Gender equity in college faculty pay: A cross-classified random effects model examining the impact of human capital, academic disciplines, and institutions

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In the forty years since the passing of the Equal Pay Act of 1964, researchers and policy makers have attempted to assess salary equity among college faculty members. The focus of most of this research has been to identify factors that explain the gender gap in pay or what some call the unexplained wage gap. 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 faculty members earn less than do male faculty (Barbazet, 2002; Barbezat, 1991; Bellas, 1993, 1994, 1997; Perna, 2001; Toutkoushian, 1998a, 1998b; Toutkoushian & Conley, 2005). Recent reports of the American Association of University Professors (1996, 1997, 2001) and the U.S. Department of Education (Bradburn & Sikora, 2002; Nettles, Perna, & Bradburn, 2000) support these assertions.

Much of this research applies human capital theory to control for differences in faculty salaries and then concludes the unexplained gender differences are a result of inequities in rewards systems. Human capital theory suggests that individuals accumulate capital through investments in education, training, productivity, and work experiences, which then can be exchanged for increased earnings (Becker, 1993; Rosenbaum, 1986). Some have argued that human capital theory alone does not fully explain economic inequality, nor does it provide "an explanation of occupational sex segregation that fits the evidence" (DeYoung, 1989, p. 358). Some work on faculty salaries supports the notion that sex differences are caused by 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 also 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, 1994; Bellas, 1997; Umbach, 2007).

Although some have studied the effects of gender segmentation of academic labor markets of faculty salaries, these studies are not without their shortcomings. First, they either examine only academic disciplines (Barbezat, 1991; Bellas, 1994; Bellas, 1997; Umbach, 2007) or only institutional affiliations (Smart, 1991, Toutkoushian, 1998). Little, if any, research has examined simultaneously the effects of gender representation of academic disciplines and institutions on academic salaries and the gender wage gap. Second, much of the 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 of the unexplained wage gap and the factors that affect salaries. In the past, many have built statistical models attaching group-level variables, either characteristics of disciplines or institutions, to individuals. This technique is considered by many as inappropriate when examining complex data at multiple levels (Heck & Thomas, 2000; Luke, 2004). In fact, it is quite possible that this strategy will result in inaccurate parameter estimates (Ethington, 1997; Heck & Thomas, 2000; Luke, 2004; Raudenbush & Bryk, 2002). Others have collapsed disciplines and institutions into categories, 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

Given the continued labor market inequities and the gaps in the previous research, this study explores salary inequities using a cross-classified random effects model where faculty are nested both within institutions of higher education and academic disciplines. Using this modeling technique, this study integrates and expands on the research by exploring the effect of attributes of the academic disciplines and institutions, as well as individual human capital accumulation, on faculty salaries and salary inequities. That said, this study asks several questions:

1. How much of the variance in faculty salaries lies between disciplines, between institutions, and between individuals?

2. To what extent does the representation of women within disciplines and within institutions affect faculty salaries?

3. Do other structural characteristics of academic disciplines (e.g., productivity) and colleges and universities (e.g., sector, Carnegie Classification) contribute to the explanation of faculty salaries?

4. After controlling for human capital and disciplinary and institutional effects, do gender inequities persist?

Review of the Relevant Literature and Theoretical Framework

This study combines human capital theory and structural theory as a framework to explore faculty salaries and the gender wage gap. 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 (Perna, 2001; Youn, 1992). 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). Investments in these areas result in increased earnings.

Implicit in human capital theory is that individuals are the primary actors in career rewards, and their opportunities depend solely on the amount they are willing to invest in education and work experiences. Some researchers suggest individual work differences between men and women explain gender differences. They argue that men out-publish women and therefore men earn more (Cole & Zuckerman, 1984; Long, 1990; Persell, 1983). Others argue that differences in salaries between men and women can be explained by the amount of time spent on research (Bognanno, 1987) . Women tend to spend less time on research, and as a result, earn less money.

Researchers argue 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 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). Youn (1992) found that academic labor markets are unique in that they are segmented by academic discipline, institution type, job task (primarily teaching, research, or administration), or job status (e.g., academic rank or full-time/part-time).

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 structural theory to faculty salaries reveals that sex differences are caused by 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, 1994; Bellas, 1997; Umbach 2007).

