# TWO TO TANGO? GENDER DIFFERENCES IN THE DECISIONS TO PUBLISH AND COAUTHOR

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*The existence of old boy networks has long been postulated as a possible explanation for the presence of gender differences in market outcomes but with little empirical support because of the difficulty of measuring network access. This article exploits the unique attributes of academic labor markets and detailed data on individuals and jobs for PhD economists over nearly four decades. The results suggest that networks impact the joint decision to publish and coauthor, that these network effects differ by gender, and that gender differences in network access change over time as women become more well represented in a profession.* (*JEL* J44, J77, J24)

## I. INTRODUCTION

There is a well-developed mythology regarding the presence of "old boy networks" and their importance in explaining gender differences in labor market outcomes, as articulated by Saloner (1985). Nonetheless, aside from works such as Simon and Warner (1992), there is relatively little empirical evidence examining the impact of networks on market outcomes, how these effects differ by gender, and whether gender differences in network access change over time as women become more well represented in a profession. The paucity of empirical evidence arises in part from the difficulty of measuring the presence of such networks.

Prior work, including that of Saint-Paul (2001) and Erickson and Jacoby (2003), has found evidence that networks facilitate the adoption of team-oriented work practices and information sharing that increase average worker productivity in management and professional jobs. On the other hand, studies such as that by Marmaros and Sacerdote (2002) have also found that women have less access to networks than their male counterparts in both private and public sector jobs, which has been shown to yield gender differences in job placement and other labor market outcomes. This article considers how gender differences in networks are manifested in a specific male-dominated profession (i.e., academic economists) and in a specific work-related outcome (i.e., the decision to coauthor articles) in which access to networks is likely to be important.

The analysis uses uniquely detailed individual and job-level data for PhD economists included in nearly four decades of American Economic Association (AEA) membership to examine the role of networks on the joint decision to publish and coauthor. The unique matching process of PhD economists between academic and nonacademic jobs and within the hierarchy of academic departments along with the relative ease of observing joint research provide a rare opportunity to distinguish differential network access and measure joint production. The results demonstrate the importance of networks in the production of research output and that new (female) entrants into a male-dominated profession do not have equal access to these professional networks. The results also provide evidence that women are able to plug into networks

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**ABBREVIATION**

AEA: American Economic Association



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over time as the profession becomes more gender representative.

Our study contributes to the literature on the role of networks in the labor market in several ways. First, the profession of academic economist is well suited to this study, because it is made up of workers who produce a relatively homogenous output (i.e., scholarly journal articles) and that share a common set of job-related tasks (i.e., teaching, research, and service). Second, the incidence of coauthorship is an observable outcome measure of network utilization (a phenomenon inherently difficult to measure) in the tradition of the business productivity literature, as found in Sabel (1993). Third, there is extensive evidence in the literature that journal publications are positively linked to academic salaries, as found in Siegfried and White (1973) and Sauer (1988); that the propensity to coauthor is positively associated with publication output, as in as found in Durden and Perri (1995) and Maske et al. (2003); that there are gender differences in tendencies to coauthor, as shown by Ferber and Teiman (1980) and McDowell and Smith (1992); and that there are gender differences in professional outcomes, such as publications, salary, and promotion, as seen in McDowell (1982), Hansen et al. (1978), Formby et al. (1993), and Broder (1993). Cumulatively, these studies suggest that understanding the determinants of coauthorship is important for evaluating the sources and the extent of gender inequity in the profession.

Prior work on coauthorship behavior has analyzed patterns over time and across disciplines. Several studies, including Hudson (1996), McDowell and Melvin (1983), and Barnett et al. (1988), document a strong trend toward increasing collaboration over time in economics and other fields. McDowell and Melvin (1983) reason that this trend is due to increasing gains to specialization and division of labor in the profession, whereas Laband and Tollison (2000) point out the increasingly complex quantitative nature of economic research. Hamermesh and Oster (2002) suggest that technological advances that have lowered the cost of long-distance communication have allowed economists to reap consumption benefits from collaborative work.

There are several major ways this article builds on and extends these prior studies of coauthorship. First, the data utilized contain a richer set of observed attributes than available in prior studies, such as Buchmueller et al. (1999), and in particular, include information on the institutions where individual economists received their doctorates and where they currently work. This enables us to construct observable measures of the extent and quality of potential networks available to academic economists. These measures are useful for assessing the impact of network access, formation, and utilization on the publication and coauthorship behavior of male and female economists. Therefore, the detailed data used in this study enable us to gain insight into the extent of gender differences in networks and resulting differences in publishing and coauthorship, both within institutions and over time.

Second, the approach taken herein is to treat publication and coauthorship as joint decisions in the sense that coauthorship can only be observed among those economists who have published. In effect, considering coauthorship behavior in isolation subjects a study to sample selection bias if unobservable attributes that affect publication behavior also influence coauthorship. Thus, this article estimates the effect of observed attributes on the likelihood of coauthorship, conditioned on unobserved attributes that determine publication and are correlated with coauthorship (e.g., unobserved ability). This approach has not been previously taken in the literature, and the present results suggest that failure to account for the joint nature of the publication and coauthorship decision can yield misleading results, particularly with regard to gender.

Studies of gender differences in coauthorship suggest that women tend to coauthor less than men, in part due to the propensity of economists to coauthor with individuals of the same gender. Thus, in a male-dominated discipline, women appear to be disadvantaged in forming networks of potential coauthors. However, a key issue that these studies do not address is whether the observed lower propensity of women to coauthor can be explained to a large extent by their lower propensity to publish, which has been documented by Hansen et al. (1978) as well as Barbezat (1987). If so, then the disparities in promotions and salary that women experience in the profession may reflect publishing differences that arise from sources other than the ability to form adequate networks of coauthors in a male-dominated

profession. With a focus on institutions where research productivity matters most, this article extends prior work by looking at overall gender differences as well as gender differences according to the quality and dynamics of networks.

The base results suggest that there are no gender differences in coauthorship conditioned on the selected sample of economists who publish in a broad-based set of journals. However, the results suggest that women's coauthorship opportunities differ from their male counterparts in top departments and when a narrower set of high-quality journals are considered, suggesting gender differences in networks. Moreover, an Oaxaca-type decomposition of the bivariate publication and coauthorship probabilities also shows that men derive a larger publication benefit from coauthorship than women, which is due both to gender differences in attributes as well as the return to those attributes. Thus the role that networks play in research appears to have differed for male and female economists, but time interactions also suggest that significant differences by gender in both publication and coauthorship tendencies have disappeared for the most recent cohort of economists.

## II. EMPIRICAL MODEL

The decisions to publish and/or coauthor may arise simultaneously as two or more individuals collectively formulate an idea or sequentially if a researcher decides to publish and then finds that he or she requires collaboration to complete a project. In either case, these two decisions are likely to be correlated because they depend on many of the same individual, institutional, and labor market attributes. Moreover, the decision to coauthor is observed only for those persons who decide to and are capable of publishing. For simplicity, the decisions to publish and coauthor are modeled as discrete outcomes, where coauthorship is observed only for a select pool of economists who publish.

