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GENDER EQUITY IN THE ACADEMIC LABOR MARKET: AN ANALYSIS OF ACADEMIC DISCIPLINES

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This study uses hierarchical linear modeling (HLM) to analyze the effect of human capital, structural characteristics of the discipline, and disciplinary labor market conditions on faculty salaries. Faculty in disciplines characterized by relatively low demand, high teaching loads, and low amounts of research funding earn less than do faculty in other disciplines. Additionally, even after controlling for an array of individual and disciplinary characteristics, women faculty members earn less than their male peers.

KEY WORDS: faculty; gender equity; salaries; labor markets; academic disciplines; hierarchical linear modeling.

A common line of inquiry of the academic labor market is salary equity research. In the 40 years since the passing of the Equal Pay Act of 1964, researchers have attempted to assess salary equity among faculty members. Nearly all of these studies seek to identify the pay gap between men and women that cannot be explained by differences in faculty characteristics and institutional attributes. They find that even after controlling for education, productivity, experience, institution type, and academic discipline, women earn less than men (Barbezat, 2002; Barbezat, 1991; Bellas, 1993, 1994, 1997; Perna, 2001; Toutkoushian, 1998a, b; Toutkoushian and Conley, 2005).

Although researchers have studied faculty salary equity extensively, several important conditions of the academic labor market remain unstudied or understudied. In particular, few have undertaken

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comprehensive studies of the impact that disciplinary labor markets have on gender inequities. We know that Biglan's categorization of academic fields suggests that salaries are dependent upon the degree of consensus concerning theory and methods within a discipline (Nettles, Perna, and Bradburn, 2000; Smart and McLaughlin, 1978). We also know that salaries are lower for faculty in disciplines with high proportions of female faculty members (Barbezat, 1991; Bellas, 1993, 1994, 1997; Perna, 2001; Smart, 1991).

All of these studies suffer from a variety of methodological problems and fall short of providing a comprehensive examination of the effect of disciplinary labor markets. First, previous research examines only a few characteristics of labor markets. For example, we know little about the impact that supply of Ph.Ds in a particular discipline has on salaries and salary equity. Second, previous research on disciplinary affects on salary equity is dated or relies on limited samples. Third, the methods employed in previous research are limited and may result in inaccurate estimates. In the past, researchers of faculty salary equity have attempted to solve this problem in various ways. Many have built statistical models attaching group-level variables to individuals. This technique is considered by many as inappropriate when examining complex data at multiple levels (Heck and Thomas, 2000; Luke, 2004). In fact, it is quite possible that this strategy will result in inaccurate parameter estimates (Ethington, 1997; Heck and Thomas, 2000; Luke, 2004; Raudenbush and Bryk, 2002). Others (Perna, 2001; Smart and McLaughlin, 1978) have collapsed disciplines into categories such as those proposed by Biglan, reducing variability and masking true differences between disciplines. These studies are useful in finding the differences, but they do little to explore the attributes of the discipline that may explain salary inequities.

PURPOSE AND RESEARCH QUESTIONS

Therefore, this study attempts to overcome these shortcomings by integrating two national datasets and employing hierarchical linear modeling (HLM) to examine disciplinary and individual characteristics related to academic salaries. Using HLM overcomes the estimation problems presented in previous research by simultaneously estimating equations for both individual and disciplinary structural and labor market effects. Yet few, if any, studies of salary equity at colleges and universities have used HLM to examine the contextual effects of academic disciplines on faculty salary equity (Loeb, 2003; Perna, 2003). That said, this study asks two questions:

1. After controlling for individual human capital, what affect do structural characteristics (e.g., research productivity) and labor market conditions (e.g., supply/demand) of the academic discipline have on faculty salaries?
2. What influence do structural characteristics and labor market conditions of the academic discipline have in explaining the gender wage gap?

REVIEW OF THE RELEVANT LITERATURE AND THEORETICAL FRAMEWORK

This study combines human capital theory, labor market theory, and structural theory as a framework to explore gender differences in labor market outcomes. Human capital theorists use individual characteristics to explore differences in rewards, while structural theorists explore elements of organizations, social structures, and labor market conditions to explain these differences. Economists use human capital theory to explain the non-physical attributes of an individual that affect career mobility and earnings. The most common attributes discussed by human capital theorists are an individual's knowledge, skills, education and training (Becker, 1993). Human capital theory suggests that individuals accumulate human capital through investments in education, training, and work experiences, which then can be exchanged for increased earnings, power, and occupational status (Becker, 1993; Rosenbaum, 1986). Scholars have used educational attainment, experience, research productivity, teaching outputs, and rank as measures of human capital (for a full description of these see Perna, 2003; Toutkoushian, 2002, 2003a, b).

Researchers suggest that, because of this sole focus on individual attributes, human capital theory inadequately explains the complexities of social structures and labor markets (Perna, 2003; Rosenbaum, 1986). Some turn to structural theory and theories related to labor markets to explain these complex factors that impact salaries. Structural theory suggests that salary inequities are caused in part by the way in which positions are structured and labor markets are segmented (Youn, 1992).

Some argue that the application of the idea of comparable worth is useful when exploring the gender wage gap. Researchers who ascribe to the comparable worth perspective suggest "that because women are socially devalued, so too is the work that women do. Consequently, employers may set wages for work that is typically done by a woman lower than wages for comparable worthwhile work typically done by men" (Bellas, 1994, p. 808). Therefore, when individuals work in environments that are easily identified as being dominated by women, the value of the work done in those environments is seen as less valuable (England, 1992; Feldberg, 1984). As a result, both women and men in female dominated fields will earn less than those in who are in more male-dominated fields.

