PROFESSIONAL ACHIEVEMENTS AND GENDER DIFFERENCES AMONG ACADEMIC ECONOMISTS

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This paper tests for gender differences in remuneration and professional achievement among academic economists using data on grants and grant applications to the National Science Foundation. A simultaneous equations model is used to examine the determinants of salary, rank, department affiliation and research output. In addition to confirming some long-standing folklore about the composition of faculty in research-oriented institutions, significant gender differences were found among older cohorts. Although the signs of the gender coefficients are consistent with a discrimination hypothesis for the sample of assistant professors, the results were not statistically significant.

I. INTRODUCTION

While the academic labor market for economists attracts a good deal of attention among its participants, work on the differences in remuneration for economic research and other professional characteristics between men and women in academic institutions has been limited. This paper tests for gender differences using data on grants and grant applications from the National Science Foundation.

Ault, Rutman and Stevenson [1979], addressing issues of academic placement, found that "the highest rated institution at which an academic economist will be employed is the institution of first employment." Willis and Pieper [1991] found that women who received doctorates in economics in the 1970s had a somewhat higher rate of placement at doctoral-degree granting institutions than men but that there was no difference in the rank of the institutions for these placements. Lower-tier institutions must offer promotions to attract candidates. Moore et al. [1983] reported that the rank of the department at which one earned the doctorate is critically important in determining initial academic placement. Hamermesh, Johnson and Weisbrod [1982] found that for those at prestigious departments increases in citations lead to salary increases, but that the department's rank was not inversely related to salary. In his review of work by sociologists, Youn [1988] reported that the prestige of an academic institution was positively related to the research productivity of its scientists. There are two competing hypotheses that might explain this result: better departments select better scientists (achievement model) or better departments foster greater productivity (ascription model). Empirical efforts to distinguish between these hypotheses have been mixed.

The research on salary differentials in academia has generally found that there

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are significant gender differences that widen during the careers of men and women.[1] Barbezat [1991], the most recent evidence, suggests that salary differentials in the academic community may have diminished somewhat since the 1960s but still remain. Weiler [1990] separated the influence of the department's rank on salary by treating it in a separate equation and found that standard formulations underestimate the degree of salary discrimination.

Although important, salary is not the only measure of achievement in academe. Promotion to a higher rank, employment in key departments and the production of well-placed articles all help determine an economist's influence in the profession. But despite the dramatic increase in the percentage of women receiving the Ph.D. during the past two decades, the number of senior women at graduate institutions is still very low.[2] To what extent does gender bias exist in economics departments, as measured not only by salary but also by other achievements such as the likelihood of achieving a senior position or being employed by a top department? Is there a difference in the experiences of the younger cohorts compared to their more senior counterparts? This paper attempts to answer these important questions by (1) taking into account the endogeneity of the variables that are usually treated as exogenous in models of salary determination and thereby broadening the characteristics that traditionally reflect "discrimination," and (2) using a new, detailed data base developed from the National Science Foundation. The results of this more complete model, in which salary as well as other measures of professional achievement are explained, show significant differences between men and women at the more senior level. At the assistant professor level, although the signs of the gender coefficients are consistent with a discrimination hypothesis, the results are not statistically significant.

1. See the foundation work of Bayer and Astin [1975], Johnson and Stafford [1974] (and reappraisals by Ferber, Loeb and Lowry [1978] and Strober and Quester [1977]), Ferber and Kordick [1978] and more recently papers by Barbezat [1987; 1989; 1991] and Weiler [1990].

2. In the top thirty graduate economics programs, only 3.5 percent of the full professors are women (Broder [1992]).

II. THE MODEL

Single equations using the techniques developed by Oaxaca [1973] and Blinder [1973] have long been used to estimate gender salary differentials in academia, with productivity measures such as books and articles published, administrative experience, etc. as explanatory factors. However, there are other characteristics of the academic labor market, such as the prestige of one's academic affiliation, that are an important part of the academic experience. For the segment of the profession with a heavy emphasis on research, salary depends on academic rank and research output (publications). But academic rank is also determined by research output, and research output is in turn a function of one's academic environment. This reasoning suggests a model in which the variables are simultaneously determined. The model proposed here is specifically developed for that component of the profession with a strong research orientation. A dummy variable for females is included in each equation to test for possible gender differences.