Specifically, a random utility approach is adopted where an individual $i$ publishes and/or coauthors in period $j$ if the utility of the decision exceeds the utility of the next best opportunity. Although the net utility from these decisions is not observed, the decisions to publish ($P$) and coauthor ($C$) are observed and are modeled as linear index functions:

$$(1a) \qquad P_{ij} = \alpha \cdot X_{ij}^{P} + \varepsilon_{ij}^{P}$$
$$P_{ij} = 1 \text{ if publish; } 0 \text{ if not;}$$

$$(1b) \qquad C_{ij} = \beta \cdot X_{ij}^{C} + \varepsilon_{ij}^{C}$$
$$C_{ij} = 1 \text{ if coauthor and}$$
$$P_{ij} = 1; \quad 0 \text{ if not,}$$

where the net utility of publishing and coauthoring by person $i$ at time $j$ depends on observed individual and institutional attributes, $X_{ij}^{P}$ and $X_{ij}^{C}$, and unobservables, $\varepsilon_{ij}^{P}$ and $\varepsilon_{ij}^{C}$, which are assumed to be distributed bivariate normal, $[0,0,1,1,\rho]$.

The coauthor decision, $C_{ij}$, is observed only if the person published, $P_{ij} = 1$, which can be estimated using the bivariate log-likelihood function with sample selection proposed by Meng and Schmidt (1985):

$$(2) \qquad \ln L(\alpha, \beta, \rho) = \sum_{i=1}^{N} P_{ij} C_{ij} \ln \Phi(\alpha \cdot X_{ij}^{P}, \beta \cdot X_{ij}^{C}; \rho) + C_{ij}(1 - P_{ij}) \ln[F(\alpha \cdot X_{ij}^{P}) - \Phi(\alpha \cdot X_{ij}^{P}, \beta \cdot X_{ij}^{C}; \rho)] + (1 - C_{ij}) \ln[1 - F(\alpha \cdot X_{ij}^{P})],$$

where $\Phi$ and $F$, respectively, denote the bivariate standard normal cumulative density function and the univariate standard normal cumulative density function for the errors in (1a) and (1b). The model is identified through the nonlinearity of (2) and because the differential role of networking in the two processes leads elements of $X_{ij}^{C}$ and $X_{ij}^{P}$ to differ, as discussed in the data section.

Estimating the coauthorship model jointly with the publishing decision offers efficiency gains by explicitly modeling the correlation $\rho$ between the error terms in (1a) with (1b). More important, the empirical model uses the unobserved attributes that determine the publishing decision that are likely correlated with the unobserved attributes that determine coauthorship, to condition the marginal responsiveness of the decision to coauthor on the observed attributes. Thus, the censored

model estimates the marginal impact of the observed attributes, such as gender, on coauthorship conditioned on the unobserved attributes, such as motivation or ability, that enter into the error term of the publishing model. It follows that the estimated effects of observed attributes (e.g., gender) on the decision to coauthor, though based on data for AEA members, may be generalized to broader populations that could have different propensities to publish.

## III. DATA

The data used to estimate equation (2) are primarily drawn from the 1964, 1974, 1985, 1989, 1993, and 1997 AEA directories, where the sample includes PhD economists who work in a job located in the United States.[1] These data provide a uniquely detailed set of contemporaneous attributes of AEA members, including their current job placement, title, and areas of interest, but provide only limited information regarding past career history other than their degree-granting institution. Nonetheless, whereas research output over a career depends on a host of time-varying factors (e.g., the number and type of past jobs) that are not observed in the AEA directories, it is reasonable to expect that research produced over a short interval of time depends on the current researcher attributes available in the data, such as job placement and academic rank, that reflect previous work-related performance. Thus, the AEA data are supplemented with information related to contemporaneous publication activity gathered from various issues of the AEA *Index of Economic Articles* for the membership years between 1964 and 1993 and from *EconLit* for the 1997 AEA directories. Specifically, the decision to publish (coauthor) is measured by a binary variable that equals 1 if an individual is observed to publish (coauthor) in the year of the cross-section or the subsequent year (i.e., 1964–65, 1974–75, 1985–86, 1989–90, 1993–94, 1997–98).[2]

The publication and coauthorship models share a common set of explanatory variables with the exception of a single exclusion restriction for each model. There are several categories for the explanatory variables that include individual-, institution-, time-, and market-specific controls. The individual-specific controls include life-cycle measures along with a control for gender. The publication model includes both age and a quadratic in post-PhD experience, thus allowing human-capital depreciation and accumulation, respectively, to vary over a career. In contrast, although the coauthorship model also includes the experience measures that permit network formation to vary nonlinearly over a career, the coauthorship equation does not explicitly model depreciation in network utilization due to an economist's age. In addition, a binary variable that equals 1 for female economists is included and is interacted with network and market measures in several specifications to examine whether women's coauthorship and publishing opportunities and outcomes systematically differ from their male counterparts.

Institution-specific controls include two qualitative measures of the economist's degree-granting institution and current job. A contemporaneous measure of PhD and current job quality is derived from the quality-adjusted average number of publications for in-sample economists from a given PhD institution or current job and net of the economist's own contribution.[3] The qualitative

1. McDowell et al. (2001) include a detailed explanation of the data and their construction. The current data have been extended and include economists who are AEA members in the years 1964, 1974, 1985, 1989, 1993, and 1997 (as identified in the respective AEA directories), as well as all female AEA members who had a PhD and were working in a job located in the United States, or 5,098 female economists.

2. The binary approach simplifies the analysis by avoiding the need to model correlations across multiple publication and coauthorship decisions. Even so, for the vast majority of economists, the two-year interval is sufficiently short that the publication decision is truly binary. Specifically, in the sample, the modal number of publications among all AEA economists is 0, whereas the modal number of publications among AEA economists who publish is 1. Nevertheless, our analysis does not exploit all the information potentially available in the data, and our results may not be fully applicable to exceptional academics who annually publish multiple papers throughout a career.

3. This variable is measured over the two-year window around the directory date. Publications are weighted by a journal quality measure, which is accounted for by using the SSCI *Journal Citation Reports* Impact Factor as a weight. For PhD institutions, the average quality is institution-specific, whereas these average measures are calculated across all non-PhD-institutions, business, government, or nonprofit placements because each specific placement has relatively few individual observations.

measures are included in both the publication and coauthorship equations because economists who originate (place) in a more publishing-oriented PhD program (job) may be more likely to publish but less dependent on coauthors. The contemporaneous average propensity to coauthor over a two-year window around the directory date for economists from a given PhD institution or current job, net of the economist's own coauthorship decisions, is also included in the coauthorship equation to reflect the institutional culture regarding coauthorship. However, the variables controlling for coauthorship within PhD cohorts and coauthorship within current jobs are excluded from the publication equation because coauthorship is of secondary importance to the propensity to publish after conditioning on institutional quality that directly determines the propensity to publish and coauthor.[4]

The institutional measures also include several descriptive measures of the economist's degree-granting institution and current job. The cohort size of an economist's PhD class is measured by the number of in-sample economists from a particular PhD institution for a given directory date and over the previous five years. This cohort measure is used in both models to proxy for a natural network within the profession that arises from a shared common graduate school experience. For academic jobs, access to a well-established stable network is measured by a binary variable that takes on the value of 1 for those 14 institutions that have been ranked in the top 20 by four publication rankings published in the four decades of the sample from the 1960s through the 1990s.[5] In addition, several binary variables are included in both the publication and coauthorship models that indicate whether the academic economist is an administrator or nontenured lecturer or has placed in an agricultural economics, business, or other department as opposed to an economics department, because these academics may have different publication expectations and opportunities to coauthor than regular economics faculty. Finally, three binary variables are included that indicate a job in government, business, or other nonacademic institutions, which might also indicate different incentives or opportunities to publish and coauthor.