This study, therefore, proposes an integrated conceptual model of faculty salaries and gender salary equity (see Figure 1). The proposed model suggests that individual faculty attributes, namely human capital and demographic factors, and their disciplinary and institutional affiliations affect faculty salaries. In other words, faculty salaries are not only determined by who the faculty member is and what they have done, but by the structural attributes of their academic discipline and college or university. It also is important to note that the model indicates (with dashed lines) that faculty members are nested simultaneously within disciplines and institutions. Any analysis of faculty salaries must attend to these cross-classified nestings.

Methodology

Data Set and Sample

The primary data sources for this study are the faculty and institutional surveys of the 2004 National Study of Postsecondary Faculty (NSOPF). The 2003-4 administration of the NSOPF offers a unique way to understand the complex issue of faculty salaries because the data represent a stratified sample of faculty from across the United States. The 2004 NSOPF included a sample of 1,080 public and private not-for-profit degree granting postsecondary institutions and a sample of 35,000 faculty and instructional staff. The weighted response rates for the two surveys were 86 and 76 percent, respectively. Thus, the final data faculty-level data set includes 26,108 faculty members, and the institution-level data set includes 920 colleges and universities.

I limit my sample to those respondents with faculty status and instructional duties in Fall 2003, as well as those faculty who had matching data in the institutional survey data file. Because the reward systems and work objectives of community colleges faculty are quite different than faculty at four-year institutions (Perna, 2003), I removed community college faculty from the analyses. I also include only full-time tenured or tenure-track faculty. My final analytic sample includes 7,889 faculty members from 472 four-year colleges and universities and 87 different disciplinary categories. See Table 1 for the descriptive statistics on those included in the analyses. All analyses are weighted using the contextual weight (WTC00) at level one, as recommended by the National Center for Educational Statistics when conducting multilevel analyses (for an explanation see Heuer, Kuhr, Fahimi, et al., 2004).

Analytic Approach

I use a cross-classified random effects model to explore the impact of human capital, structural characteristics of the discipline and institutions on faculty salaries and salary equity. Handling both human capital characteristics and structural attributes presents a unique challenge to researchers. The problem lies in the challenge of how to handle disciplinary and institutional effects in the models. Should researchers aggregate to the group 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 ordinary least squares regression models attaching group level variables to individuals. Variables such as institution type (Bradburn & Sikora, 2000; Fairweather, 1996; Nettles, et al., 2002; Toutkoushian, 1998), 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 models of faculty salaries. 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 and a college or university is overlooked in such models. Second, using these methods make it very difficult to partition what can be attributed to disciplinary and institutional 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 poor or even misleading policy analyses. Finally, they are limited in their ability to explore the interaction effects of disciplines, institutions, and individuals.

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 group-level differences (Fairweather, 1996; Perna, 2001; Smart & McLaughlin, 1978; Toutkoushian, 1998). 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 models. Again, this strategy can hide the differences between disciplines that have been placed into larger categories. But 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 & Umbach, 2001; Umbach, 2007). They employ hierarchical linear modeling (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 few, if any, studies of salary equity at colleges and universities have used HLM to examine faculty salary equity (Loeb, 2003; Perna, 2003).

The problem of modeling strategy is further exacerbated by the fact that faculty are not nested clearly within groups. To use a standard HLM that incorporates both institutions and disciplines, one would have to assume a hierarchical nesting where faculty members are nested within disciplines which are nested within colleges. However, academic disciplines span institutions, and many times disciplinary affiliations are stronger than institutional ties (Clark, 1987). Complex data structures like these, where individuals are cross-classified by two or more higher-level units, are typically modeled using a cross-classified random effects model (see Raudenbush & Bryk, 2002 for a full explanation of cross classified models). For example, cross-classified random effects models have been used to study the effects of neighborhoods and schools on educational attainment (Garner & Raudenbush, 1991), the educational attainment of students from two different types of schools (Goldstein, 1995), the influence of industry sector and city on earnings (Shu, 2005), and the contribution of reviewer and research attributes on grant proposal ratings (Jaysinghe, Marsh, & Bond, 2003),