In the first equation of the model, salary (measured in natural logs) is dependent on both labor market and demographic variables:

$$(1) \qquad \ln SALARY = f(TOPART, EXPERIENCE, RANK, PUBLIC, FEMALE),$$

where *TOPART* is the number of articles published in (top) journals, *EXPERIENCE*

is the number of years since receiving the Ph.D., *RANK* is an ordered variable, where full professors are coded as "3," associate professors as "2" and assistant professors as "1." *PUBLIC* and *FEMALE* are dummy variables.[3] It is also possible that the prestige of an institution has an effect on salary, although previous research in this area has produced mixed results, and the effect of departmental ranking on salary will be tested in the empirical section. Current experience may be included here as a possible explanatory factor as well, since institutions may bid away top prospects with significantly higher salary offers.

The next set of equations involve achievements in academia. The most important variable in explaining salary, as found by earlier studies, is the academic rank of the individual. This, of course, is partially determined by the number of years since degree completion as well as productivity and (perhaps) gender. The influence of the number of articles on academic rank should vary by departmental prestige: more articles are needed for a given rank at a more prestigious department.

(2) $RANK = g(TOPART, EXPERIENCE, CURRENT\ TIER, FEMALE)$

CURRENT TIER is an ordered variable referring to the tier of the department, where tier 1 is the most prestigious and tier 6 the least prestigious.

The tier of the individuals current employing institution is modeled as dependent on predicted ability to produce top quality research (signalled by his or her Ph.D.–granting institution)[4] as well as actual output:[5]

(3) $CURRENT\ TIER = h(TOPART, PHD\ TIER, FEMALE)$

where *PHD TIER* is an ordinal variable for the tier of the Ph.D.–granting institution. As above, tier 1 corresponds to the most prestigious institution and tier 6 the least prestigious.

Finally, another difference between this paper and other economic studies of the academic labor market is that here productivity measures are treated as endogenous. The ascription model suggests that employment at a more prestigious institution (a more stimulating research environment) would lead to more quality publications. This would also show up if publications in top journals result from a "halo" effect.[6] Therefore, it is hypothesized that the prestige of the employing institution has an effect on productivity that is independent of the ability of the individual (signalled by the Ph.D.–granting institution).

(4) $TOPART = j(EXPERIENCE, PHD\ TIER, CURRENT\ TIER, FEMALE)$.

3. Although it would have been interesting to include other productivity gauges such as the number of books published, the reasoning of the model that such variables are endogenous would also lead to more equations.

4. In an aggregate model for the academic labor market, Scott [1979] argued that the rank of the graduate program attended indicates the research and teaching potential for new Ph.D.s.

5. Experience cannot be a factor in determining current output, given the academic tenure system. However, movement to a more prestigious institution occurs when people are recruited because of their productivity.

6. Blank [1991] found that based on the differences between non-blind and truly blind refereeing, department affiliation has a significant influence on the acceptance rate of publications. This gives empirical confirmation to a "halo" effect. She also reviews the evidence of the possible negative impact of single-blind refereeing on women's acceptance rates in journals. Her findings show no significant impact for acceptance rates.

III. THE DATA

Description of the Data Set

A data set was collected from the files of grants and grant proposal applications[7] to the National Science Foundation, Division of Social and Economic Science, Economics Program for 1988 and 1989.[8] When a proposal is submitted, the principal and all co-principal investigators submit a curriculum vitae and a budget request along with the proposal. The information collected for this project was contained in these appendices.

Salary information was obtained from the budget request and was annualized and converted into 1989 dollars.[9] Other background information, current employment status and output variables were obtained from the curriculum vitae of the principal investigator and any co-investigators. These variables included those necessary to estimate the model, including current institutional affiliation[10] and rank, beginning date of current position, number of positions since obtaining the doctorate, Ph.D.-granting institution,[11] articles in top journals,[12] gender and year the doctorate was earned, and other characteristics such as the number of books, total number of articles as well as number of editorial boards served on. Quality of department was based on the American Economic Association's rating of graduate programs in economics, which lists ninety-one institutions and divides them into five tiers with tier 1 being the most prestigious.[13] Other graduate departments are placed in a sixth, or least prestigious, tier.[14]

Description of the Sample

Sample characteristics appear in Table I, which provides summary measures on the entire sample and the assistant professor subsample, with breakdowns also given by gender. About half of the sample have the following characteristics: full professor rank, or employed by institutions in the top two tiers, or received their

7. All actions taken during the 1989 fiscal year were included in the data set. All 1988 grants were included, as well as a random sample of 1988 declined proposals.