Several variables are included to measure market conditions. The cohort size of market entrants, which is measured by the total number of in-sample new PhDs in a given PhD year and the five previous years, is used to proxy for the number of direct competitors for journal space. As such, more market entrants should be negatively related to the probability of publishing. However, a greater number of recently minted PhDs might also increase the number of potential similarly situated coauthors, which could increase the probability of coauthoring. Finally, the model includes five binary variables that equal 1 for the directory dates 1974, 1985, 1989, 1993, and 1997, where 1964 is the excluded date. These binary variables are included to examine whether there is any pattern in the tendency to publish or coauthor over time that might reflect changes in the relative valuation of these two activities within the economics profession.

Descriptive statistics for the full sample and disaggregated by gender are presented in Table 1. The means indicate that men are both more likely to publish and coauthor than their female counterparts. Some of these gender differences in the publication and coauthorship tendencies may reflect the fact that female economists are younger and have less experience than male economists. However, the descriptive statistics also show that women tend to have different opportunities than men. For example, female economists tend to place in jobs that have a lower contemporaneous publishing productivity and are less likely to place in top departments that have a historically high reputation. Women also appear to more frequently place in other-related departments relative to economics departments and in

4. Neither coauthorship variable is significant when included in a bivariate or univariate probit model for the decision to publish. Again, the coauthorship measure is institution-specific for PhD institutions, whereas these average measures are calculated across all non-PhD-granting, business, government, or nonprofit placements because each has relatively few individual observations.

5. The rankings for the 1960s were drawn from Cartter (1966), the 1970s from Graves et al. (1982), for the 1980s from Scott and Mitias (1996), and for the 1990s from Kalaitzidakis et al. (1999). Departments that have demonstrated publication excellence over 40 years have consistently hired and maintained a faculty who are among the best in their field, and who are likely to be superior coauthors in addition to being relatively well represented in professional networks (including editor positions at journals). Thus, access to professional networks, although available to some degree for most scholars, is likely to be relatively greater and more immediate for faculty who place in departments that demonstrate consistent excellence.

**TABLE 1**
Descriptive Statistics

| | Full Sample | | Women | | Men | |
|---|---|---|---|---|---|---|
| **Variables** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** |
| Female | 0.2939 | 0.4555 | 1.0000 | 0.0000 | 0.0000 | 0.0000 |
| Publication | 0.3666 | 0.4819 | 0.3237 | 0.4679 | 0.3844 | 0.4865 |
| Coauthorship | 0.2427 | 0.4287 | 0.2062 | 0.4046 | 0.2579 | 0.4375 |
| Age | 0.4361 | 0.0916 | 0.4157 | 0.0889 | 0.4446 | 0.0913 |
| Experience | 0.1313 | 0.0883 | 0.1046 | 0.0821 | 0.1424 | 0.0884 |
| PhD Institution Quality | 0.5368 | 0.3684 | 0.5045 | 0.3522 | 0.5502 | 0.3741 |
| Coauthorship within PhD Cohort | 0.2351 | 0.1097 | 0.2351 | 0.1084 | 0.2351 | 0.1103 |
| Cohort size of Market Entrants | 0.2746 | 0.1131 | 0.2814 | 0.1049 | 0.2718 | 0.1163 |
| Cohort size of PhD Class | 0.7709 | 0.6024 | 0.7526 | 0.5861 | 0.7785 | 0.6090 |
| Current Job Quality | 0.5048 | 0.5815 | 0.4697 | 0.5469 | 0.5194 | 0.5948 |
| Current Job in Top Department | 0.1176 | 0.3221 | 0.0985 | 0.2980 | 0.1256 | 0.3314 |
| Coauthorship within Current Job | 0.2214 | 0.1701 | 0.2193 | 0.1652 | 0.2223 | 0.1721 |
| Administrative Position | 0.0706 | 0.2562 | 0.0530 | 0.2240 | 0.0780 | 0.2681 |
| Lecturer | 0.0504 | 0.2187 | 0.1030 | 0.3040 | 0.0285 | 0.1664 |
| AgEcon Department | 0.0145 | 0.1194 | 0.0033 | 0.0577 | 0.0191 | 0.1369 |
| Business Department | 0.0858 | 0.2801 | 0.0457 | 0.2089 | 0.1025 | 0.3034 |
| Other Department | 0.0584 | 0.2345 | 0.0738 | 0.2614 | 0.0520 | 0.2220 |
| Government Sector | 0.0899 | 0.2861 | 0.0877 | 0.2829 | 0.0909 | 0.2874 |
| Business Sector | 0.1125 | 0.3159 | 0.1081 | 0.3105 | 0.1143 | 0.3182 |
| Other Sector | 0.0964 | 0.2952 | 0.1275 | 0.3336 | 0.0835 | 0.2767 |
| Year 1974 | 0.1194 | 0.3243 | 0.0804 | 0.2720 | 0.1357 | 0.3425 |
| Year 1985 | 0.1910 | 0.3931 | 0.1758 | 0.3806 | 0.1973 | 0.3980 |
| Year 1989 | 0.1988 | 0.3991 | 0.2156 | 0.4113 | 0.1918 | 0.3938 |
| Year 1993 | 0.2270 | 0.4189 | 0.2487 | 0.4323 | 0.2180 | 0.4129 |
| Year 1997 | 0.2134 | 0.4097 | 0.2444 | 0.4298 | 0.2005 | 0.4004 |
| No. observations | 17,348 | | 5,098 | | 12,250 | |

*Notes:* The variables Age, Experience, and Cohort Size of PhD Class size measures are divided by 100. The Cohort Size of Market Entrants is divided by 10,000.

"other" nonacademic jobs, in general. Finally, the descriptive statistics indicate that female economists are relatively overrepresented in the more recent sample years, which indicates that they are relatively new entrants into the profession. Thus, although women appear to differ in both the average propensity to publish and coauthor, the empirical analysis examines whether such differences remain after conditioning on the observed differences in attributes and accounting for the correlation in the unobserved attributes related to the probability of publishing and coauthoring.

## IV. EMPIRICAL RESULTS

### *All AEA Members*

For the total sample of AEA members, Table 2 presents the estimated coefficients from the bivariate probit model of publication and coauthorship, along with univariate probit results (for comparison), in which the publication and coauthorship decisions are estimated separately.[6] For the bivariate probit model, most of the coefficients are significant at traditional levels including the coefficient on the correlation coefficient ($\rho$), which indicates that the decisions to publish and coauthor are jointly determined. The negative coefficient on $\rho$ indicates that the unobserved

6. The bivariate probit model is estimated assuming that observations of the same individual over time are correlated, whereas there is no correlation between different individuals. Accounting for this individual-specific clustering generally increases the standard errors relative to a standard bivariate probit model with sample selection, reflecting the fact that there are fewer independent observations than the full 17,348 person-year observations would suggest.