Research applying these theories to faculty salaries reveals that sex differences are related to market segmentation resulting from the greater likelihood that women work in institutions with lower prestige and focus on work roles that are not rewarded (Smart, 1991). Women also tend to teach in fields where the pay is lower, such as the arts and humanities (Bergmann, 1985). Researchers find that faculty in disciplines with high proportions of women faculty earn less than those in disciplines with high proportions of male faculty (Barbezat, 1991; Bellas, 1993, 1997).

While labor markets are generally national in scope, many consider them to be segmented into a number of separate markets for each discipline (Bowen and Sosa, 1989; Toutkoushian, 2003a, b). This makes sense both theoretically and empirically. Theoretically, individuals qualified to teach in a particular field define the supply of faculty labor; and those seeking to hire an individual qualified to teach in that field determine demand. Empirically, many have found that faculty within a particular discipline are more similar in their earnings than faculty from different disciplines (Smart, 1991; Barbezat, 1991; Bellas, 1994, 1997). For these reasons, this study seeks to understand labor market conditions of the discipline that affect salaries and salary inequities.

DATA AND METHODS

Data Description

The primary data sources for this study are the 1999 National Study of Postsecondary Faculty (NSOPF) and the Survey of Earned Doctorates (SED). The 1999 administration of the NSOPF offers a unique way to understand the complex issue of salaries because the data represent a stratified sample of faculty from across the United States. The 1998–99 study (NSOPF:99), included 960 degree-granting postsecondary institutions and approximately 28,600 faculty and instructional staff. A subsample of 19,813 faculty and instructional staff was drawn for additional survey follow-up. Approximately 18,000 faculty and instructional staff completed questionnaires for a weighted response rate of 83%.

Because this study focuses on disciplinary labor markets, I restricted my sample to faculty from Research I and Research II Universities, institutions where faculty affiliation to the academic discipline tends to be more salient than their institutional affiliation (Clark, 1962, 1987). From these universities, I also included only full-time, tenured or tenure-track faculty holding the rank of full, assistant, or associate professor. I used principal field or discipline of teaching as the academic discipline of appointment. When respondents did not indicate a teaching field, I used principal field of research as their disciplinary home. My final dataset included 2,758 faculty from 79 academic disciplines.[1]

I also used the SED,[2] an annual census of doctoral recipients, to obtain labor market measures. With an approximate response rate of 92% for each of the five most recent administrations, the SED provides a comprehensive picture of a major component of supply and demand in the academic labor market. Included in the dataset are variables such as discipline of degree, race/ethnicity, gender, and work activities planned.

Methodology

I employ hierarchical linear modeling to analyze the impact of human capital, structural characteristics of the discipline and disciplinary labor market conditions on faculty salaries. Handling both human capital characteristics, labor market conditions, and structural attributes presents a unique challenge to researchers. The problem lies in the challenge of how to handle these disciplinary effects in the models. Should researchers aggregate to the group (discipline) level and ignore the impact of individuals, or should researchers attach group-level characteristics and ignore obvious assumptions about the statistical tests we use?

In the past, researchers of faculty salary equity have attempted to solve this problem in three ways. First, they built statistical models attaching group level variables to individuals. Variables such as institution type (Bradburn and Sikora, 2002; Fairweather, 1996; Nettles, Perna and Bradburn, 2000; Toutkoushian and Conley, 2005; Toutkousian, 1998a, b, c), whether the discipline is a high-paying field or not (Fairweather, 1996), gender composition of the discipline (Bellas, 1997), average number of courses taught in a discipline (Fairweather, 1996) have all been attached to individuals in ordinary least squares regression models. Models using this strategy have four problems. First, they violate a fundamental assumption of regression by treating the observations as if they were independent of one another. The impact of being nested within a discipline is overlooked in such models. Second, using these methods make it very difficult to partition what can be attributed to disciplinary membership and what can be attributed to the individual. Third, these approaches can result in inaccurate parameter estimates or inappropriate degrees of freedom, thus leading to misleading results that then may mislead decision making or policy analyses. Finally, they are limited in their ability to explore the interaction effects of disciplines and individuals.

Others (Perna, 2001; Smart and McLaughlin, 1978) have collapsed disciplines into categories such as those proposed by Biglan, reducing variability and masking true differences between disciplines. These studies are useful in finding the differences, but they do little to explore the attributes of the discipline that may explain salary inequities.

A third approach commonly taken by researchers is to build a model for every discipline or institution type. Using this approach, researchers build dozens of models in a single study to examine and control for disciplinary differences (Fairweather, 1996; Toutkoushian, 1998a, b, c). This approach is problematic from a policy analysis standpoint. These models can be difficult to interpret and fall short of providing a clear and parsimonious analysis. In an attempt to simplify, researchers often collapse disciplines into larger categories and use these categories to build only a handful of models. Again, this strategy can hide the differences between disciplines that have been placed into larger categories. Even more important, this method tells policy makers and researchers very little about what might be explaining differences between disciplines.

Only recently have higher education researchers begun to recognize the need to analyze data taking into account the nested organizational structures of higher education (Ethington, 1997; Porter and Umbach, 2001). They employ HLM techniques in an attempt to appropriately handle the complex organizational effects of colleges and universities and provide the tools necessary to arrive at results that are more accurate. Yet some (Loeb, 2003; Perna, 2003) have asserted that few, if any, studies of salary equity at colleges and universities have used HLM to examine the contextual effects of academic disciplines on faculty salary equity. This study employs hierarchical linear modeling to examine disciplinary and individual characteristics related to academic salaries. In HLM, I am able to allow the intercept to vary by academic discipline. I then model the intercept (average salary for an academic discipline) using disciplinary characteristics. At level-2 (academic discipline), I include several structural variables and labor market characteristics in the models.