8. Some grants in the Economics Program are made on a continuing basis. That is, a grant may be awarded and paid out in increments over a two or three year period. Some of the observations in this data set are based on grant applications submitted as early as 1985, but are considered 1988 or 1989 grants because of the continuing increments.

9. In 1989 a salary cap was imposed by the National Science Foundation on grantees. Subsequently, many individuals began to submit budgets with the salary cap amount rather than their actual salary. These data were collected from projects that were submitted before the salary cap became a constraint.

10. Individuals whose primary institution was outside the United States were eliminated from the sample.

11. Individuals who received a Ph.D. from a foreign institution were eliminated from the sample.

12. The list of top journals in economics was compiled using a reference article in *The American Economic Review* by Graves et al. [1982]. The list included the *American Economic Review, Econometrica, Economic Development and Cultural Change, Economic Inquiry, Economic Journal, Economica, Industrial and Labor Relations Review, International Economic Review, Journal of Business, Journal of Economic History, Journal of Economic Theory, Journal of Finance, Journal of Human Resources, Journal of Law and Economics, Journal of Money, Credit and Banking, Journal of Political Economy, Journal of Regional Science, Journal of the American Statistical Association, National Tax Journal, Oxford Economic Papers, Quarterly Journal of Economics, Review of Economic Studies, Review of Economics and Statistics* and *the Southern Economic Journal.* The 1988 *Citation Index* was used to compare those journals with the current status in the profession. Added to the list were the *Journal of Econometrics, Journal of Public Economics, Journal of International Economics,* and *Public Choice,* since these journals had more citations than the least cited journal in Graves et al.

13. An alternative classification system would have been that used by Carnegie. However, since most of the applications come from Ph.D.-granting institutions, the AEA classification provides better distinction among those schools.

14. The tier rankings are also used to rate the Ph.D. program of the individuals in the sample. Although there may have been changes in the rankings of departments over time, it is assumed that there would be no inter-tier changes.

TABLE I
Descriptive Statistics

Variable	*FULL SAMPLE* All (n=392)	Men (n=362)	Women (n=30)
	ARTICLES IN TOP JOURNALS		
fewer than 6	188	163	25
6–10	79	77	2
11–20	81	77	3
21–30	30	23	0
more than 30	14	14	0
	CURRENT INSTITUTION/PHD INSTITUTION		
Tier 1=Highest	92/196	87/184	5/12
Tier 2	99/111	91/100	8/11
Tier 3	66/43	64/40	2/3
Tier 4	59/19	54/18	5/1
Tier 5	37/16	34/14	5/2
All Others	39/7	34/6	5/1
	SAMPLE MEANS		
Salary (AY, 1989 Dollars):	62,606	64,288	42,302
Years since PhD	11.0	11.4	5.8
Years in current position	4.8	5.0	2.8
Percent in Public Institution	42	41	57

Variable	*ASSISTANT PROFESSOR SUBSAMPLE* All (n=134)	Men (n=115)	Women (n=19)
	CURRENT INSTITUTION/PHD INSTITUTION		
Tier 1=Highest	33/65	29/58	4/7
Tier 2	40/44	35/36	5/8
Tier 3	23/13	21/11	2/2
Tier 4	15/8	11/7	4/1
Tier 5	11/1	8/0	3/1
All Others	12/3	11/3	1/0
	SAMPLE MEANS		
Salary(AY 1989 Dollars)	43,004	43,653	39,076
Years since PhD	3.6	3.7	3.1
Years in current position	2.8	2.9	2.4
Percent in Public Institution	45	43	52

