10]

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[9]Because of potential correlation between unobserved heterogeneity and measured research, we estimate linear probability models separately by gender including the time-varying variables and individual-specific fixed effects. An Oaxaca-Ransom decomposition (1994) indicates that a lower probability of promotion for women is primarily due to gender differences in the parameters. We focus on the random effects approach because it permits identification of time-invariant control variables and does not require gender-specific estimates that rely on relatively few observations of female economists for identification of the parameters.

[10]Gender differences in promotion over time are restricted to the cross-sections because there are too few female economists in finer time intervals to make statistically reliable comparisons.

Table 3. Probit Models for Promotion from Assistant to Associate Professor.[a]

	Sample-Selection: Experience ≤ 10		*Random Effects*	
Independent Variable	*Model 1 Coefficient (Standard Error)*	*Model 2 Coefficient (Standard Error)*	*Model 3 Coefficient (Standard Error)*	*Model 4 Coefficient (Standard Error)*
Constant	–23.246**	–22.493**	–26.652**	–28.077**
	(4.929)	(4.991)	(9.473)	(10.049)
Female	–0.375**	–0.519**	–0.321*	0.019
	(0.093)	(0.189)	(0.175)	(0.771)
Articles Wtd. by Quality	0.166**	0.166**	0.092	0.092
	(0.023)	(0.023)	(0.058)	(0.059)
Current Job in Top 50[b]	0.097	0.085	–0.065	–0.009
	(0.235)	(0.236)	(0.586)	(0.609)
Log Rank in Top 50[b]	–0.076	–0.072	–0.036	–0.059
	(0.075)	(0.075)	(0.195)	(0.202)
Top 35 Ph.D.[b]	–0.146*	–0.150*	–0.110	–0.096
	(0.079)	(0.079)	(0.162)	(0.168)
Age[c]	140.358**	135.085**	157.989**	163.538**
	(34.172)	(34.663)	(64.163)	(68.515)
Age^2	–291.367**	–279.048**	–326.184**	–332.391**
	(77.413)	(78.562)	(143.251)	(152.531)
Age^3	19.579**	18.672**	21.714**	21.754**
	(5.739)	(5.828)	(10.466)	(11.109)
Experience[c]	33.107**	32.837**	39.976**	40.299**
	(2.442)	(2.462)	(7.073)	(7.101)
$Experience^2$	–75.809**	–74.442**	–98.525**	–100.240**
	(9.423)	(9.567)	(24.001)	(24.975)
$Experience^3$	–0.018	–0.193	3.820	3.743
	(1.691)	(1.696)	(3.121)	(3.504)
Cross-Section: 1974	0.144	0.119	0.612*	0.703
	(0.119)	(0.158)	(0.354)	(0.743)
Cross-Sectlon: 1985	–0.603**	–0.629**	–0.067	0.216
	(0.122)	(0.171)	(0.304)	(0.741)
Cross-Section: 1989	–0.393**	–0.569**	0.334	0.638
	(0.124)	(0.177)	(0.268)	(0.755)
Business Department	–0.002	0.011	–0.009	–0.111
	(0.117)	(0.116)	(0.211)	(0.219)
Other Department	0.043	0.052	–0.062	–0.080
	(0.176)	(0.172)	(0.415)	(0.429)
1974*Female	—	0.075	—	–0.016
		(0.230)		(0.892)
1985*Female	—	0.107	—	–0.434
		(0.222)		(0.824)
1989*Female	—	0.377*	—	–0.450
		(0.229)		(0.816)
Rho: Selection Cols. 1–2	–0.736**	–0.768**	0.349**	0.386**
Heterogeneity Cols. 3–4	(0.132)	(0.125)	(0.128)	(0.121)
Log-Likelihood	–1,776.14	–1,774.26	–421.83	–420.14
Number of Obs.[d]	2,261	2,261	1,085	1,085

[a]Explanatory variables also include 13 field-of-specialization variables.
[b]Department ranking based on publication rankings in Graves et al. (1982).
[c]Age and experience are divided by 10 and their square and cubic terms are divided by 100 and 1,000, respectively.
[d]The data include assistant and associate professors only. The selection model also includes non-academics with 10 or fewer years' experience. The panel excludes academics who are not observed in at least two cross-sections.
*Statistically significant at the 10% level; **at the 5% level.