Dependent variable and the unconditional model. The first step is to determine the amount of variance explained by disciplines, institutions, and individuals. I derive the dependent variable from a faculty member's basic salary from the institution[1]. I calculate the natural logarithm of salary to obtain a more normally distributed dependent variable. In a cross-classified random effects approach, the first step is to create a model with no predictor variables. The within cell model can be expressed as

$$\ln Y_{ijk} \quad = \quad \pi_{0jk} + \quad e_{ijk} \qquad [1]$$

where ln Y_{ikj} , the dependent variable, is the natural log of salary for faculty member *i*, in *j* college and discipline *k*. The π_{0jk} term is the mean for salary for faculty member in cell *ij* (i.e., faculty in *j* college and discipline *k).* Finally, e_{ijk} is the random faculty effect, or the deviation of faculty member *ijk*'s salary from the cell mean. The within-cell model allows us to describe the variation among faculty members within each cell of the cross-classification of disciplines and institutions.

We also can assess the variation between cells that is attributable to institution and disciplinary effects:

$$\pi_{0jk} = \theta_0 + b_{00j} + c_{00k} + d_{0jk} \qquad [2]$$

where θ_0 is the grand mean salary of all faculty members; b_{00j} is the main effect of institution *j* across all disciplines, or the contribution of *j* institution averaged across all disciplines; c_{00k} is the main effect of discipline *k* across all institutions, or the contribution of *k* discipline averaged across all institutions; and d_{0jk} is the random interaction effect, or the deviation of the cell mean from the predicted grand mean and the two main effects.

By substituting equation 2 into equation 1 to create a single model

$$\ln Y_{pjk} \quad = \quad \theta_p + \beta_p X_k + \gamma_p W_j + b_{p0j} + c_{p0k} + d_{pjk} \qquad [3]$$

which is analogous to a two-way analysis of variance with random row effects (institution), random column effects (discipline), two-way interaction, and within cell deviation. This model allows us to partition the variance in faculty salaries that can be attributed to institutions, disciplines, and individual faculty members.

Independent variables and the within cell model. I include gender and several human capital and demographic variables at level-1 (individual level) to assess the faculty gender wage gap:

[1] 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"?

$$\ln Y_{ijk} \quad = \quad \pi_{0jk} + \pi_{1jk} a_{ijk} + \pi_{2jk} X_{ijk} + e_{ijk} \qquad [4]$$

where a_{ijk} is the gender of faculty member *ijk*; π_{1jk} is the regression coefficient representing the wage gap; and $\pi_{2jk} X_{ijk}$ is the vector of human capital and demographic variables.

I rely heavily on the recent work of Perna (2003), Toutkoushian (1998), Toutkoushian and Conley (2005), Barbezet (1991), Fairweather (1996), and Bellas (1993, 1994, 1997) in the construction of my individual level models. I introduce the level-one independent measures in blocks. The first includes only a dummy-coded variable that represents gender (female=1; male=0) to get a sense of gender differences[2] in salary with limited controls. The second block includes dummy-coded variables representing race/ethnicity. Faculty will be coded according to racial/ethnic group and will be included in the models as African American/Black, Asian/Pacific American, and Other faculty of color (Caucasian/White is the omitted category). I also include measures of whether a faculty member is married and whether they have children[3].

The third block includes a series of measures of human capital. Because an investment in education has been found to result in an increase in earnings (Fairweather, 1996; Fox, 1981; Smart, 1991), I will include a series of dummy-coded variables to represent educational attainment. In addition to variables representing investments in education, I will include several experience variables (years of seniority in current position, years teaching in higher education, and age). The returns of experience are often nonlinear; therefore, I include a quadratic terms for each of the experience variables included in the models. Because research is rewarded differentially than teaching (Smart & McLaughlin, 1978), I include a number of controls for productivity. To represent research 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 total number of class sections taught.

In the third block, I introduce academic rank. 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.