Ph.D. from institutions in the top tier, or published fewer than six articles in top journals.[15] Average academic year salary (in 1989 dollars) was over sixty-two thousand dollars. Although there is a large dispersion, the average number of years since the doctorate was earned is about eleven (reflecting the bimodal rank frequencies) but less than five years in the current position. Forty-two percent of the individuals were employed at public institutions. Women represent less than 10 percent of the entire sample, reflecting their proportions in the leading research institutions.[16] There are some striking differences in the characteristics of the sample by gender—a much heavier representation of younger women (again reflecting the greater representation of women in the lower ranks of the top research institutions) and, consequently, they have a lower average salary and have fewer articles published. Forty percent of the women in the sample have their degrees from institutions in the top tier (compared to 51 percent for the men), while 17 percent of the women are employed by institutions in the top tier (compared to 24 percent of the men). Women assistant professors receive on average, 90 percent of the male salaries, but have only 82 percent as much "experience."

IV. EMPIRICAL RESULTS

These results are based on data from the most research-oriented segment of the academic economics profession, which is arguably the most influential.[17] Therefore, its behavior is an important signal to the entire profession even though it is not known to what extent the findings are generalizable to all academics. In order to see if there are differences in older and younger cohorts, three different samples were estimated: the full sample, individuals who had more than six years experience since obtaining the Ph.D. (older cohort), and the assistant professors only. In general, the results show that gender differences are much more pronounced for the older cohort. Two-Stage Least Squares (2SLS) was used to estimate the model for each sample.[18]

Full sample

Salary Equation. Not surprisingly, rank had the most important influence on salary, a higher rank leading to about a 20 percent higher salary. Experience (and current experience, when included) was marginally significant and had a very small impact, which probably reflects the automatic cost of living increases that are forthcoming at most institutions. This is expected to explain more of the variation in salaries at the senior level, since big jumps in salary due to promotions in rank are no longer possible. The highly significant coefficient on top articles (as much as a 3.4 percent higher salary for every additional article) suggests that an article in a top journal may be worth as much as $2,129 per year at the average salary level. The results also show an insignificant salary premium for the more prestigious institutions. The size of the coefficient on the dummy variable for public institution is surprisingly large, averaging about 8 per-

15. The assistant professor profile is about the same for both (Ph.D.-granting and current institution).

16. In the top thirty ranked Ph.D. departments, 8.2 percent of the faculty are women (Broder [1992]).

17. Even within that component of the community, there may be differences in the individuals who apply for National Science Foundation grants and those who do not, which may affect the empirical results.

18. Because two of the endogenous variables in the model are ordered, discrete variables, a mixed system of ordered probit and linear regression in a simultaneous equations system would be the most appropriate method of estimation. Because of the lack of such an econometric program, a linear probability model was used for all four equations. The ideal models could not be estimated because of multicollinearity among the instruments.

TABLE II
2SLS Estimation of Full Sample (n=392)

Variable:	Ln Salary	Ln Salary	Rank	Rank	Tier	Topart
Constant	10.28*	10.48*	1.15*	.795*	1.88*	4.98*
Top Articles	.034*	.019*	.032**	.085*	-.002	—
Experience	.007***	-.007	.096*	.023	—	.744*
Rank	.208*	.237*	—	—	—	—
Current Tier	—	-.027	—	.116**	—	-1.17***
Current Exper.	—	—	-.073*	—	—	—
Public Inst.	-.105*	-.071**	—	—	—	—
PhD Tier	—	—	—	—	.541*	-.370
Female	-.048	-.083**	-.124	-.082	.391***	-1.91***
R^2	.58	.64	.66	.32	.18	.43
Differential unexplained (%)	24.5	24.8	14.6	18.5	75.3	31.7

*statistically significant at the 1 percent level
**statistically significant at the 5 percent level
***statistically significant at the 10 percent level

cent.[19] Finally, the coefficient for the female dummy variable suggests that women receive lower salaries than their male counterparts, the differential falling somewhere between 5 percent and 8 percent.

Rank Equation. Two specifications are presented since current tier and current experience could not be included together. The coefficient on current tier is positive. This means that the less prestigious the employing institution (higher numerical value), the higher the predicted value of the academic rank of the individual, holding other factors, such as the number of articles, constant. The negative coefficient on *FEMALE* means that women have lower predicted ranks, although the coefficient is not significant.