The female-time interactions in the sample-selection probit model (model 2) suggest that prospects for promotion from assistant to associate professor were not as good for female economists as for their male colleagues in 1964, but improved in the later cross-sections. However, only the coefficient on the 1989 interaction is statistically significant at traditional levels. Interestingly, there is no evidence of gender differences in promotion opportunities in the random effects model 4, which may suggest that any apparent improvement in the cross-sectional results is due to heterogeneity in the quality of female economists observed in each period. We explore the role of heterogeneity across cohorts in a subsequent sensitivity analysis, which compares promotion opportunities in research-oriented versus non-research-oriented institutions.

Promotion from Associate to Full Professor

The results for the probit model for associate-to-full promotion are provided in Table 4, where models 1–4 are the same specifications as those in Table 3. The coefficient on rho for the random-effects probit is again positive and statistically significant, suggesting that the unobserved heterogeneity is positively correlated with the probability of promotion from associate to full professor. Thus, the random-effects probit again appears to control for some unobserved skills that are not captured by the standard probit analysis.

The negative selection coefficient (rho in models 1 and 2), while similar to the probit analysis for assistant and associate professors, is not statistically significant in this instance. Thus, the self-selection into non-academic jobs does not appear to have been as strongly related to the probability of promotion to full professor as to the probability of promotion to associate professor. This may reflect that tenure (which is commonly granted upon promotion to associate professor) was an up-or-out decision based primarily on publishing that caused some faculty to "involuntarily" switch to non-academic jobs, while changes between academic and non-academic jobs at the senior ranks were made based on factors unrelated to the tendency to publish. It also may be the case that, because the AEA is primarily affiliated with academic institutions, non-academic economists who moved away from the academic pursuit of publishing over their career were less likely to be members of the AEA. This is an interesting avenue for future research because, unlike the findings for promotion to associate professor, the selection results presented in columns (5) and (6) of Appendix Table A1 indicate that experienced female economists were significantly less likely than similar male economists to select academia.

In general, the coefficients on the productivity and life-cycle variables indicate the same effect on the probability of promotion from associate to full professor as was found for the probability of promotion from assistant to associate professor. Moreover, the qualitative variables have effects that differ between the two promotion decisions in the direction that might be expected. For example, to compare the impact of a one unit increase in quality-adjusted articles on the assistant-to-associate promotion to its impact on the associate-to-full promotion requires the calculation of a marginal effect for each model, which is non-linear and depends on the value of explanatory variables at which it is evaluated.[11] If the marginal effects for the selection models are calculated for the average person in the assistant-to-associate and associate-to-full samples, an additional quality-adjusted article increases the probability of promotion by 7% from assistant-to-associate professor and by 4% from associate-to-full professor (both effects are statis-

[11]The marginal effect is $\beta_k\phi(X\beta)$, where β_k is the coefficient on the variable of interest, β and X are the estimated coefficient and explanatory variable vectors, and $\phi(*)$ is a standard normal density. $\beta_k\phi(X\beta)$ varies with X and is usually calculated at the mean sample attributes (that is, $\bar{X}$).

Table 4. Probit Models for Promotion from Associate to Full Professor.[a]