Level-two or between-cell model. At level-two (the discipline level), I test the effects of several structural variables. Again, I introduce these variables in blocks. The first block includes only the percentage of females in institutions (X_j) and disciplines (W_k) as fixed effects in my level-two models. In this case, the level two equation would be

$$\ln Y_{pjk} \quad = \quad \theta_p + \beta_p X_k + \gamma_p W_j + b_{p0j} + c_{p0k} + d_{pjk} \qquad [5]$$

Given the data requirements to run cross-classified random effects models, it is important to be parsimonious when specifying them. Likewise, it is often difficult to find structural measures that are not highly collinear. That said, I include several other variables in my level two models. Research

[2] When running the within cell model, I examined whether the gender effect varied between disciplines and between institutions. The variance components for both were not statistically significant; thus, I fixed the gender effect for all models presented in this paper.
[3] I tested for interactions between gender and whether they had a partner and whether they had children. . These interactions were not statistically significant and were dropped from the models.

suggests that faculty activities are rewarded differently across disciplines (Smart & McLaughlin, 1978) and institutions (Clark, 1987; Perna, 2001). In the second block of my level-two models, I include disciplinary and institutional aggregates of research teaching productivity. Included are averages (both for the discipline and the institution) of number of career peer-reviewed articles or creative works in juried media, percentage of faculty on a grant-funded research project, and number of class sections taught. My final level-two block includes other structural measures of colleges and universities. I include (Perna, 2001; Toutkoushian, 1998; Smart, 1991) Carnegie Classification to control for research emphasis of a college. I also introduce sector (Weiler, 1990) and unionization (Barbazet, 1989).

Results

Null Model

As suggested in the methods section, the first step in building a cross-classified random effects model is partition the variance that can be attributed to institution affiliation, disciplinary affiliation, and individual faculty members. Table 2 presents the variance components for faculty salary resulting from the null model. Approximately 16% of the variance in faculty salaries can be attributed to the college or university where a faculty member works, and almost 10% is explained by disciplinary affiliation. These numbers are not trivial and suggest that further modeling of between institution and between discipline differences is warranted.

Within Model

Table 3 presents the unstandardized coefficients from the within cell models of the natural log of faculty salary. After partitioning disciplinary and institutional effects, females earn approximately 14 percentage points less than males (approximately $10,300) when no individual factors are accounted for. When I enter race/ethnicity, marital status, and whether the faculty member has children the difference between men and women faculty members drops to approximately 13 percentage points. After controlling adding human capital variables into the model, female faculty members earn 5.8 percentage points less than males. The difference drops to 4.5 percentage points, or approximately $3,300, after introducing controls for academic rank.

The final within model also suggests other statistically significant salary differences between faculty members. Asian Pacific American faculty members earn approximately 5% less than do their White peers. Faculty members with children earn approximately 3% more than do childless faculty members, holding all other variables in the model constant.

With regard to human capital, faculty members with a terminal degree or with a professional degree earn statistically significantly more than those with a master's or less. Likewise, salaries increase 0.6 percentage points with every year of experience as a faculty member. In contrast, salaries are related to a .4 percentage point decrease with every year spent at a particular institution. This may be a reflection of salary compression. As expected, faculty rank is associated with salaries. Full professors, on average, earn approximately 31 percentage points more than assistant professors, and associate professors earn 13 percentage points more than assistant professors.

The final within model also suggests that faculty productivity is related to salaries. Research productivity, as measured by number of patents, whether they are participating in a funded research project, and number of articles published, is positively related with salary. Teaching productivity, or the number of course sections taught, is negatively related with salary. With each additional course section taught, faculty salaries decrease by approximately 3 percentage points.

Full model results

The full model results explore the effects of structural characteristics of academic disciplines and institutions on faculty salaries (See table 4). Column one tests the notion of comparable worth by including measures of the proportion of female faculty members within a college and within an academic discipline. In the relatively uncontrolled level-two model, the proportion of female faculty members in both disciplines and institutions is negatively related with faculty salaries. Every percentage point increase in representation of women in an institution translates to a .3 percentage point drop in average faculty salaries. Similarly, with every percentage point increase in female representation in an academic field, average salaries within the field drop approximately 10 percentage points. However, when I add institutional and disciplinary aggregates representing faculty research and teaching productivity, the effect of percentage female for both colleges and disciplines is no longer statistically significant.

Aggregates of faculty productivity have pronounced affects on average disciplinary and institutional salaries. With a one-unit increase (one article) in average institutional article production, institutional salaries increase .3 percentage points. In other words, a standard deviation increase in average articles published (SD=15.71) translates into an average increase in salaries of approximately $2,900. Similarly, with every percentage point increase in the representation of faculty members at an institution who are on a grant-funded research project, average faculty salaries increase 10 percentage points (approximately 13 percentage points in the full model). In contrast, the average course loads on a campus are negatively related to average faculty salaries. A single course increase in average campus course loads reduces faculty salaries by approximately 6 percentage points, or approximately $4,200.