Modeling Strategy

I derive the dependent variable from a faculty member's basic salary from the institution.[3] I calculate the natural logarithm of salary to obtain a more normally distributed dependent variable. In a multi-level context, the first step is to create a model with no predictor variables. The intercept for this model, often called the null model or one-way ANOVA model, is allowed to vary, thereby partitioning the variance within and between disciplines. Equation 1 displays the null model,

$$\ln Y_{ij} = \beta_{0j} + r_{ij} \tag{1}$$

where ln Y_{ij} is the dependent variable (natural log of salary), and β_{0j} is the mean for discipline j, and r_{ij} is the deviation from the discipline mean for faculty ij, where i is the individual faculty member and j is the discipline. The result of the null model is used to estimate the proportion of variance that exists between and within colleges. In this case, the proportion of variance explained by academic disciplines is approximately .07.

The second step of the modeling procedure is the creation of the within discipline models (also know as the level-1 models or the individual level models). I enter the individual-level independent variables into the equation in blocks to isolate the effects that demographic characteristics, human capital, and disciplinary labor market and structural characteristics have on salary equity. Table 1 presents the descriptive statistics and descriptions of the independent variables included in the analyses. I begin with the model demographic model containing relatively few controls. In this model, I only enter in the female dummy-coded variable and a series of dummy-coded variables for race/ethnicity. This model can be represented as,

$$\begin{aligned}\ln Y_{ij} = {} & \beta_{0j} + \beta_1(\text{female}) + \beta_2(\text{AfricanAm}) + \beta_3(\text{Asian}) + \beta_4\ (\text{Latino}) \\ & + \beta_5(\text{other}) + r_{ij}\end{aligned} \tag{2}$$

where ln Y_{ij} (natural log of salary) is calculated as a deviation from the average salary of a discipline (β_{0j}) based on the effect of being female (β_1), the effect of being a person of color (β_2 to β_5), and error (r_{ij}).

In the next block, I introduce a number of human capital variables at level 1. I rely heavily on the recent work of Perna (2003), Toutkoushian (1998a, b, c), Toutkoushian and Conley (2005), Barbezet (1991), Fairweather (1996), and Bellas (1993, 1994, 1997) in the construction of my individual level models. I first include a dummy-coded variable that represents whether the faculty member is a chairperson. I also include a series of dummy-coded variables to represent educational attainment and three measures of experience (years of seniority in current position, years teaching in higher education, and age). Because research is rewarded differentially than teaching (Smart and McLaughlin, 1978), I include a number of controls for productivity. To represent research

TABLE 1. Descriptive Statistics of Variables Included in Models

Independent variable	Mean	SD	Description
Individual-level variables			
Female	0.298	0.457	1 if female, 0 if male
African American	0.053	0.224	1 if African American, 0 otherwise
Asian Pacific American	0.096	0.295	1 if Asian Pacific American, 0 otherwise
Latino/a	0.049	0.217	1 if Latino/a, 0 otherwise
Other race	0.015	0.120	1 if other race, 0 otherwise
Chairperson	0.116	0.321	1 if chairperson, 0 otherwise
Age	49.708	9.761	Age in years as of 1998
Years experience	18.123	10.780	Number of years teaching in higher education as of 1998
Years experience squared	444.591	439.170	
Years seniority	13.948	10.262	Years in current position as of 1998
Years seniority squared	299.813	364.248	
Career articles	35.473	43.455	Number of articles in peer-reviewed professional or trade journals, or creative works published in juried media in career
Career chapters	8.026	13.805	Number of book reviews, articles, and creative works, or book chapters published in career
Career books	4.136	9.163	Number of textbooks, other books, monographs, research, or technical reports published in career
Career patents	0.674	2.198	Number of career patents
Percentage time teaching	43.002	24.392	Percentage time spent on teaching related activities
Any funded research currently	0.613	0.487	1 if currently have funded research, 0 otherwise
Doctorate	0.817	0.387	1 if highest degree is doctorate, 0 otherwise
Professional degree	0.104	0.305	1 if highest degree is professional degree, 0 otherwise
MA	0.074	0.262	1 if highest degree is masters, 0 otherwise
Full professor	0.446	0.497	1 if rank is full professor, 0 otherwise

TABLE 1. (*Continued*)

Independent variable	Mean	SD	Description
Associate professor	0.316	0.465	1 if rank is associate professor, 0 otherwise
Discipline-level variables			
Percentage female	44.437	18.504	Percentage of females
Percentage unemployed	32.596	9.226	Percentage of recent graduates without job or seeking
Percentage with funded research	57.982	23.954	Percentage with funded research
Mean career articles	31.754	18.466	Mean number of articles in peer-reviewed professional or trade journals, or creative works published in juried media in career
Mean career chapters	7.772	4.945	Mean number of book reviews, articles, and creative works, or book chapters published in career
Mean career books	4.400	2.613	Mean number of textbooks, other books, monographs, research, or technical reports published in career
Mean career patents	0.627	0.616	Mean number of career patents
Mean percentage time teaching	24.938	11.325	Percentage time spent on teaching related activities
Dependent measure			
Salary	78850	36644	Base salary from institution
Natural log of salary	11.150	0.724	Natural log of salary

Note: All variables are derived from NSOPF:99 with the exception of % female and % unemployed. Both were drawn from the Survey of Earned Doctorates, years 1995–1997.