**TABLE 2**
Total Sample Estimation Results

| | Standard Probit | | Bivariate Probit | |
|---|---|---|---|---|
| **Variables** | **Publications** | **Coauthorship** | **Publications** | **Coauthorship** |
| Female | −0.2161*** (0.0244) | −0.2339*** (0.0262) | −0.2143*** (0.0301) | −0.0471 (0.0437) |
| Age | −0.0607*** (0.0028) | — | −0.0611*** (0.0036) | — |
| Experience | 0.0560*** (0.0049) | 0.0144*** (0.0046) | 0.0562*** (0.0056) | 0.0367*** (0.0068) |
| Experience Squared | −0.0007*** (0.0001) | −0.0011*** (0.0001) | −0.0007*** (0.0001) | −0.0010*** (0.0002) |
| PhD Institution Quality | 0.2149*** (0.0379) | 0.0770 (0.0493) | 0.2144*** (0.0447) | −0.1865*** (0.0698) |
| Coauthorship within PhD Cohort | — | 0.6053*** (0.1566) | — | 0.3425 (0.2415) |
| Cohort Size of Market Entrants | −0.0047*** (0.0013) | −0.0001 (0.0014) | −0.0047*** (0.0015) | 0.0036* (0.0022) |
| Cohort Size of PhD Class | 0.0005** (0.0002) | 0.0001 (0.0002) | 0.0005* (0.0003) | −0.0011*** (0.0004) |
| Current Job Quality | 0.3464*** (0.0242) | 0.1563*** (0.0308) | 0.3446*** (0.0294) | −0.0559 (0.0465) |
| Current Job In Top Department | 0.1304*** (0.0412) | 0.1873*** (0.0418) | 0.1284*** (0.0488) | 0.1100* (0.0585) |
| Coauthorship within Current Job | — | 1.1022*** (0.0984) | — | 0.5697*** (0.1358) |
| Administrative Position | −0.3730*** (0.0449) | −0.2861*** (0.0491) | −0.3731*** (0.0518) | 0.2376*** (0.0849) |
| Lecturer | −0.4251*** (0.0518) | −0.4649*** (0.0577) | −0.4201*** (0.0590) | −0.0619 (0.0959) |
| AgEcon Department | 0.0444 (0.0827) | 0.0615 (0.0860) | 0.0439 (0.0954) | 0.1587 (0.1270) |
| Business Department | −0.2214*** (0.0385) | 0.1780*** (0.0402) | −0.2197*** (0.0455) | 0.0723 (0.0646) |
| Other Department | −0.2922*** (0.0471) | −0.2557*** (0.0500) | −0.2894*** (0.0586) | −0.0122 (0.0796) |
| Government Sector | −0.5612*** (0.0401) | −0.3809*** (0.0440) | −0.5606*** (0.0480) | 0.3177*** (0.0828) |
| Business Sector | −0.9897*** (0.0427) | −0.7359*** (0.0498) | −0.9887*** (0.0495) | 0.3726*** (0.1132) |
| Other Sector | −0.2797*** (0.0356) | −0.1913*** (0.0380) | −0.2790*** (0.0438) | 0.1119* (0.0616) |
| Year 1974 | 0.1133* (0.0621) | 0.2781*** (0.0785) | 0.1105* (0.0627) | 0.3907*** (0.1057) |
| Year 1985 | 0.3667*** (0.0644) | 0.4981*** (0.0832) | 0.3642*** (0.0668) | 0.5607*** (0.1211) |
| Year 1989 | 0.4729*** (0.0650) | 0.5665*** (0.0855) | 0.4710*** (0.0676) | 0.5728*** (0.1251) |
| Year 1993 | 0.4957*** (0.0647) | 0.6109*** (0.0852) | 0.4936*** (0.0686) | 0.6689*** (0.1264) |
| Year 1997 | 0.6309*** (0.0650) | 0.7236*** (0.0876) | 0.6287*** (0.0692) | 0.7429*** (0.1334) |
| Constant | 1.3847*** (0.1070) | −1.5065*** (0.0722) | 1.4021*** (0.1343) | −0.1628 (0.1565) |
| ρ | — | — | −0.5154*** (0.1095) | |
| Log likelihood | −9762.02 | −8497.82 | −13,616.53 | |

*Notes:* The variables Age, Experience, and Cohort Size of PhD Class size measures are divided by 100. The Cohort Size of Market Entrants is divided by 10,000. SEs in parentheses, and *** (**, *) indicates significance at 1% (5%, 10%) level.

heterogeneity in the publication decision (e.g., unobserved ability) is inversely related to those unobserved factors that determine coauthorship, which suggests that economists who are relatively inclined to publish are less dependent on coauthors. This result supports prior findings, such as those of McDowell and Melvin (1983), that coauthored work occurs more frequently among relatively specialized economists who require coauthors to publish. In addition, the sign and magnitude of the bivariate coefficients for coauthorship frequently differ from the univariate model, which indicates that it is important to condition for the correlation in the unobserved heterogeneity across the joint decisions to publish and coauthor.

The coefficients on experience and its quadratic term indicate that the publishing and coauthorship probabilities increase at a decreasing rate over a career. In particular, the magnitudes of the coefficients suggest that the probability of coauthorship increases over the first 19 years of a career (e.g., to the age of 49 for the average economist), whereas the probability of publishing increases with experience throughout a career (e.g., to the age of 70 for the average economist). Thus human capital and network formation appear to improve academic productivity and collaboration,

although coauthorship networks only appear to yield more joint work during the most productive years of an academic's career. Moreover, the coefficient on age in the publication equation indicates that older economists tend to publish less, conditioning on experience, indicating that depreciation of skills, reductions in the incentives to publish over a career (e.g., the tenure process), or increasing opportunity costs of publishing versus alternative activities (e.g., administrative responsibilities) yield lower research output. The joint effect of experience and age suggest that the publication probability declines throughout a career.

The coefficients on the contemporaneous quality measures of the economist's degree-granting institution and current job placement have opposite signs in the publishing and coauthorship equations. In particular, PhD institution and current job placement quality are positive and significant in the publishing equation, indicating that economists who originate or place in higher-quality departments are more likely to publish. However, the results also indicate that conditioned on publishing, both the PhD and current job quality are negatively related to the probability of coauthoring, which suggests either that more able economists are less dependent on coauthors or that economists who originate from (or place in) more publishing-oriented institutions have reward structures that provide greater incentives to produce single-authored work. Indeed, Sauer (1988) finds evidence that coauthored articles are discounted most heavily by top research departments. In fact, the coefficients on the variables that measure the contemporaneous coauthorship activity within the PhD cohort or within the current job suggest that economists coauthor more if they originate from or place in institutions where their colleagues are observed to more frequently collaborate.