Research productivity of academic fields is also positively related to faculty salaries. A single unit increase in disciplinary article production translates into a .3 percentage point increase in faculty salaries in the discipline. Thus, a standard deviation increase in an academic field’s article productivity (SD=18.48) translates into a $3,700 increase in average member salaries. Salaries are also positively related with the percentage of faculty members in an academic discipline who are on grant-funded projects. With every percentage point increase in those who are on grant funded projects, average faculty salaries in an academic discipline increase approximately 12 percentage points.

The introduction of additional institutional characteristics contributes a little to our understanding of faculty salary differences. Controlling for all other factors in the model, faculty members at private colleges and universities earn approximately 5 percentage points more than do faculty at public institutions. In addition, faculty members who work at campuses with a union presence earn approximately 5 percentage points more on average than do their peers on non-union campuses.

Discussion and Implications

Women faculty members continue to earn less than male faculty. After controlling for disciplinary and institutional attributes, individual demographic characteristics, and accumulated human capital, it appears that the gender wage gap continues. In the model where disciplinary and institutional effects are partition yet no controls are included, women earn approximately 14 percentage points than their male counterparts. After controlling for demographic characteristics and human capital, the gap drops to approximately 6 percentage points. In the final, fully-controlled model, women earn 4.2 percentage points less than men, resulting in a $3,100 gap.

The wage gap found in this study differs somewhat from previous research. Using NSOPF 1993 and 1999, Toutkoushian (1998a, b) found that pay differences range from 6 to 8 percentage points. A follow-up study (Toutkoushian and Conley, 2005) using the 1988 NSOPF, found women on average earned between 4 and 6 percentage points less than men. In previous study that used HLM to look only at disciplinary differences in salaries, Umbach (2007), again using the 1999 NSOPF, found that women faculty earned approximately 7 percentage points less than their male peers. When we examine the wage gap from the current study in relation to previous work, we can arrive at several conclusions. First, the current study appears to be at the lower bound of the most of the previous work related to the faculty salary wage gap. This could be the result of increased precision gained from the modeling strategy employed here, or it could suggest that the wage gap persists but is declining. No matter what conclusion one adheres to, the technique employed in this study adequately controls for disciplinary and institutional influences on salaries and likely provides an accurate representation of the wage gap. Second, although a cross-classified random effects model might give greater precision, given the relative wage gap similarities between this study and previous research, one might agree with Loeb (2003) that little is gained by using a multilevel technique to study salary equity. However, the use of a cross-classified random effects model allows this study to provide a clearer picture of the context of disciplinary and institutional labor markets and structures that affect faculty salaries.

This study and the analytic techniques employed make several contributions to our understanding of faculty salaries and the gender wage gap. Simply partitioning the variance of salaries between what can be attributed to individuals, institutions, and academic fields extends previous research. To know that 15.5% of the variance in salaries can be explained by institutional membership and 9.5% can be explained by disciplinary affiliation raises compelling questions about the extent to which we understand all of the forces at play in determining faculty salaries.

Furthermore, this study is the first to test the notion of comparable worth in both disciplines and institutions. Those who subscribe to the notion of comparable worth suggest that work in fields dominated by women is devalued; therefore, workers within female-dominated fields earn less. Previous research found a negative relationship between the proportion of female within a discipline and faculty salaries. Likewise, they find the same negative relationship between percentage of females within a college or university and faculty salaries. While this study does provide further evidence to suggest a negative relationship between the representation of females in academic fields and institutions and faculty salaries, it seems that this relationship is more complex than others may have suggested.

When only percentage of females in a discipline and percentage of females within an institution are included in the level-two models, they are both negatively related with faculty salaries. However, once productivity measures of disciplines and institutions are added, the effect of female representation is no longer statistically significant. Looking at the correlations between female representation and productivity provides some insight into these complex relationships. It seems that representation of female faculty members in college or university is negatively related with article production (r=-.358) and the percentage of faculty members working on a grant funded project (r=-.219). The correlations within academic discipline are even higher. Representation of female faculty members in an academic field is negatively related with article production (r=-.515) and percentage of faculty members with grant-funded research (r=-.442), but it is positively related with the average number of courses faculty members teach (r=.307).