	Sample-Selection: Experience >10		*Random Effects*	
Independent Variable	*Model 1 Coefficient (Standard Error)*	*Model 2 Coefficient (Standard Error)*	*Model 3 Coefficient (Standard Error)*	*Model 4 Coefficient (Standard Error)*
Constant	–13.747**	–13.504**	–32.421**	–32.209**
	(3.969)	(3.987)	(8.322)	(8.421)
Female	–0.252**	–0.648**	–0.469**	–1.158*
	(0.090)	(0.190)	(0.243)	(0.605)
Articles Wtd. by Quality	0.113**	0.117**	0.180**	0.185**
	(0.029)	(0.029)	(0.057)	(0.058)
Current Job in Top 50[b]	0.607**	0.584**	0.744	0.747
	(0.189)	(0.190)	(0.469)	(0.484)
Log Rank in Top 50[b]	–0.134**	–0.130**	–0.120	–0.123
	(0.060)	(0.060)	(0.149)	(0.154)
Top 35 Ph.D.[b]	–0.036	–0.047	–0.107	–0.122
	(0.073)	(0.073)	(0.194)	(0.201)
Age[c]	65.006**	63.241**	158.784**	156.452**
	(26.008)	(26.176)	(55.186)	(55.916)
Age^2	–114.321**	–109.123**	–280.563**	–272.698**
	(55.688)	(56.116)	(119.724)	(121.568)
Age^3	6.796*	6.361	16.847**	16.204*
	(3.922)	(3.954)	(8.552)	(8.694)
Experience[c]	17.708**	17.513**	29.739**	30.468**
	(2.133)	(2.149)	(4.263)	(4.398)
$Experience^2$	–23.018**	–21.934**	–36.791**	–36.302**
	(6.079)	(6.206)	(12.216)	(12.585)
$Experience^3$	–1.509*	–1.634*	–3.417	–3.779
	(0.836)	(0.863)	(2.187)	(2.694)
Cross-Section: 1974	0.245**	0.199	0.821**	0.646**
	(0.101)	(0.125)	(0.242)	(0.274)
Cross-Section: 1985	–0.122	–0.232*	0.056	–0.229
	(0.109)	(0.128)	(0.234)	(0.290)
Cross-Section: 1989	–0.310**	–0.504**	–0.126	–0.602**
	(0.118)	(0.138)	(0.252)	(0.296)
Business Department	0.142	0.161	0.384	0.446*
	(0.101)	(0.102)	(0.252)	(0.263)
Other Department	0.111	0.151	0.163	0.229
	(0.113)	(0.114)	(0.323)	(0.332)
1974*Female		0.227		0.613
	–	(0.213)	–	(0.607)
1985*Female		0.419**		0.738
	–	(0.210)	–	(0.667)
1989*Female		0.652**		1.254*
	–	(0.214)	–	(0.665)
Rho: Selection Cols. 1–2	–0.262	–0.267	0.772**	0.783**
Heterogeneity Cols. 3–4	(0.239)	(0.239)	(0.038)	(0.037)
Log-Likelihood	–2621.90	–2616.74	–871.362	–867.302
Number of Obs.[d]	3,258	3,258	2,142	2,142

[a]Explanatory variables also include 13 field-of-specialization variables.
[b]Department ranking based on publication rankings in Graves et al. (1982).
[c]Age and experience are divided by 10 and their square and cubic terms are divided by 100 and 1,000, respectively.
[d]The data include associate and full professors only. The selection model also includes non-academics with 10 more than 10 years of experience. The panel excludes academics who are not observed in at least two cross-sections.
*Statistically significant at the 10% level; **at the 5% level.

tically significant). Thus, publications appear to have mattered more for promotion to associate professor than for promotion to full professor.

Similar to the findings for promotion from assistant to associate professor, the results indicate gender differences in promotion from associate to full professor. For example, the marginal effect calculated from the sample-selection analysis in model 1 predicts that women had a 9% lower probability of promotion from associate to full than their comparably skilled male colleagues. By comparison, the marginal effect from the same probit specification for assistant-to-associate professors indicates women were 16% less likely than men to be promoted to associate professor. The marginal effects from the random effects models indicate smaller, but qualitatively similar, gender differences in promotion to full and associate professor (8% and 12%, respectively). Thus, while women have historically been under-represented at the rank of full professor (Blank 1996), our results suggest that this may be due to the cumulative impact of a relatively large gender difference in the probability of being promoted to associate professor in combination with a smaller gender difference in the probability of promotion from associate to full professor. This result accords with prior evidence on gender differences in promotion up the job ladder for other populations of workers (Jones and Makepeace 1996).

The results in Table 4 indicate that gender differences in the probability of promotion from associate to full professor changed over time. In both the probit model with sample-selection effects and that with random effects, the coefficient on the gender dummy is negative and the interactions with the 1974, 1985, and 1989 cross-sections are positive. Consistent with the findings for assistant-to-associate promotion, the results suggest that the promotion opportunities of female economists improved significantly in the 1980s. In particular, both the standard bivariate and random effects probit models predict no significant gender differences in promotion for the 1989 cross-section. Overall, the empirical results suggest promotion opportunities have improved for female economists.