The results for the quality measures also highlight the importance of estimating the coauthorship decision jointly with the publication decision. In particular, counter to the bivariate probit results, the univariate probit estimates indicate that economists who originate or place in high-quality departments are more likely to coauthor. This difference likely reflects the fact that qualitative differences among economists affect coauthorship through two offsetting channels. Specifically, more able economists (1) coauthor more because they publish more, but (2) coauthor less because are they are less dependent on coauthors. The positive sign for the quality measures in the univariate model suggests that the impact of (1) dominates (2).

The variable that measures the number of PhDs from the economist's PhD institution at a particular point in time is positive and significant in the publication model but negative and significant in the coauthorship equation. These opposing signs may indicate that the number of institution-specific PhDs who are AEA members is another dimension of PhD quality, which improves the probability of publishing and reduces the dependence on coauthors. In the publishing equation, the positive sign of the coefficient on number of PhDs is consistent with a more developed network in the profession that results from a shared experience. However, the negative sign for the coefficient on the number of PhDs in the coauthorship equation is counter to the network hypothesis, because networks might also be expected to facilitate coauthorship. Alternatively, the coefficients on the variable indicating a placement in a historically top-rated department suggest that having access to a network of high-quality colleagues significantly improves an economist's probability of publishing and coauthoring, which supports the hypothesis that networks improve productivity.

The results also indicate that the type of job matters for the decision to publish and coauthor. Specifically, academic economists who are lecturers or administrators are significantly less likely to publish, reflecting differences in the publication incentives and publication-related productivity for these jobs. However, conditioned on publishing, administrators are significantly more likely to coauthor, suggesting that the duties of academic economists who are drawn into administration require them to rely relatively more on collaborative activities to publish. The bivariate probit results also indicate that although AEA members in business and other related departments are significantly less likely to publish in economics journals, they do not appear to coauthor less given that they publish less. In contrast, whereas economists who place outside of academia (i.e., business, government, or other sectors) also are predicted to be significantly less likely to publish, they are significantly more likely to collaborate

conditioned on publishing. Thus nonacademic institutions appear to place less emphasis on publishing, while at the same time they may encourage (or at least not discount) collaborative publications.

The empirical findings also suggest some broad market forces or trends in the decision to publish and coauthor. In particular, the coefficient on cohort size of market entrants is significantly negative in the publication equation, suggesting that increases in the number of potential competitors for journal space reduce the probability of publishing, whereas it is significantly positive in the coauthorship equation, suggesting that it increases the potential number of coauthors. The sign and magnitude of the coefficients on the directory-year binary variables also indicate that the probability of publishing and coauthorship has significantly increased over time, which most likely reflects the increasing emphasis on research within the profession, particularly at institutions that have not historically required academic scholarship.

Finally, the results indicate that conditioned on placement, gender is significantly related to publication output. Specifically, consistent with the work of Johnson and Stafford (1974), female economists are predicted to be significantly less likely to publish than their male counterparts at comparable institutions. It is noteworthy that, whereas the univariate probit results predict that women are also significantly less likely to coauthor than men, the bivariate results indicate no gender differences in the probability of coauthoring conditioned on publishing. Thus, the results suggest that gender differences in coauthorship within the profession, which have also been documented by McDowell and Smith (1992), appear to be due to the fact that women are less likely to publish than comparably placed men and not because they have different opportunities to coauthor. However, as discussed by Kolpin and Singell (1996), women face relatively poor opportunities in academic institutions and, in particular, at the best academic institutions, where networks and publishing are likely to matter most. Therefore, the subsequent analyses focus on degree-granting institutions and publications in the most cited journals, where networks may be relatively ubiquitous and therefore sensitive to the growing representation of women in the profession over time.

*All PhD Granting Institutions*

*Nonnteractive Specifications.* Table 3 replicates the specification presented in Table 2, restricting the sample to the 7,048 academic economists who place at degree-granting institutions. In the results presented in Table 2, publication data have not been adjusted for quality (i.e., any journal research output enumerated in the respective volumes of the AEA *Index of Economic Articles* or *EconLit* is counted as a publication), and therefore for a more direct comparison across samples, we first consider the findings in Table 3 that relate to the results without the quality adjustment. Overall, the results appear to be quite robust across these two different samples. Although some coefficients on the explanatory variables become insignificant in the smaller sample of PhD-granting institutions, none of the coefficients that are significant in the previous analysis experience a change in sign that is significant, and most of the coefficients remain significant at traditional levels. In particular, although female economists publish significantly less than their male counterparts, they exhibit no significant differences in the observed propensity to coauthor, conditioned on the decision to publish. Thus gender differences in the probability of placing in PhD-granting economics departments, as documented by McMillen and Singell (1994), do not appear to explain the observed research pattern among male and female faculty.

The last two columns in Table 3 provide findings for the sample of degree-granting institutions when the publication data are adjusted for quality (i.e., a publication record is counted only if it is of high quality).[7] A comparison of the results with and without quality adjustments reveal three particularly noteworthy differences. First, with the quality-adjusted data, the coefficient on *Female* is insignificant in both the publication and coauthorship equation. Therefore, there are no apparent gender differences in the tendency to coauthor in either a broad-based or high-quality set of journals. On the other hand, although female economists are less likely to

7. Publications are weighted by a journal quality measure, which uses the SSCI *Journal Citation Reports* Impact Factor as a weight. In the quality-adjusted data, a publication count is recorded only if it has an average Impact Factor of 1.0 or higher, which is the minimum Impact Factor for the top 66 rated journals in our sample.