These relationships do not suggest that female faculty members cause institutions or disciplines to have lower levels of research productivity, but that it is possible that previous research attributed the effects of gender representation to forces other than discrimination resulting from comparable worth. Perhaps women are attracted to fields that have certain attributes of disciplines and institutions, such as high teaching loads and low research productivity, which 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. Still others might look at these results and suggest that women are socialized at a very young age to work in academic fields (and later in life to work in institutions) that have high teaching loads and low research productivity. The question then becomes, why is the work done by these disciplines and institutions valued less?

The findings of this study also have policy discussions at institutional level. First, it is important to consider that women tend to take a double, and sometimes triple, hit in the academic labor market. They work in disciplines where they will earn less, regardless of their gender. Not only do they suffer from a gender pay gap, they often work in disciplines and institutions were pay is low. 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 and triple 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. Understanding the impact of institutional and disciplinary contexts on inequities among faculty is important to institutions seeking to create an equitable environment for diverse faculty members. 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 members are nested within departments. Campuses might consider attaching variables to their departments that account for labor market conditions and structural characteristics of academic disciplines.

These findings also have implications for policy makers and the courts as they attempt to understand labor conditions among college faculty. The continued frequency of lawsuits makes it imperative that we have an understanding of the gender wage gap and all of the components that contribute to the explanation of faculty salaries. Such an imperative compels researchers and policy scholars to continue to expand their analytic approaches to techniques that allow them to examine complex factors that affect pay inequities and gender discrimination. The conceptual framework and analytic technique proposed in this study will no doubt extends previous work by exploring the interplay between disciplines and institutions. Policy informed by models that focus only on individual-level variables are limited and may provide misleading results.

This study also has implications for future research. Methodologically, this study is the first of its kind to use a cross-classified random effect model to provide accurate estimates of the impact that various contextual variables on faculty salaries. The inability to partition the variance between individuals, academic disciplines, and institutions prevented previous research from adequately exploring the impact of multiple individual and structural characteristics on salary and arrive at accurate estimates of their effects. Approximately 25% of the variance in faculty salaries can be explained by institutional and disciplinary membership. Previous studies of faculty salaries attempt to account for these effects by controlling for Carnegie Classification of the institution where a faculty member works or by introducing a series of dummy-codes for discipline of appointment, but it is unlikely that these attempts were able to fully account for these affiliations. Given the effects that the interconnected web of disciplinary and institutional affiliations has on faculty work (Clark, 1987; Umbach, 2007), it would seem the applications of this analytic approach would be endless. For example, to what extent do disciplinary and institutional affiliations influence pedagogy, job satisfaction, and productivity?

Future research might also overcome some of the methodological problems that limit this study. For example, because of the sampling strategy of NSOPF, many of the cells in the academic discipline by college matrix have very small numbers or are empty. As a result, I had to use caution with the number of variables in the level-two models. In addition, the small within cell size number prevented me from full testing whether disciplinary characteristics vary between institutions and whether institutional characteristics vary between academic disciplines. This is a powerful technique that can be employed within the cross-classified random effects modeling context that would yield additional useful and interesting information about faculty salaries.

Other research might employ techniques that will mitigate the issue of selection bias, an issue that seem particularly relevant when discussing disciplinary and institutional effects. A panel study that collects relevant data from individuals prior to entry into the faculty ranks (and even earlier if possible) and follows the group for several years would reduce some of the error resulting from selection. Others might also consider statistical techniques that attempt to account for selection such as propensity score matching.