productivity, I include the number of career peer-reviewed articles or creative works in juried media, book chapters, books, and patents. I also measure grant production using a dummy-coded variable that represents whether the faculty member is currently on any grant-funded research project. To represent teaching efforts, I use the percentage of time faculty report dedicating to teaching and teaching-related activities (e.g., grading papers, preparing for class). Because there has been some debate about whether rank should be include in models of faculty salaries (see discussion of debate in Perna, 2003), I include it in the third block of variables as a series of dummy codes in an attempt to isolate its affects on the female salary coefficient. The full human capital model including rank can be expressed as follows:

$$
\begin{aligned}
\ln Y_{ij} = {} & \beta_{0j} + \beta_1(\text{female}) + \beta_2(\text{AfricanAm}) + \beta_3(\text{Asian}) + \beta_4(\text{Latino}) \\
& + \beta_5(\text{other}) + \beta_6(\text{chairperson}) + \beta_7(\text{age}) + \beta_8(\text{experience}) \\
& + \beta_9(\text{experience}^2) + \beta_{10}(\text{seniority}) + \beta_{11}(\text{seniority}^2) + \beta_{12}(\text{articles}) \\
& + \beta_{13}(\text{chapters}) + \beta_{14}(\text{books}) + \beta_{15}(\text{teaching}) + \beta_{16}(\text{funded}) \\
& + \beta_{17}(\text{doctorate}) + \beta_{18}(\text{professional}) + \beta_{19}(\text{MA}) + \beta_{20}(\text{full}) \\
& + \beta_{21}(\text{associate}) + r_{ij}
\end{aligned}
\tag{3}
$$

In the next stage of the analysis, I model the intercepts or the disciplinary salary averages. I enter a series of discipline-level variables representing labor market properties and structural characteristics of the academic discipline. I use two labor market variables in my model. Because research suggests that faculty in disciplines with high proportions of females earn less than do their peers in other disciplines, I create a variable that represents proportion of females within a disciplinary labor market. Following Bellas' (1994) method, I calculate the percentage of women earning terminal degrees within the 3 years prior to the 1998 implementation of the NSOPF. Thus, all of the 79 disciplines used in these analyses had corresponding disciplines in the NSOPF and the SED or the IPEDS Completions database. I also derived the second labor market measure to estimate the supply and demand of recent doctoral recipients using the SED. I created the variable called "unemployed" by estimating the percentage of doctoral recipients in the 3 years prior to the NSOPF who did not have a job upon the completion of their degree. I also added several structural characteristics to the model. Because faculty are rewarded more for research than for teaching, it is reasonable to assume that average disciplinary salaries are higher in fields where faculty emphasize research compared with fields that emphasize teaching. I represent these outputs using disciplinary aggregates of career articles, chapters, books, patents, and percentage of time spent on teaching activities. I also include percentage of faculty members in a discipline who have funded research projects. Therefore, the full level-2 model can be represented as,

$$
\begin{aligned}
\beta_{0j} = {} & \gamma_{00} + \gamma_{01}(\%\text{female}) + \gamma_{02}(\%\text{unemployed}) \\
& + \gamma_{03}(\%\text{funded}) + \gamma_{04}(\textit{mean}.\text{articles}) + \gamma_{05}(\text{mean.chapters}) \\
& + \gamma_{06}(\text{mean.books}) + \gamma_{07}(\text{mean.patents}) + \gamma_{08}(\text{mean.\%teaching}) + u_{0j}
\end{aligned}
\tag{4}
$$

where the average disciplinary salary (β_{0j}) is derived from labor market (γ_{01} and γ_{02}) and structural (γ_{03} to γ_{08}) deviations from the disciplinary average (γ_{00}), plus error (u_{0j}).

RESULTS

Table 2 presents the frequencies and salary averages for men and women in the 79 disciplines used in this study. Overall, women represent approximately 30% of the sample and are represented at least once in every discipline. On average, women faculty members earn approximately 21% or $18,000 less their male peers. Women earned more than men did in only nine[4] of the 79 disciplines. The differential ranged from approximately $1100 in Philosophy to almost $100,000 in Health Services Administration.[5] Among the disciplines, the median female salary differential was approximately $13,000.

The results of my models are presented in Table 3. Because I have used the natural log of salaries as my dependent variable, the coefficients presented represent proportional differences in faculty salaries. The demographic model suggests that after controlling for race/ethnicity and partitioning the effects of being in a particular discipline, women earn approximately 22% less than men. The earnings of faculty of color are not statistically significantly different than the earnings of their white peers.

After controlling for human capital and disciplinary effects, women faculty earn approximately 10% less than their male counterparts (see column 2 of Table 3). This steep decrease in the wage gap is not surprising given after controlling for some of the possible work differences of men and women. For example, women tend to have less experience because of work stoppages due to childrearing. Additionally, women tend to dedicate more time teaching and less time to research.

In general, research productivity has a positive effect on earnings. Career articles, career patents, and funded research are positively related with salary. In contrast, the percentage of time spent on teaching is negatively related with salaries. With every additional hour spent on teaching activities, salaries on average drop .2%. The more educated a faculty member is the greater their earnings. Compared with faculty members who have less than an MA, faculty members with doctorates earn 18% more and faculty members with professional degrees earn 37% more.