Effective Experience and Timing Differences in Promotion

As suggested above, the observed gender differences in promotion opportunities could arise because women were more likely than men to stop the tenure clock due to family responsibilities. The finding that the gender effect was stronger for promotion to associate professor than to full professor is consistent with the hypothesis that women take longer to be promoted to associate professor because this hurdle occurs during their child-bearing years, while promotion to full professor frequently occurs after most women consider having children (Shapiro and Mott 1994). The AEA data do not directly include information on fertility, but the sensitivity of the results to effective versus observed experience is tested by assuming that women stopped the tenure clock for two years (Kahn 1993), thus resulting in a female economist's "effective" experience being measured as observed experience minus two years. A finding that gender differences remain after we adjust for effective experience would suggest that the promotion probability differed between men and women due to factors other than the timing of promotion.

Using the interactive specification, Table 5 presents the results when experience for women is set equal to observed experience minus two, thus reflecting the assumption that women have less effective experience than men. The table focuses on the female-specific coefficients because the qualitative conclusions from the other explanatory variables remain unchanged. The results indicate that statistically significant gender differences disappear for promotion to associate professor, suggesting that timing is important. This does not necessarily confirm that women were more likely to stop the tenure clock, because women would also have taken longer to be promoted to associate professor if they were more likely

Table 5. Estimates of Gender Differences in the Probability of Promotion When Experience for Women Is Set Equal to Observed Experience (in Years) Minus Two.[a]

	Assistant to Associate		*Associate to Full*	
Group	*Probit with Selection*	*Random-Effects Probit*	*Probit with Selection*	*Random-Effects Probit*
Female	−0.035	0.634	−0.624**	−1.074*
	(0.199)	(0.753)	(0.189)	(0.616)
Cross-Section: 1974	0.159	0.706	0.177	0.654**
	(0.164)	(0.728)	(0.126)	(0.265)
Cross-Section: 1985	−0.399**	0.345	−0.278**	−0.076**
	(0.186)	(0.716)	(0.127)	(0.273)
Cross-Section: 1989	−0.244	0.789	−0.572**	−0.416
	(0.191)	(0.737)	(0.132)	(0.273)
Female*1974	0.085	0.069	0.315	0.873
	(0.238)	(0.830)	(0.214)	(0.609)
Female*1985	−0.053	−0.580	0.497**	0.825
	(0.233)	(0.763)	(0.213)	(0.661)
Female*1989	0.158	−0.630	0.737**	1.288**
	(0.244)	(0.779)	(0.216)	(0.667)
Number of Obs.	2,261	1,085	3,258	2,142
Log-Likelihood	−1,788.21	−419.23	−2,598.47	−817.29

[a]The empirical model includes the same explanatory variables as the specifications in models 2 and 4 in Tables 3 and 4.

*Statistically significant at the 10% level; **at the 5% level.

to be denied tenure on their first job due to gender discrimination and had to change jobs in order to obtain a promotion. Nonetheless, the results are consistent with women taking longer to be promoted to associate professor.[12]

The associate-to-full professor results indicate that statistically significant gender differences in promotion remain even after we control for "effective" experience. Indeed, the overall results are remarkably similar to those presented in Table 4. This suggests that gender differences in the probability of promotion to full professor were not due to women taking longer to be promoted. This result does not necessarily confirm the presence of discrimination. For example, gender differences in the probability of promotion would be present if family responsibilities made women less mobile than their male colleagues, thus preventing them from seeking promotion through job changes.[13] Nonetheless, the

[12]The random-effects model is also estimated including (a) a binary variable that equals one if the academic is continuously employed at the same institution and (b) its interaction with the female dummy. Although assistant-to-associate promotion is found to be statistically unrelated to continuous employment, the coefficient on the female interaction is negative and statistically significant. This suggests that women who stay at a given institution take longer to be promoted than those who move between institutions. In addition, the gender dummy is now statistically insignificant, suggesting that all of the gender difference in promotion can be attributed to women who stay and are promoted at a given institution.

[13]The random effects probit model for promotion to full professor is also estimated including the binary variable for continuous employment and its interaction with the female dummy variable. The coefficient on the continuous employment variable is negative and statistically significant, suggesting that mobile associate professors were better able to obtain promotion to full professorship by changing institutions. On the other hand, the female interaction term indicates no statistically significant gender difference in the return to mobility.