Current Tier Equation. Surprisingly, the number of articles does not have a significant impact on current placement, although this may reflect the large number of assistant professors in the sample. The negative sign of this coefficient means that as the number of articles increases, the prestige of the employing institution increases (a lower tier number means higher prestige). Accordingly, the positive sign on *FEMALE* means that women, ceteris paribus, are located at less prestigious institutions. The sign of the coefficient on *PHD TIER* is positive, as expected, showing that there is a significant, positive correlation between the rank of the graduate school attended and the rank of the employing institution.

19. A dummy variable was included if the institution was located in the southern United States, but it was not statistically significant. Also, non-linear versions of the model were estimated (in experience and article output) but the fits were much worse than the linear models.

Top Article Equation. The tier of the current department is the most important influence on the number of articles in top journals, although the ranking of the institution where the doctorate was earned has the expected sign (but it is not significant). Women have significantly fewer publications in top journals, even when other factors in the model are accounted for.[20]

Oaxaca's methodology[21] of decomposing the gender differences into explained (differences in average characteristics) and unexplained (discrimination) components was applied to each equation in the model, after separately estimating the equations for males only.[22] The results are presented in the last line of Table II. The salary decomposition indicates that almost one quarter of the actual differences by gender cannot be explained by the differences in measured characteristics, even when the simultaneity between some of the covariates is taken into account.[23] The rank equation that includes current tier suggests that 18.5 percent of the differential cannot be explained, and 14.6 percent cannot be explained for the equation with current experience. For the final two equations the unexplained components are 75.3 percent and 31.7 percent respectively for the current tier and top article equations. The magnitude of the unexplained component on the current tier equation is substantially larger than that of the other equations, but not surprising given the extremely low representation of women in top departments, especially at senior levels.

Older Cohort Sample

The most striking difference between the results of the full sample equations and the sample consisting of individuals with more than six years of experience (in Table III), is the size of the coefficient on the *FEMALE* variable. In every equation, the gender differential is larger than for the full sample. The coefficients are also more highly significant in this mature sample subset than in the full sample (except for the top article equation). The other major difference between these results and those of the full sample is that the number of top articles has a more significant and larger influence on the current placement, since sorting (denial of tenure) would occur after the sixth year.

Assistant Professors

The results of the estimation of this subsample are presented in Table IV, and they show limited evidence of gender differences for a recent cohort entering the profession. The *FEMALE* coefficients in every equation are "correctly" signed for gender discrimination but none is significant.

Only three equations are estimated because there is no variation in academic rank for this subsample. Correspondingly, there is also much less variability in many important characteristics, such as number of articles and experience, and the assis-

20. In this study there was no distinction between sole or co-authorship of articles. Since women tend to have fewer co-authored papers than men (McDowell and Smith [1992]), this may explain some of the difference in the results since having more coauthored papers leads to more total papers.

21. Using D_f and D_m to denote the dependent variable for females and males in any given equation, with b_f and b_m and X_f and X_m symbolizing the estimated coefficients and vectors of independent variables for the female and male equations, respectively, the decomposition of the total difference (left-hand side of the equation) into components explained by differences in characteristics (first term on the right-hand side of the equation) and unexplained differences which could be due to discrimination (second term on the right-hand side of the equation) is:

$$D_m - D_f = b_m(\overline{X}_m - \overline{X}_f) + X_f(b_m - b_f).$$

22. This breakdown was done only for the full sample. Because the model was not able to explain much of the variation in the characteristics of the assistant professors, the decompositions are much less reliable.

23. The calculations were also made for a salary equation estimated using OLS with this data base. The results showed about one-third of the salary differential to be unexplained, which is almost identical to Barbezat's [1991] recent findings.