When I add rank to the model (column 3 of Table 3), the female faculty salary differential decreases by approximately 2%. After controlling for race/ethnicity, human capital, and rank, women earn

TABLE 2. Frequencies and Mean Salaries by Academic Discipline

	Frequency			Salary		
Academic discipline	Women (%)	Men (%)	*N*	Women	Men	Female differential
Agribusiness and agricultural production	5.9	94.1	34	$60,001	$72,404	−$12,403
Agricultural, Animal, Food and Plant Sciences	13.9	86.1	72	$68,941	$72,257	−$3,316
Renewable Natural Resrcs	11.8	88.2	17	$59,001	$72,659	−$13,658
Other Agriculture	20.0	80.0	10	$50,251	$57,243	−$6,992
Other Arch. and Environmental Design	18.4	81.6	38	$69,501	$70,754	−$1,253
Art History and Appreciation	43.5	56.5	62	$53,150	$57,408	−$4,258
Dramatic Arts	46.7	53.3	15	$47,591	$62,888	−$15,297
Music	30.9	69.1	55	$46,871	$60,594	−$13,723
Accounting	30.0	70.0	30	$95,446	$90,475	$4,971
Banking and Finance	11.1	88.9	27	$89,909	$106,567	−$16,658
Business Administration and Management	22.7	77.3	22	$92,001	$84,816	$7,185
Organizational Behavior	8.3	91.7	12	$80,301	$103,681	−$23,380
Marketing and Distribution	45.8	54.2	24	$85,456	$91,982	−$6,527
Other Business	45.5	54.5	22	$66,446	$96,495	−$30,048
Other Communications	47.6	52.4	42	$51,123	$69,001	−$17,878
Computer and Information Sciences	8.8	91.2	57	$53,559	$84,485	−$30,926
Curriculum and Instruction	72.7	27.3	22	$64,529	$66,168	−$1,639
Education Administration	55.6	44.4	9	$67,101	$103,326	−$36,225
Education Evaluation and Research	66.7	33.3	6	$52,941	$66,364	−$13,423
Educational Psychology	25.0	75.0	8	$54,001	$76,847	−$22,846
Higher Education	57.1	42.9	7	$76,326	$71,034	$5,292
Special Education	57.1	42.9	14	$65,394	$64,073	$1,321
Student Counseling and Personnel Services	57.1	42.9	7	$51,751	$83,834	−$32,083
Other Education	44.8	55.2	29	$55,232	$58,332	−$3,100
Pre-Elementary	53.8	46.2	13	$48,871	$77,016	−$28,145
Adult and Continuing	83.3	16.7	6	$52,201	$95,001	−$42,800
Other Teacher Education Programs	44.4	55.6	18	$42,814	$63,340	−$20,526
Civil Engineering	15.0	85.0	40	$65,169	$78,829	−$13,660
Electrical Engineering	3.4	96.6	59	$106,566	$93,966	$12,600
Mechanical Engineering	8.0	92.0	50	$66,979	$88,958	−$21,979

TABLE 2. **(*Continued*)**

	Frequency			Salary		
Academic discipline	Women (%)	Men (%)	*N*	Women	Men	Female differential
Chemical Engineering	20.0	80.0	20	$68,164	$93,008	−$24,845
Other Engineering	12.3	87.7	73	$70,390	$84,295	−$13,904
English, General	40.0	60.0	15	$52,818	$52,254	$563
English Literature	43.3	56.7	30	$52,253	$64,901	−$12,649
Linguistics	25.0	75.0	16	$49,846	$81,258	−$31,412
English, Other	50.9	49.1	53	$50,874	$63,972	−$13,098
French	41.2	58.8	17	$63,774	$68,804	−$5,030
German	28.6	71.4	14	$50,236	$61,376	−$11,140
Other Asian	27.3	72.7	11	$55,456	$57,514	−$2,058
Other Foreign Languages	37.5	62.5	48	$50,617	$69,419	−$18,802
Allied Health Technologies and Services	57.1	42.9	14	$77,330	$77,226	$104
Health Services Administration	50.0	50.0	6	$92,168	$192,001	−$99,833
Medicine, including Psychiatry	25.0	75.0	208	$95,511	$129,143	−$33,632
Nursing	100.0	0.0	48	$68,342	–	–
Pharmacy	18.2	81.8	22	$64,540	$99,451	−$34,911
Public Health	50.0	50.0	22	$86,170	$113,287	−$27,117
Veterinary Medicine	23.5	76.5	34	$77,846	$83,995	−$6,149
Other Health Sciences	45.1	54.9	71	$64,872	$85,653	−$20,782
Law	44.0	56.0	50	$106,218	$120,587	−$14,369
Library and Archival Sciences	56.4	43.6	39	$47,210	$63,821	−$16,612
Mathematics/Statistics	9.6	90.4	125	$51,619	$77,702	−$26,083
Biochemistry	21.6	78.4	51	$72,245	$97,065	−$24,820
Biology	32.6	67.4	46	$60,774	$70,857	−$10,083
Botany	40.0	60.0	5	$63,751	$72,001	−$8,250
Genetics	42.1	57.9	19	$103,671	$82,858	$20,813
Immunology	31.3	68.8	16	$100,995	$78,852	$22,143
Microbiology	15.6	84.4	32	$66,601	$75,173	−$8,572
Physiology	17.1	82.9	35	$68,265	$89,535	−$21,270
Zoology	37.5	62.5	8	$51,241	$63,793	−$12,552
Biological Sciences, Other	31.0	69.0	42	$66,958	$82,595	−$15,638
Chemistry	2.0	98.0	50	$45,001	$79,310	−$34,309
Physics	7.3	92.7	55	$55,411	$86,600	−$31,189
Earth, Atmosphere, and Oceanographic Sciences	8.0	92.0	50	$64,751	$79,410	−$14,659
Physical Sciences, Other	15.0	85.0	20	$67,418	$76,327	−$8,909
Philosophy	7.7	92.3	26	$66,501	$67,605	−$1,104
Religion	31.3	68.8	16	$63,757	$67,487	−$3,730

TABLE 2. (*Continued*)