Table 6. Estimates of Gender Differences in the Probability of Promotion for Ph.D. and Non-Ph.D. Institutions.[a]

	Ph.D. Institutions				*Non-Ph.D. Institutions*			
	Assistant to Associate		*Associate to Full*		*Assistant to Associate*		*Associate to Full*	
Indep. Var.	*Probit with Selection*	*Random-Effects Probit*	*Probit with Selection*	*Random-Effects Probit*	*Probit with Selection*	*Random-Effects Probit*	*Probit with Selection*	*Random-Effects Probit*
Female	−0.778**	−2.330	−0.811**	−1.108	−0.214	−0.294	−0.721**	0.921
	(0.316)	(5.711)	(0.253)	(1.110)	(0.319)	(1.151)	(0.301)	(2.698)
1974	0.100	1.012	0.242	0.644*	0.145	0.838	−0.010	1.537
	(0.222)	(1.575)	(0.156)	(0.356)	(0.272)	(1.136)	(0.225)	(1.043)
1985	−0.712**	−0.004	−0.144	−0.299	−0.447	0.662	−0.558**	−0.778
	(0.287)	(1.244)	(0.175)	(0.398)	(0.279)	(1.417)	(0.208)	(0.893)
1989	−0.430	0.903	−0.361*	−0.521	−0.460	0.969	−0.875**	−3.128**
	(0.291)	(1.348)	(0.190)	(0.413)	(0.300)	(1.496)	(0.217)	(1.037)
Female*1974	0.396	2.018	0.290	0.500	−0.194	−0.335	0.366	−0.529
	(0.365)	(5.607)	(0.281)	(1.202)	(0.387)	(1.540)	(0.354)	(2.791)
Female*1985	0.647*	1.436	0.498*	0.348	−0.347	−1.011	0.589*	−0.598
	(0.357)	(5.132)	(0.283)	(1.204)	(0.369)	(1.609)	(0.339)	(2.828)
Female*1989	0.831**	1.467	0.679**	0.326	−0.026	−0.322	0.904**	2.636
	(0.371)	(5.381)	(0.277)	(1.205)	(0.388)	(1.644)	(0.347)	(2.796)
Number of Obs.	1,431[b]	478[c]	2,203[b]	1,238[c]	1,376[b]	553[c]	1,805[b]	844[c]
Log-Likelihood	−1,065.56	−126.10	−1,702.98	−434.00	−1,119.39	−226.96	−1,470.50	−362.58

[a]The empirical model includes the same explanatory variables as the specifications in models 2 and 4 in Tables 3 and 4.
[b]The number of observations across institution types differs from that found in Tables 3 and 4 because the non-academics in the selection model are included in each specification.
[c]The number of observations across institution types differs from that found in Tables 3 and 4 because some sample members may change institution type and thus are dropped from the analysis.
*Statistically significant at the 10% level; **at the 5% level.

findings suggest that, unlike the promotion to associate professor, the gender difference in the promotion to full professor did not arise because women had less effective experience.

Promotion at Ph.D. versus Non-Ph.D. Institutions

Recent evidence suggests that the likelihood of women placing in top departments has increased over time (Singell and Stone 1993). If discriminatory preferences caused economics departments to initially hire only superior female economists who were very likely to be promoted, then declining gender bias or increasing affirmative action pressures might encourage less able female candidates to be hired. As a consequence, a change in the placement mix could tend to offset improvements in the probability of promotion for female economists, because research-oriented departments are likely to be more frugal than teaching-oriented institutions in granting promotions. One implication is that there should be separate analyses of women's promotion opportunities in research-oriented institutions and teaching-oriented institutions. This is particularly important because the productivity model that dictates the inclusion of a control for research output in the empirical specification is most likely to be relevant at research-oriented universities.

For simplicity, we define research-oriented departments as those granting Ph.D.s in economics. Although this division is somewhat arbitrary, the publication ranking by Graves et al. (1982) indicates that all of the top 50 departments and 96 of the top 100 departments are Ph.D.-granting. Thus, the presence of a Ph.D. program is highly correlated with research activity in economics. The results for persons starting their academic careers in Ph.D.-granting and non-Ph.D.-granting institutions are presented in Table 6, where, for brevity, the focus is again on the female-specific results. The coefficients on the non-gender-specific coefficients are qualitatively similar across the models for the two institutional types, except for the publication variable, which is statistically significant for Ph.D.-granting institutions but not for non-Ph.D.-granting institutions. The discussion focuses on the bivariate probit results because the coefficients from the random-effects models are largely statistically insignificant, which is likely due to the relatively small degrees of freedom in the panel data.