**TABLE 3**
Bivariate Probit Estimation Results for the Sample of PhD Institutions

| Variables | Without Quality Adjustment | | With Quality Adjustment | |
|---|---|---|---|---|
| | Publications | Coauthorship | Publications | Coauthorship |
| Female | −0.2372*** (0.0460) | −0.0312 (0.0602) | 0.0314 (0.0527) | 0.0525 (0.1028) |
| Age | −0.0641*** (0.0060) | — | −0.0526*** (0.0073) | — |
| Experience | 0.0715*** (0.0085) | 0.0375*** (0.0090) | 0.0537*** (0.0103) | 0.0498*** (0.0162) |
| Experience Squared | −0.0009*** (0.0002) | −0.0010*** (0.0003) | −0.0008*** (0.0002) | −0.0014*** (0.0006) |
| PhD Institution Quality | 0.2218*** (0.0641) | −0.2389*** (0.0907) | 0.3128*** (0.0706) | −0.0567 (0.2456) |
| Coauthorship within PhD Cohort | — | 0.3259 (0.3619) | — | −1.0691 (1.6170) |
| Cohort Size of Market Entrants | −0.0002 (0.0023) | 0.0050* (0.0029) | −0.0037 (0.0024) | 0.0066 (0.0052) |
| Cohort Size of PhD Class | −0.0002 (0.0004) | −0.0007 (0.0005) | 0.0014*** (0.0005) | −0.0018* (0.0010) |
| Current Job Quality | 0.1602*** (0.0325) | −0.0306 (0.0489) | 0.1843*** (0.0343) | 0.0099 (0.1085) |
| Current Job In Top Department | 0.1633*** (0.0508) | 0.0805 (0.0621) | 0.3565*** (0.0550) | −0.0720 (0.1364) |
| Coauthorship within Current Job | — | 0.4828*** (0.1632) | — | 0.2889 (0.5301) |
| Administrative Position | −0.3834*** (0.0723) | 0.2499** (0.1089) | −0.0912 (0.0823) | 0.0291 (0.1736) |
| Lecturer | −0.5003*** (0.0807) | −0.0032 (0.1444) | −0.4125*** (0.1006) | 0.0335 (0.2704) |
| AgEcon Department | −0.1057 (0.1038) | 0.2039 (0.1284) | −0.4799*** (0.1475) | 0.4247 (0.4089) |
| Business Department | −0.3136*** (0.0535) | 0.1019 (0.0756) | −0.0449 (0.0612) | 0.1151 (0.1167) |
| Other Department | −0.3712*** (0.0646) | −0.0246 (0.0901) | −0.3296*** (0.0748) | −0.0522 (0.1724) |
| Year 1974 | 0.1618** (0.0819) | 0.4299*** (0.1327) | −0.1061 (0.0955) | 0.3891** (0.1839) |
| Year 1985 | 0.4527*** (0.0928) | 0.5397*** (0.1651) | −0.2505** (0.1045) | 0.6505*** (0.2162) |
| Year 1989 | 0.5600*** (0.0949) | 0.5450*** (0.1712) | −0.3217*** (0.1067) | 0.7492*** (0.2176) |
| Year 1993 | 0.5940*** (0.0978) | 0.6530*** (0.1765) | −0.1004 (0.1067) | 0.8478*** (0.2286) |
| Year 1997 | 0.7077*** (0.0999) | 0.7276*** (0.1882) | −0.0721 (0.1100) | 1.1693*** (0.2340) |
| Constant | 1.5495*** (0.2108) | −0.1760 (0.2052) | 0.3922 (0.2477) | 0.0067 (0.5940) |
| ρ | −0.5653*** (0.1659) | | −0.3362 (0.3391) | |
| Log likelihood | −6542.83 | | −3401.15 | |

*Notes:* The variables Age, Experience, and Cohort Size of PhD Class size measures are divided by 100. The Cohort Size of Market Entrants is divided by 10,000. SE in parentheses, and *** (**, *) indicates significant at 1% (5%, 10%) level.

publish in a broad set of journals, they are no less likely than male economists to publish in the leading journals in economics. This evidence supports the work of Ginther and Kahn (2004), which finds that women tend to produce the same number of high-quality publications as their male counterparts but tend to produce fewer lower-quality publications.

In addition, publication trends over time differ depending on whether publications are adjusted for quality. For instance, among our sampled AEA members, publications have generally (i.e., without quality adjustments) increased over time, but publications adjusted for quality have not done so. In fact, the coefficients on the time dummies are generally negative (significantly so in 1985 and 1989), which may reflect that journal quality measures adjust with a lag and that growth in the number of PhD economists has made it relatively more difficult to publish in the fixed set of select journals. Moreover, concerning coauthorship, although the propensity to coauthor has increased over time within both quality-adjusted and unadjusted articles, the increase appears to be most pronounced within the quality-adjusted publications. Thus, the general rise in publication and collaborative activity may reflect the growth in more specialized journal outlets, which has increased demand for specialized research skills and enhanced the premium associated with coauthorship.

Finally, the correlation coefficient (ρ) continues to be negative in the quality-adjusted specification, but unlike in the unadjusted specification, it is now insignificant. This

**TABLE 4**
Bivariate Probit Estimation Results for the Sample of PhD Institutions with Interactions

| | Without Quality Adjustments | | With Quality Adjustments | |
|---|---|---|---|---|
| **Variables** | **Publications** | **Coauthorship** | **Publications** | **Coauthorship** |
| Female | 0.1016 (0.1749) | 0.1179 (0.2948) | 0.4015** (0.1946) | 1.1372*** (0.4559) |
| Current Job in Top Department | 0.1718*** (0.0571) | 0.1434** (0.0682) | 0.4424*** (0.0611) | −0.0694 (0.1602) |
| Year 1974 | 0.2158*** (0.0867) | 0.4220*** (0.1418) | −0.0839 (0.1029) | 0.5531*** (0.2049) |
| Year 1985 | 0.5206*** (0.0981) | 0.5555*** (0.1729) | −0.1618 (0.1122) | 0.9201*** (0.2406) |
| Year 1989 | 0.6015*** (0.1013) | 0.5164*** (0.1784) | −0.3240*** (0.1163) | 1.0441*** (0.2427) |
| Year 1993 | 0.6164*** (0.1052) | 0.6499*** (0.1849) | −0.0465 (0.1176) | 1.2065*** (0.2707) |
| Year 1997 | 0.7131*** (0.1092) | 0.7261*** (0.1980) | −0.0011 (0.1235) | 1.6398*** (0.3080) |
| (Female) * (Top Department) | −0.0313 (0.0928) | −0.2789*** (0.1114) | −0.3472*** (0.1007) | 0.0584 (0.2057) |
| (Female) * (Year 1974) | −0.4204** (0.2004) | −0.0057 (0.3256) | −0.1467 (0.2314) | −0.6729 (0.4582) |
| (Female) * (Year 1985) | −0.4789*** (0.1930) | −0.1611 (0.3181) | −0.4473** (0.2213) | −1.0319** (0.5099) |
| (Female) * (Year 1989) | −0.3632* (0.1907) | 0.0338 (0.3122) | −0.0959 (0.2172) | −1.1249** (0.4832) |
| (Female) * (Year 1993) | −0.2952 (0.1890) | −0.0731 (0.3104) | −0.2768 (0.2096) | −1.3209*** (0.4888) |
| (Female) * (Year 1997) | −0.2433 (0.1901) | −0.0731 (0.3095) | −0.3177 (0.2155) | −1.6030*** (0.5189) |
| ρ | −0.5765*** (0.1642) | | −0.3756 (0.3603) | |
| Log likelihood | −6533.31 | | −3379.75 | |

*Notes:* In addition to the interaction terms, the publication and coauthorship specifications include the same explanatory variable as presented in Tables 2 and 3. SE in parentheses, and *** (**, *) indicates significant at 1% (5%, 10%) level.

result suggests that those unobserved attributes that raise the probability of publishing in top-tier journals do not necessarily lower the probability of coauthorship. Publication in a high-quality journal is itself an indicator of ability (observed and unobserved). Thus the decline in the magnitude and significance of ρ in the quality-adjusted specification likely reflects a reduction in the level of unobserved publishing ability that is inversely correlated with an economist's dependence on coauthors and, thus, the decision to coauthor.

*Interactive Specifications.* If networks take time to establish and the quality of networks varies across jobs, then women's opportunities to collaborate may have changed as their representation in the profession has increased, particularly at those departments where there is access to high-quality coauthors. Table 4 provides the results for a specification that examines whether the probabilities of coauthorship and publishing differ for women over time and/or at top departments that are likely to have the most comprehensive and well-established networks. For brevity, only the coefficients on gender, top department, time, and their respective interactions are presented, because the qualitative conclusions for the excluded variables do not differ from those in the previous specifications.