TABLE III
2SLS Estimation for Older Cohort (n=249)
(more than 6 years of experience)

Variable:	Ln Salary	Rank	Current Tier	Top Articles
Constant	10.54*	2.55*	3.24*	11.30*
Top Articles	.019**	.013	-.073*	—
Experience	-.006	.020**	—	.541*
Rank	.183***	—	—	—
Current Tier	-.017	-.098	—	-1.96**
Current Exper.	-.005	—	—	—
PhD Tier	—	—	.377*	-.437
Public	-.093**	—	—	—
Female	-.131**	-.304**	.719***	-2.07
R^2	.46	.28	.30	.31

*statistically significant at the 1 percent level
**statistically significant at the 5 percent level
***statistically significant at the 10 percent level

TABLE IV
2SLS Estimation for Assistant Professors (n=134)

Variable	Ln Salary	Current Tier	Top Articles
Constant	10.76*	.902**	1.66*
Top Articles	.028	.224***	—
Experience	.003	—	.559*
Current Tier	-.058**	—	-.69***
PhD Tier	—	.736*	.171
Public	-.023	—	—
Female	-.033	.381	-.329
R^2	.15	.21	.17

*statistically significant at the 1 percent level
**statistically significant at the 5 percent level
***statistically significant at the 10 percent level

tant professor equations have much lower explanatory power. More prestigious departments pay assistant professors about a 6 percent differential (per tier), with very little else explaining the salary equation. As expected, tier placement is more strongly affected by the prestige of the Ph.D.-awarding institution in this subsample than in the mature sample since new entrants into the academic market generally have more promise than portfolio. The most surprising finding is the statistically significant positive sign for the top article variable in the current tier equation. A negative sign is expected because more articles should lead to employment at a more prestigious institution (lower tier number). The likely explanations for this result are that assistant professors are locked into contracts for at least three years and end up not producing enough for the prestige of their department (and are subsequently sorted out) or that assistant professors who do publish in the most prestigious journals are bid away to more prestigious departments, but only after the assistant professor level. The publication equation suggests that even accounting for endogeneity, more prestigious department placement helps produce more articles.

VI. CONCLUSIONS

The gender differences among economists in academic institutions that are presented in this paper are the first to be reported based on a multi-equation model. Because the data set contained the relevant variables, the results were also able to confirm some long-standing folklore about the composition of faculty in research-oriented institutions. When the endogeneity of academic rank, prestige of institution and article production is accounted for, there are still significant differences in male and female professional characteristics, most prominently appearing at the senior level. Despite the relatively small number of women in the sample, the gender coefficients are consistent with a hypothesis of "discrimination" and in most cases achieve statistical significance for the full sample and the older cohort. However, the results at the assistant professor level suggest fewer differences between men and women because the gender coefficients fail to achieve statistical significance. Unfortunately, because of the cross-sectional nature of the sample, it is impossible to tell if this finding is a cohort effect (because of changes in the treatment of women in the profession) or whether the differentials will grow as the current cohort ages (as has been the experience of older cohorts).

The data and analysis presented here show gender differences in the professional characteristics (in addition to salary) of research economists. As reported, the magnitude and significance is generally inversely related to the age of the cohort. What could explain these differences? For the older group it could be the accumulated effects of past discrimination and/or differences in unmeasured ability or not-easily-quantified attitudes between men and women.[24] Differences in field choice and the extent to which they are valued by top departments may also explain placement and article differences but could not be tested here. Also, differences in mentoring and collaboration patterns in graduate school and beyond, geographical immobility, childrearing responsibilities, and demands on women professors to participate in administrative duties (in order to have female representation on university-wide and professional committees) which distract from research are

24. The results of Barbezat's [1992] recent survey of graduate students found that graduate tier was positively correlated to job choice but that women thought it more likely that they would choose a job at a liberal arts college than a top tier institution. She points out that preferences stated by an individual are, to some extent, influenced by the likelihood that the individual can obtain a job with those characteristics. This may be an important factor in accounting for the large unexplained differences in tier placement.

likely factors in explaining any gender differences that appear.

Although the results presented here for the older cohorts are discouraging, especially for the placement equation, they are being driven by a small number of individuals (who are clearly "special" in many ways, given the low proportion of senior women in the profession). The number of women receiving the Ph.D. in economics has exploded in the past decade, going from an average of 8 percent during the 1970s to 15 percent in 1984/85 and 21 percent in 1988/89.[25] If the findings in this paper, that there are smaller gender differentials among current assistant professors, is because of changes in the way new female cohorts are being treated, it is possible that over the next decade many more women will achieve leadership positions in the profession. A definitive answer to the gender discrimination question in academic economics still awaits a detailed, longitudinal database and analysis.

25. Committee on the Status of Women in the Economics Profession [1992].

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