	Frequency			Salary		
Academic discipline	Women (%)	Men (%)	*N*	Women	Men	Female differential
Physical Education	45.5	54.5	11	$52,261	$71,751	−$19,490
Psychology	39.4	60.6	109	$68,256	$84,646	−$16,390
Public Affairs	47.8	52.2	23	$65,019	$87,540	−$22,521
Anthropology	60.0	40.0	20	$63,158	$77,104	−$13,946
Area and Ethnic Studies	23.1	76.9	13	$51,001	$60,001	−$9,000
Economics	14.7	85.3	68	$71,312	$94,606	−$23,294
Geography	20.0	80.0	15	$67,534	$70,702	−$3,167
History	41.3	58.8	80	$59,309	$76,323	−$17,014
International Relations	44.4	55.6	9	$63,876	$111,851	−$47,975
Political Science and Government	36.1	63.9	36	$65,009	$72,330	−$7,321
Sociology	25.0	75.0	52	$64,981	$80,224	−$15,243
Other Social Sciences	62.5	37.5	24	$54,559	$75,574	−$21,015
Other	42.2	57.8	64	$62,485	$72,986	−$10,502
Mean salary				$66,186	$84,227	−$18,041
Total (N)	822	1936	2758			
Total (%)	29.8	70.2	100.0			
Mean group size	10.405	24.506	34.911			

approximately 8% less than men. The other coefficients in the model remain relatively unchanged after the inclusion of rank.

When modeling the intercept, or the average salary of a discipline, I find that labor market characteristics significantly affect salaries.[6] With every percentage point increase in the percentage of women in the disciplinary labor market, faculty salaries reduce by .3%. Likewise, with every percentage point increase in unemployed graduates in an academic discipline, faculty salaries decrease by nearly 1%.The final model suggests some important structural differences as well. On average, faculty members in disciplines with high percentages with funded research earn more than do faculty in disciplines where few have funding. With every percentage point increase of those with funding, average salaries within a discipline increase by .2%. While only statistically significant at the .10 level, it is still noteworthy given the relatively small group level sample size ($N = 79$). It perhaps has some substantive value as well. A 10 percentage point decrease in the percentage of those having funding results in a 2% decrease in average salary for faculty within that

TABLE 3. Results of Hierarchical Linear Models of Natural Log of Faculty Salary

	Demographic	Human Capital	Human Capital with Rank	Labor Market + Structural
Intercept	11.136***	11.149***	11.150***	11.150***
Individual-level variables				
Female	−0.218***	−0.096**	−0.078**	−0.068**
African American	−0.079	0.004	0.018	0.022
Asian Pacific American	0.015	0.075+	0.085+	0.075+
Latino/a	−0.003	0.072	0.074	0.091*
Other race	−0.414	−0.277	−0.252	−0.254
Chairperson		0.077	0.054	0.065
Age		−0.002	−0.005	−0.005+
Years experience		0.017**	0.003	0.004
Years experience squared		0.000	0.000+	0.000
Years seniority		0.005	−0.004	−0.005
Years seniority squared		0.000	0.000	0.000
Career articles		0.002***	0.001***	0.001***
Career chapters		0.001+	0.000	0.001
Career books		−0.003	−0.004	−0.004
Career patents		0.009*	0.007*	0.007*
Percentage time teaching		−0.002***	−0.001**	−0.001*
Any funded research currently		0.089**	0.077*	0.082**
Doctorate		0.183*	0.154+	0.133*
Professional degree		0.368**	0.324**	0.271**
MA		0.065	0.074	0.055
Full professor			0.428***	0.426***
Associate professor			0.160**	0.159***
Discipline-level variables				
Percentage female				−0.003**
Percentage unemployed				−0.008***
Percentage with funded research				−0.002+
Mean career articles				0.000
Mean career chapters				−0.004
Mean career books				0.003
Mean career patents				−0.034
Mean percentage time teaching				−0.004*

TABLE 3. (*Continued*)

	Demographic	Human Capital	Human Capital with Rank	Labor Market + Structural
Variance components				
Variance between institutions	0.019***	0.014***	0.012***	0.003 +
Variance between explained	22.0%	44.9%	51.0%	89.5%
Variance within institutions	0.490	0.450	0.439	0.440
Variance within explained	1.8%	9.9%	12.1%	12.0%
Reliability	0.503	0.470	0.425	0.156

Note: $+P < .10$, $*P < .05$, $**P < .01$, $*** < .001$.

discipline. Likewise, a one percentage point increase in the average amount of time a discipline spends on teaching results in a .4% decrease in average salaries in that discipline. I observe only modest changes in the other individual-level and discipline-level coefficients from the labor market model to the final model. In the fully controlled model, female faculty members earn 6.8% less than do their male counterparts, dropping from 7.8% in the human capital model.

To many, it would seem that the magnitude of these effects are quite small. However, taken in the context of real dollars, these earnings differences appear substantial. Table 4 presents the result in dollars of a one-unit change in some of the statistically significant independent measures. Controlling for all of the variables included in the final model, the wage gap for women is $5356. A standard deviation change in the percentage of females in a discipline results in an average decrease in salaries of $3658. Therefore, men in a discipline that is one standard deviation above the mean in their representation of women will earn approximately $75,000 and women will earn $69,000. Thus, the effect of gender composition of a labor market has an effect on both men and women, but it is more damaging for women in the high-proportion female discipline who are already at a disadvantage because of their gender.