Consider first the results in Table 4, columns one and two, which pertain to the without-quality-adjustment estimations. Although there are no significant gender differences in the temporal trend in coauthoring conditioned on publishing, the coefficients on the female-time interaction terms do indicate that gender differences in the probability of publishing have changed significantly over time. Specifically, in terms of the probability of publishing, the estimated effects indicate that female economists in 1964 (when women made up roughly 3% of the profession) were not significantly different from their male counterparts at comparable institutions. However, there was a large influx of women into the profession starting in the early 1970s, which corresponds with female economists having a significantly lower publishing probability than male economists in 1974. The gender difference in the publishing probability peaked in 1985 and thereafter declined in magnitude, with the significant lower publishing probability of female economists disappearing by 1993. Thus the relative research productivity of female economists has varied over time in a pattern

suggesting that an underrepresented group's surge in entry into a profession may be accompanied by a lag in productivity before that group's members develop the professional capital necessary to be as productive as those who are well established in the profession.

The coefficient on the interaction of gender with placement in a top department is negative but insignificant in the publication equation, indicating that women who place in top departments do not publish less than their male colleagues net of gender-specific trends in the probability of publishing. However, in the coauthorship equation, the coefficient on the top department and gender interaction is negative and highly significant. Therefore, although women outside the top departments do not differ significantly from men in terms of the probability of coauthorship (although the coefficient is positive), female economists who place in the top departments are significantly less likely to coauthor. On the other hand, the estimated effect of being in a top department is positive and significant, indicating that men are more likely to coauthor when they place in the best schools, holding the contemporaneous measures of quality constant. Therefore, male economists appear to benefit from the network of high-quality coauthors at top departments. However, because the combined effects of top department and its interaction with gender are not jointly significant, women do not likewise benefit from a top placement in terms of coauthorship opportunities. Thus when it comes to publishing in a broad-based set of journals, it appears that women who place in the historically best academic departments either do not have access to or are unable to take advantage of networks to the same extent as men who place in these departments.

The publication results for the quality-adjusted interactive specification (column 3) differ from those for the unadjusted data (column 1). Specifically, the quality-adjusted findings indicate that female economists observed in 1964 are significantly more productive than their comparably placed male colleagues. This finding may reflect that the very early entrants from a particular group into a profession must be relatively able to compensate for any possible disadvantages that may be associated with being from an underrepresented group. However, although the female-time interactions are not significant (except for 1985), the negative coefficients on these interaction controls suggest that the publishing propensity of female economists has become more similar to their male counterparts over time. On the other hand, the interaction term of female with top department is negative and significant and this result, combined with the significant positive coefficient on female, suggest that early female entrants published more than their male colleagues, but only those female economists who placed outside the top departments. This evidence is consistent with prior findings, such as those of Kolpin and Singell (1996), that women were initially underplaced in the profession and produced more research than their comparably placed male colleagues at lower-ranked departments.

With respect to coauthorship, the quality-adjusted data reveal results that are strikingly different from those found with the unadjusted data. For instance, after quality adjustments, the estimated effect of being in a top department is insignificant and does not differ by gender. Therefore, with respect to the production of high-quality articles, neither male nor female economists appear to benefit from a potential collaboration network of high quality coauthors at top departments, or if they do, this is offset by an incentive structure that emphasizes more single-authored work on high-quality publications.

Although the findings do not provide evidence indicating that women are faced with any disadvantage within top departments in terms of coauthorship opportunities on high-quality articles, there are significant gender differences in coauthorship. It is noteworthy, however, that the extent of such gender differences has diminished over time. Specifically, female economists in 1964 had a significantly higher probability of coauthoring conditioned on publishing, which suggests either that they were more dependent on coauthors or that they had greater relative incentive to produce coauthored work than did males. Thereafter, in the production of high-quality articles, female economists generally became less reliant on collaboration and, since around 1985, have become roughly equal to their male counterparts in terms of their propensity to collaborate.

The observed pattern of gender differences in coauthorship is consistent with a number of hypotheses that cannot be distinguished with these data despite the relatively detailed controls. For example, if women were initially underplaced within the hierarchy of academic

jobs as suggested by McMillen and Singell (1994) and Ginther and Kahn (2004), then they might tend to publish relatively more in high-quality versus a broader set of journals. Moreover, they might also tend to coauthor more, both because they would be relatively able coauthors and because lower-ranked departments may have reward structures that place less emphasis on solo-authored work. However, as women's placement in the hierarchy of jobs improved, their publishing and coauthoring tendencies moved toward those of their male colleagues. Alternatively, Ferber and Teiman (1980) find evidence indicating that articles with at least one female coauthor had a higher acceptance rate for manuscripts. This may reflect that women initially needed to plug into the male-dominated network to be successful and establish themselves in the profession or perhaps to overcome a perceived bias. This effect would tend to diminish as women become a larger fraction of the profession and more gender-neutral networks are established. Nonetheless, in the end, such hypotheses are purely speculative.

Although it is not possible to directly distinguish between these various competing hypotheses, the next section examines how the differences in the impact of coauthorship on the publishing decision can be decomposed into the effect of gender-differences in attributes (observed or unobserved) versus gender differences in the return to these attributes. However, before doing so, it is important to emphasize that several alternative specifications (not presented) indicate that these observed gender differences in coauthorship are not an artifact of the exclusion restrictions and are robust to alternative identification strategies. On the other hand, the sign and magnitude of the correlation coefficient ($\rho$) are sensitive to both the specification and the identification strategy and indicate, as expected, that the correlation of the errors in the publication and coauthorship equation depend on the explanatory variables that are assumed to explain these research decisions.

### *Gender Decomposition of Coauthorship's Contribution to Publication*

The observed decision to coauthor is itself a measure of a network that is expected to enhance research output. The prior findings, although suggesting possible gender differences in the use of networks over time and in better departments, indicate relatively few differences by gender in coauthorship behavior controlling for observed attributes and conditioned on the correlation of unobserved attributes in the publishing and coauthorship models. However, as Ginther and Kahn (2004) point out, the attributes of male and female economists often differ systematically, and the return to these attributes for research differs by gender. Thus, it is reasonable to ask whether networks facilitate research production differently by gender based on observed and unobserved differences in attributes or the productive return to these attributes.

To examine this issue, separate gender-specific bivariate probit models are estimated using the base specifications in Table 3, excluding the gender dummy. The gender-specific coefficient estimates are used to calculate the difference between the bivariate probability of both publishing and coauthoring (i.e., *publish* = 1 and *coauthor* = 1) and the bivariate probability of publishing but not coauthoring (i.e., *publish* = 1 and *coauthor* = 0) for the average male and female economist. The difference in the joint probability of publishing with a coauthor versus without a coauthor provides a measure of the contribution made by coauthorship to research production, which is now allowed to differ by gender.