The results indicate differences in assistant-to-associate promotion opportunities for women in Ph.D. versus non-Ph.D. institutions. In particular, whereas female assistant professors at Ph.D. institutions in the 1960s were significantly less likely to be promoted than were their male colleagues, the promotion opportunities significantly improved in the 1980s, such that there was no statistically significant gender differential in promotion by 1989. On the other hand, there were no apparent gender differences in the assistant-to-associate promotion opportunities for female economists in non-Ph.D. institutions. Thus, the observed gender difference in promotion in the full sample of economists appears to have been largely due to the experience of those women who placed in research-oriented departments.

The sample-selection probit results for promotion to full professor are quite similar across Ph.D. and non-Ph.D. institutions. In general, for both Ph.D. and non-Ph.D. institutions, female associate professors were significantly less likely than similar men to be promoted to full professor during the 1960s, but there was significant improvement in their promotion opportunities in the 1980s. Overall, the results suggest that in the earlier period gender differences in promotion to full professor were pervasive across all institution types, but that significant improvements occurred in the 1980s across the quality spectrum of economics departments.

Conclusion

We have used panel data on American Economic Association members from 1964 to 1989 to examine whether the professional attainment and career advancement opportunities of female economists differed from those of their comparable male colleagues. Academia is a good setting for studying promotion because it has well-defined hierarchies that rank both departments within a profession and faculty within a department and because research productivity can be observed and directly compared across the profession. The focus on the economics profession provides an opportunity to examine whether women's promotion opportunities have improved in a male-dominated occupation that is transitioning toward more even representation.

Our ordered-probit model results indicate that women were under-represented at the senior ranks. This finding remains even when we include detailed controls for personal attributes and self-selection between academic and non-academic jobs. Bivariate probit models of promotion from assistant to associate professor and associate to full professor suggest that the gender differences in professional attainment arose because women were less likely than men to be promoted at each rung of the job ladder. Random-effects specifications indicate that the finding of gender differences in promotion is robust with respect to controls for both observed productivity and unobserved heterogeneity. Comparisons between the two probit models suggest that promotion to associate professor was a higher hurdle for women than promotion to full professor. Thus, the results suggest that the relatively small representation of female full professors was due to the cumulative impact of gender differences in promotion as faculty moved up the job hierarchy. Nonetheless, while women were less likely than men to be promoted, models that include time-varying gender dummies suggest that the promotion opportunities of female economists improved over time, particularly at research-oriented departments. The improvement in promotion prospects for female economists was such that the evidence indicates no unexplained gender differences in promotion by the end of the 1980s.

Overall, the results suggest the presence of a "glass ceiling" during the 1960s and continuing into the early 1980s in an occupation where men and women were likely to have relatively similar labor-market attachments and in circumstances affording ample controls for contemporaneous gender differences in productivity. Although the evidence for gender discrimination is compelling, prior research found that female economists during this period preferred a less research-oriented job than their male colleagues (Barbezat 1992) and that female academics dedicated more time to teaching and service than did their male counterparts at comparable institutions (Singell et al. 1996). Moreover, specifications that control for possible differences in "effective experience" between male and female economists eliminate all statistically significant gender differences in promotion from assistant to associate professor. It follows that the apparent equalization of promotion opportunities across gender in the late 1980s indicates that the glass ceiling broke, or men and women became more alike in their labor market attachment and taste for research, or some combination of those two changes came into play.

Appendix

To account for possible non-random self selection into or out of academia, we add to our models in equations (3) and (4) an index model:

$$S_i^* = W_i\delta + \eta_i, \quad \text{(A1)}$$

where S_i^* is a latent index of selection, W_i is a vector of characteristics that affect the decision to be in an academic job, δ is a vector of unknown parameters to estimate, and η_i is a standard normally distributed error. Because S_i^* is unobserved, a new Ph.D. enters academia or a senior economist remains in it if $S_i = 1$, which occurs when $S_i^* > 0$, and does not choose academia when $S_i^* = 0$.