We see similar effects for the percentage unemployed and mean percentage time teaching variables. Faculty members in disciplines whose unemployment is one standard deviation above the mean earn approximately $5500 less than the average. Likewise, faculty in fields that spend one standard deviation more than the average on teaching-related activities earn almost $4000 less than the average. Therefore, the gap between women in these high unemployment or high teaching fields

TABLE 4. Changes in Average Salaries as a Result in a One-unit Change in Independent Variables

	Salary of men	Salary of women	Change in X	Effect
Female	$78,850	$73,493	0 to 1	−$5,356
Discipline-level				
Percentage female	$75,192	$69,836	1 SD (18.5%)	−$3,658
Percentage unemployed	$73,292	$67,936	1 SD (9.2%)	−$5,558
Percentage with funded research	$82,698	$77,342	1 SD (24.0%)	$3,849
Mean percentage time teaching	$74,959	$69,602	1 SD (11.3%)	−$3,891

is substantially lower than the mean in fields that have low unemployment and low teaching loads.

In contrast, grant funding has a positive effect on average disciplinary salaries. Compared with the average, faculty in disciplines one standard deviation above the mean in percentage with funded research earn almost $4000 more. Women in this same discipline earn $77,342, still less than men in the same discipline, but only slightly less than the overall male average of $78,850.

Finally, it is instructive to explore how these effects translate to specific academic fields. I selected five different fields that vary in the percentage of females in the labor market. As expected, these disciplines also differ in the three other statistically significant level-two variables. If I apply the coefficients from the final model for the four statistically significant discipline-level characteristics (percentage female, percentage unemployed, percentage funded research, and average time spent teaching) and the gender wage gap, and I hold all other variables equal, I can simulate mean salaries within each of the five disciplines. Table 5 presents the results of these approximations.

The salaries in English Literature, a field characterized as high proportion female, high percentage unemployment, low percentage with funded research, are the lowest of those simulated. Women in English Literature earn approximately $50,000 while men earn approximately $55,000. Women in psychology earn approximately $63,000, while their male peers earn approximately $69,000. Although they have the highest proportion of women compared with the other disciplines, they also have relatively low unemployment among recent graduates and a high percentage with funded research. The salaries of the middle group, Mathematics/Statistics, are similar to the overall average salaries in this study.

TABLE 5. Simulated Faculty Salaries Based on Final Model Results

Academic discipline	Percentage female	Percentage unemployed	Percentage with funded research	Mean percentage time teach	Average salaries	
					Male	Female
English Literature	57.9%	45.2%	20.0%	45.1%	$55,571	$50,215
Psychology	66.7%	34.6%	65.1%	41.6%	$68,669	$63,313
Mathematics/ Statistics	23.1%	34.1%	69.6%	47.3%	$76,288	$70,932
Mechanical Engineering	8.2%	32.0%	82.0%	47.8%	$82,362	$77,006
Biology	42.6%	23.4%	84.8%	41.3%	$83,400	$78,044

Faculty members in Biology, on the other hand, are the highest paid. Biology is slightly below average representation of women, below average unemployment rate, and above average percentage of those with funded research. Women in Biology earn approximately $78,000, almost the same as the overall male average salary. Based on these estimates, faculty in Mechanical Engineering earn nearly as much as Biologists do, with women earning approximately $77,000 and men earning approximately $82,000. Mechanical Engineering is different than Biology on two of the four measures: percentage female and mean percentage of time spent teaching. Mechanical Engineers spend slightly more time preparing for class, and very few Mechanical Engineers are women.

Limitations

I offer three limitations for consideration when interpreting the results from this study. First, given the limits in the data, I am unable to control for institutional characteristics given the purposes of this study and the sample design of the study. Although the purpose of this study was to examine disciplinary effects on salaries and salary inequities, it is possible that some of the estimates could be biased given the lack of controls for important institutional characteristics such as location and selectivity. Unless I employ a more complex modeling strategies, such as a three-level model, which require a different sampling strategy than currently employed by any national data collection effort, I am limited in my ability to control for both institutional and disciplinary characteristics in a way that would produce accurate estimates.

It also is possible that some of the within group sample sizes biased the HLM results. However, the general rule of thumb for precise estimates is at least 30 groups with an average of 30 individuals within a group (Hox, 2002; Snijders and Bosker, 1999). This study exceeds the rule of thumb at both the individual and group level. The estimation procedure takes into account within group sample size, relying more heavily on those groups that have large numbers. Thus, it is robust to relatively small within group numbers (Raudenbush and Bryk, 2002). That said, the estimates produces from the models in this study may not be entirely free of bias.

Finally, research productivity takes many different forms across disciplines. For some disciplines, books are the common currency for promotion and tenure while for other disciplines its refereed journal articles. The decision to include the various productivity measures used in this study may have introduced bias.

Discussion and Implications

Women faculty earn less than men do, even after controlling for an array of individual characteristics and disciplinary labor market conditions and structural characteristics. As previous research has suggested, simply controlling for human capital greatly reduces the wage gap. In the uncontrolled model, females earned approximately 22% less than did males. After including controls for experience, seniority, research productivity, teaching, and education, the wage gap dropped to slightly less than 8%. Disciplinary labor market and structural effects reduced the gap even further to 6.8%. However, the statistically significan 6.8% gap found in the final models is not trivial and translates to approximately $5400 in annual salary.

The wage gap found in this study does not differ greatly from previous research. Using NSOPF 1993 and 1998, Toutkoushian (1998a, b, c) found that pay differences range from 6 to 8%. A follow-up study (Toutkoushian and Conley, 2005) using the same data employed in this study, found women on average earned between 4 and 6% less than men. Given the wage gap similarities between this study and previous research, one might agree with Loeb (2003) that little is gained by using HLM to study salary equity. However, the use of HLM allows this study to provide a clearer picture of the context of disciplinary labor markets and structures that affect faculty salaries.