For men, coauthorship's contribution to the probability of publishing can be calculated as $\Delta\Phi_M = \Phi[\bar{X}_M^P\beta_M^P, \bar{X}_M^C\beta_M^C, \rho_M] - \Phi[-\bar{X}_M^P\beta_M^P, \bar{X}_M^C\beta_M^C, -\rho_M]$, where $\Phi$ is the bivariate probability distribution, $\bar{X}_M^P$ and $\bar{X}_M^C$ are the average male attributes, $\beta_M^P$ and $\beta_M^C$ are the estimated parameters from the bivariate probit model for men, and $\rho_M$ is the estimated correlation coefficient. A discussion of this result appears in Greene (2003, p. 716). Likewise, coauthorship's contribution to the probability of publishing for female economists (i.e., $\Delta\Phi_F$) is calculated using mean female attributes and the estimated parameters from the bivariate probit model for women. It follows that the gender difference in contribution of coauthors to the probability of publishing can be calculated as $\Delta\Phi_{MF} = \Delta\Phi_M - \Delta\Phi_F$.

The resulting gender decompositions of the probabilities are summarized in Table 5.[8] For

8. The gender-specific bivariate probit models using both the quality- and nonquality-adjusted coauthorship and publication measures are available from authors upon request.

**TABLE 5**
Decomposition of Gender-Differences in the Benefits of Coauthorship to the Probability of Publishing

| | Without Quality Adjustments | With Quality Adjustments |
|---|---|---|
| $(\Delta\Phi_M - \Delta\Phi_F) = \Delta\Phi_{MF}$ | (0.295 − 0.109) = 0.186 | (0.329 − 0.208) = 0.121 |
| $\Delta\Phi^X_{MF}$ | 0.121 | 0.070 |
| $\Delta\Phi^\beta_{MF}$ | 0.102 | 0.207 |
| $\Delta\Phi^\rho_{MF}$ | −0.037 | −0.156 |

*Notes:* $\Delta\Phi^\beta_M$ and $\Delta\Phi^X_{MF}$ and $\Delta\Phi^\rho_{MF}$ measure the respective male–female difference in the contribution of coauthorship to the probability of publishing due to the coefficients, characteristics, and ρ, which must sum to the total male–female differential, $\Delta\Phi_{MF}$. $\Delta\Phi_{MF}$ also equals the contribution of coauthorship to the probability of publishing for men, $\Delta\Phi_M$ minus the same benefit calculation for women, $\Delta\Phi_F$.

males, coauthorship's contribution to the probability of publishing ($\Delta\Phi_M$) equals 29.5% using the nonquality-adjusted measures and 32.9% using the quality-adjusted measures, whereas $\Delta\Phi_F$ equals 10.9% and 20.8%, respectively. It follows that $\Delta\Phi_{MF}$ equals 18.6% for the nonquality-adjusted specifications and 12.1% for the quality-adjusted specifications. Thus, the findings suggest that the publishing probability is enhanced by coauthorship relatively more for male versus female economists and that this advantage is smaller for publications in higher-quality journals.

This observed gender difference in the publishing benefit from coauthorship may arise because male and female economists have different attributes (i.e., $X^P$ and $X^C$), receive a different productive return to those attributes (i.e., $\beta^P$ and $\beta^C$), or because the correlation of the unobserved attributes that jointly determine the decision to publish and coauthor (i.e., ρ) differs by gender. Thus, it is easy to demonstrate that $\Delta\Phi_{MF}$ can be decomposed into male and female differences in attributes ($\Delta\Phi^X_{MF}$), estimated coefficients ($\Delta\Phi^\beta_{MF}$), and correlation coefficients ($\Delta\Phi^\rho_{MF}$), or $\Delta\Phi_{MF} = \Delta\Phi^X_{MF} + \Delta\Phi^\beta_{MF} + \Delta\Phi^\rho_{MF}$.

The decomposition of $\Delta\Phi_{MF}$ using the nonquality-adjusted parameter estimates indicate that $\Delta\Phi^X_{MF}$ equals 12.1%, $\Delta\Phi^\beta_{MF}$ equals 10.2%, and $\Delta\Phi^\rho_{MF}$ equals −3.7%, whereas these estimates using the quality-adjusted parameters are 7.0%, 20.7%, and −15.6%, respectively. Thus, using both nonquality- and quality-adjusted parameters, the decompositions broadly show that gender differences in both the observed attributes and the productive return to those attributes contribute to the predicted publication advantage from coauthorship for male versus female economists, whereas the variation due to ρ actually reduces this male advantage.

Thus, overall the decompositions suggest that whereas female economists do not generally coauthor differently than their male counterparts conditioned on their attributes, there are gender differences in the benefits from coauthorship that arise from the fact that men and women differ in their observed and unobserved attributes as well as the return to those attributes. Several hypotheses might account for the apparent male publishing advantage from coauthorship and the relative importance of the parameters, including discrimination in promotion and hiring of women that heightens the relative importance of publishing in the best journals for women or simply a general preference by researchers to network and collaborate with persons of the same gender in a male-dominated profession. Nonetheless, the information requirements to test these hypotheses are beyond even these uniquely detailed data.

## VI. CONCLUSIONS

This article develops the first empirical model of the joint decision to publish and coauthor. Concerning a broad set of journals, although the analysis finds that female economists are significantly less likely to publish than their male counterparts at comparable institutions, the extent to which female economists have a lower probability of publishing has varied substantially over time. Indeed, by 1993, the significant lower publishing probability

of female economists has disappeared. The analysis also finds that after controlling for their lower observed probability of publishing, female economists are no less likely to coauthor than their male colleagues. Moreover, any apparent trend in gender-specific differences in the probability of coauthorship appears to be due to temporal differences in the probability that female economists publish relative to comparatively placed male colleagues.

Specifications that interact gender with placement in top departments indicate that women who place in top departments do not publish less than their male colleagues using a broad-based measure of publications. Nonetheless, women in top departments are found to engage in less collaborative activity, indicating that the significant gender difference in the probability of coauthorship seems to be attributable to those women who place in the best academic jobs. On the other hand, when the definition of publication is narrowed to include only higher-quality journals, women throughout the profession (in top departments and elsewhere) are found to publish comparably to their male colleagues but to coauthor relatively more than men. However, the significant gender differences in coauthorship in high-quality journals is found to disappear over time. The combined results suggest that initial female entrants into the profession produced a lower volume but more quality-oriented mix of publications and that women were more likely to coauthor if targeting better journals or if placed in less research-oriented departments. Overall, the results suggest that networks impact the joint decision to publish and coauthor, that these network effects differ by gender, and that gender differences in network access disappear over time as women become more well represented in a profession.

Gender differences in networks could help explain a number of other observed gender differences in opportunities among economists, including inferior job placement, lower research output, and a smaller likelihood of promotion for female versus male economists. Indeed, an Oaxaca-type decomposition of the bivariate publication and coauthorship probabilities suggests that women earn a lower publication benefit from coauthorship than men. This gender difference arises equally from differences in attributes and the return to those attributes for male versus female economists.

Overall, these findings may suggest that network formation tends to transition toward gender equality relatively slowly in a male-dominated occupation, which supports the theoretical work of Kolpin and Singell (1997) that suggests formal and informal organizations within the labor market can significantly affect the relative opportunities of women for a given occupation. Thus, although prior work suggests that women have made substantial progress toward equality in the economics profession, how professional interactions and resulting networks affect labor market outcomes and the role institutions play in shaping those interactions requires further study.

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