For the case of job assignment, we now have a bivariate ordered-probit model with log-likelihood given as

$$\ln L = \sum_{S_i=0} \ln \Phi(-W_i\delta) + \sum_{S_i=1} \sum_{r=0}^{2} D_{i,r} \ln[\Phi_b(\mu_r, W_i, \delta, \rho) - \Phi_b(\mu_{r-1}, W_i, \delta, \rho)], \quad \text{(A2)}$$

where $\Phi(*)$ is the standard normal cdf, $\Phi_b(*)$ is the bivariate standard normal cdf, $D_{i,r} = 1$ if person i falls in rank r, $\mu_r = p_r - (X_i\beta - Z_i\gamma)$, $\mu_{r-1} = p_{r-1} - (X_r\beta - Z_i\gamma)$, and ρ is the sample correlation between ε_i and η_i. For the ordered probit indices, note that $p_{-1} = -\infty$, $p_0 = 0$, $p_1 = p$, and $p_2 = \infty$. Because the outcome is dichotomous rather than ordered for job promotion, the log-likelihood is simplified and is given as

$$\ln L = \sum_{S_i=1, P_i=1} \ln \Phi_b(\mu_i, W_i\delta, \rho) + \sum_{S_i=0, P_i=1} \ln \Phi_b(-\mu_i, W_i\delta, -\rho) + \sum_{S_i=0} \ln \Phi(W_i, \delta), \quad \text{(A3)}$$

where $\mu_i = (X_i\beta - Z_i\gamma)$. Identification for both of the bivariate sample-selection models is achieved by assuming that some variables affect the decision to select into or out of academia but not the probability of promotion.

Appendix Table A1

Simultaneous Probit Estimates for Academic or Not

	Simultaneously Estimated with:					
	Ordered Probit: Assistant-Associate-Full Professor		*Probit: Assistant to Associate Professor*		*Probit: Associate to Full Professor*	
Indep. Var.	*(Table 2)*		*(Table 3, Model 1)*		*(Table 4, Model 1)*	
Constant	1.256**	0.143	1.014**	0.228	3.498**	0.305
Female	–0.127**	0.056	–0.031	0.088	–0.264**	0.075
Articles Wtd. by Quality	0.263**	0.020	0.279**	0.032	0.265**	0.026
Top 35 Ph.D.[a]	–0.225**	0.047	–0.161**	0.070	–0.205**	0.065
Experience[b]	–3.166**	0.851	–22.562**	4.231	–22.358**	2.667
Experience^2	9.582**	2.681	214.541**	38.427	48.806**	6.003
Experience^3	–0.852	0.549	18.720	16.469	–1.084**	0.559
Cohort: 1955–59	0.071	0.121	—	—	0.032	0.125
Cohort: 1960–64	0.075	0.120	0.373*	0.218	0.075	0.129
Cohort: 1965–69	–0.056	0.117	0.108	0.199	–0.173	0.124
Cohort: 1970–74	–0.162	0.117	0.218	0.206	–0.143	0.125
Cohort: 1975–79	–0.449**	0.117	0.032	0.196	–0.741**	0.124
Cohort: 1980–84	–0.386**	0.127	–0.095	0.188	–0.374**	0.155
Cohort: 1985–89	–0.486**	0.132	–0.033	0.197	—	—
History	0.950**	0.134	0.958**	0.236	0.912**	0.171
Economic Systems	0.826**	0.176	0.633*	0.349	0.801**	0.221
Growth	–0.406**	0.064	–0.293**	0.109	–0.431**	0.077
Quantitative Methods	–0.230**	0.068	–0.159	0.107	–0.323**	0.089
Monetary	–0.119**	0.060	–0.147	0.092	–0.096	0.078
Fiscal	–0.135**	0.063	–0.217**	0.102	–0.173**	0.082
International	–0.345**	0.074	–0.226**	0.117	–0.402**	0.094
Business	–0.110	0.074	–0.044	0.126	–0.151*	0.092
Industrial Organization	–0.249**	0.069	–0.223**	0.108	–0.291**	0.088
Agricultural	–0.191*	0.114	–0.008	0.189	–0.283**	0.147
Natural Resource	–0.326**	0.091	–0.258**	0.145	–0.387**	0.116
Labor	–0.001	0.058	–0.165**	0.086	0.094	0.079
Urban and Regional	0.228**	0.088	0.311**	0.132	0.200*	0.115
Log-Likelihood	–4512.026		-1776.143		–2621.901	
Number of Observations	4,611		2,261		3,258	

[a]Department ranking based on publication rankings in Graves et al. (1982).
[b]Experience is divided by 10, experience squared by 100, and experience cubed by 1000.
*Statistically significant at the 10% level; **at the 5% level.

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