Perhaps more important, this study explores the complex interplay between disciplinary contexts and salary inequities, something that can only be done with any precision using HLM. Previous research very often focused on the wage gap in isolation and did not full consider the disciplinary context in which faculty work. Little work prior to this study has integrated various disciplinary labor market and structural characteristics. This study allows us to draw conclusions about the impact that disciplinary context has on faculty salaries and the wage gap. Regardless of their individual characteristics, faculty in disciplines characterized by relatively low demand, high teaching loads, and low amounts of research funding earn less than do faculty in other disciplines.

This study also extends previous research and offers evidence to suggest that comparable worth (Bellas, 1994; England, 1992; Feldberg, 1984) continues to have an influence on faculty salaries in fields dominated by women. Even after controlling for disciplinary labor market conditions and structural characteristics of a discipline, faculty in fields employing high percentages of women earn less than do their peers in male-dominated fields. Although this penalty influences the salaries of both men and women in female-dominated disciplines, it disproportionately affects women because their representation in those fields is high. While the wage gap on average is statistically similar between academic disciplines, some might suggest that this represents institutionalized discrimination at the discipline-level and is particularly costly for women in female-dominated academic disciplines.

This notion of comparable worth can be extended to the other significant discipline-level effects in this study. Women also tend to work in fields that have high teaching loads and less time for research (Aguirre, 2000; Fairweather, 1996; Tierney and Bensimon, 1996). Faculty in these fields may be doing the "women's work" that is devalued in the academy and earning less as a result. If these faculty work in disciplines that have relatively low demand for workers, they may suffer an additional wage penalty. My example using English Literature emphasizes this point. Women faculty earn \$27,000 less than women in Mechanical Engineering and \$33,000 less than men in Mechanical Engineering.

It is possible to attribute these disciplinary differences to forces other than discrimination resulting from comparable worth. Perhaps women are attracted to fields that have certain attributes, such as high teaching loads, that happen to pay less. Thus, it is women's interest in particular types of work that may be driving their choice into particular fields that then become dominated by women. The question then becomes, why is the work done by these disciplines valued less? This question is underscored by the fact that the models control for demand in the labor market and productivity characteristics.

This study has important implications for policy and practice. First, it is important to consider that women in high supply, high female concentration, and heavy teaching disciplines take a double hit. They work in disciplines where they will earn less, regardless of their gender. In addition, these women suffer from a wage gap. Although policies should address all gender-based salary inequities, policymakers would be wise to begin by directing their remedies at women affected by this double hit.

Institutions might explore reward structures that disproportionately reward male faculty members. They might consider rewarding disciplines with high teaching loads differently than those with low teaching loads. In other words, if faculty in English are expected to teach more courses or offer larger course sections than their peers in Physics, perhaps research productivity in English should be given less weight in promotion and tenure decisions. Likewise, the availability of grant dollars is not the same across all disciplines. A rewards system that acknowledges that grant dollars are more plentiful in the hard sciences and engineering compared with the arts and humanities might be a step in the direction of equity. Given that grant funding has become an important source of revenue for institutions, this may be impractical. One solution might be to create an index of external funding availability and adjust rewards according to a disciplines ranking on the index. Institutions should weigh the practicality of such a solution against the possible inequities created by current reward structures.

Based on the results of this study, universities also are advised to continue the practice of regular campus salary equity studies. These studies should not overlook the effects of academic disciplines. Universities might find it useful to run models similar to the ones in this study, but structure them so that faculty are nested within departments. Campuses might consider attaching variables to their departments that account for labor market conditions and structural characteristics of academic disciplines.

This study also has important implications for future research. Methodologically, this study is the first of its kind to use HLM to provide accurate estimates of the impact that various structural variables and labor market characteristics have on salary equity. The inability to partition the variance between the individual and academic discipline has prevented previous research from adequately exploring the impact of multiple individual and disciplinary characteristics on salary and arrive at accurate estimates of their effects. Future research might explore institutional contexts using HLM. Perhaps a three-level model, where faculty are nested within departments that are nested within institutions, would yield additional information about the effect of the intersection of discipline and institution on faculty salaries. Future research might also apply these models to other institutional types to explore whether the findings of this study related to disciplinary contexts hold true in other settings. Of course, a study that examines data that are more current would be helpful to understand if some of these effects persist in the current labor market.

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NOTES

1. I conducted all analyses using the sample weight that adjusts for the sample design at the individual level.
2. In cases where the terminal degree is not a doctorate (e.g., arts), I drew upon completions data from the Integrated Postsecondary Data System for numbers of degree recipients. I also used census data to estimate employment demand for individuals within those fields.
3. Basic salary is a continous variable taken from the response to the question, "What is your basic salary from this institution for the 1998–99 academic year"?
4. Women earned more than men in the following fields: Immunology, Genetics, Electrical Engineering, Business Administration and Management, Higher Education, Accounting, Special Education, English (General), Allied Health Technologies and Services. No men were among the Nursing faculty.
5. In HLM, it is possible to randomize slopes to test whether the effect of a variable differs significantly by group (e.g., academic discipline). I allowed the female slope to vary by discipline and found that the effect of being female on salaries does not differ significantly by discipline. Therefore, I fixed the female slope and only modeled the intercept, or average disciplinary salaries.
6. HLM estimates the reliability of the sample mean as an estimate of its population mean.- The larger the between group variance and within-group sample size, the larger the reliability. Thus, it is no surprise that the reliability drops when between group variance is reduced after the introduction of level-2 variables. I report the average reliabilities for each of my models in Table 3.

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