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Figure 1. Conceptual model of faculty salaries

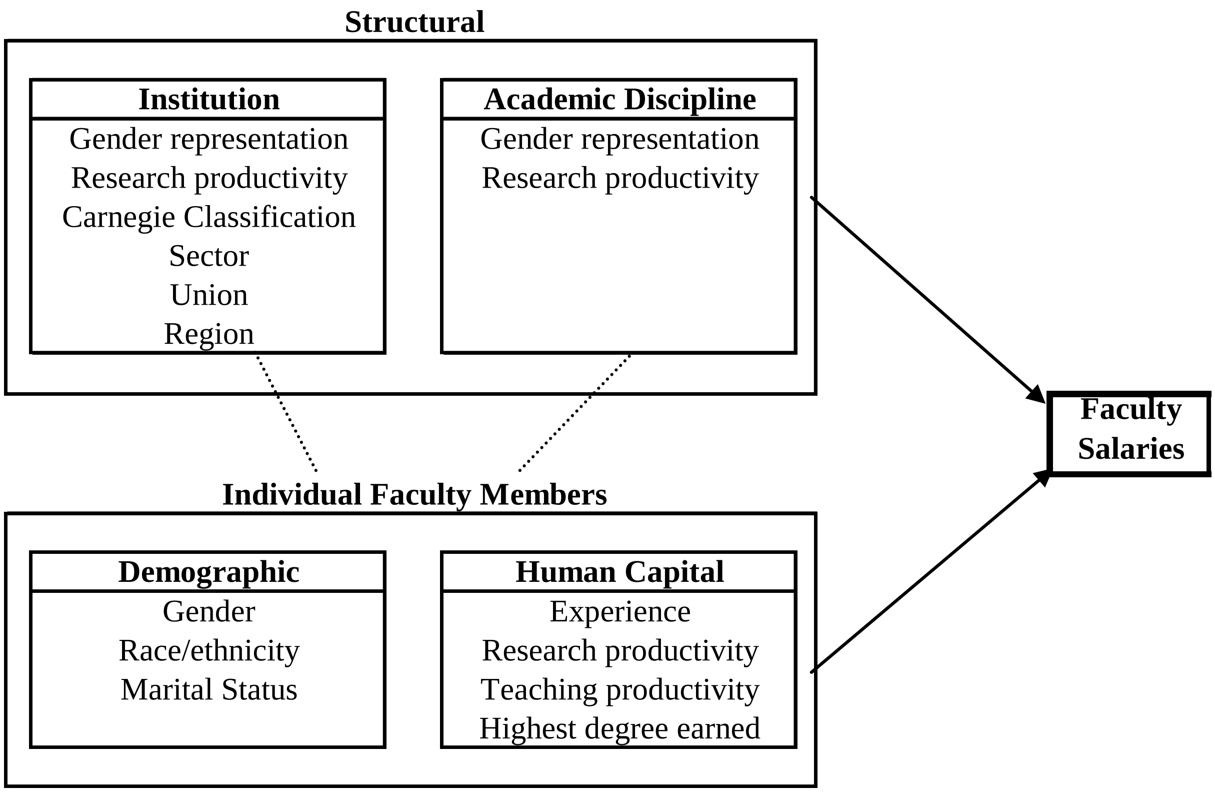

Table 1. Descriptive statistics of variables included in models

	Mean	SD	Minimum	Maximum
Institutional characteristics				
Proportion female	30.56	11	0	78.95
Average articles	17.98	15.71	0	93.36
Average course sections	2.69	1.04	0.66	13
Proportion funded research	0.38	0.23	0	1
Private	0.45	0.5	0	1
Master's	0.32	0.47	0	1
Bachelor's	0.22	0.42	0	1
Union	0.27	0.44	0	1
Disciplinary characteristics				
Proportion female	0.31	0.2	0.02	0.98
Average articles	24.87	18.48	4.47	95.47
Average course sections	2.38	0.51	1.14	3.46
Proportion funded research	0.46	0.18	0.13	0.88
Individual characteristics				
Female	0.34	0.48	0	1
Asian Pacific American	0.07	0.25	0	1
African American	0.04	0.2	0	1
Latino/a	0.05	0.21	0	1
Other race/ethnicity	0.02	0.13	0	1
Spouse	0.79	0.4	0	1
Children	0.51	0.5	0	1
Doctoral degree	0.86	0.35	0	1
1st professional degree	0.05	0.21	0	1
Experience	17.14	11.3	0	55
Experience squared	421.6	449.02	0	3025
Seniority	13.42	10.57	1	56
Seniority squared	291.72	387.35	1	3136
Age	50.44	9.96	27	89
Age squared	2643.59	1009.67	729	7921
Union member	0.19	0.4	0	1
Articles	21.93	34.27	0	200
Books	3.02	7.84	0	80
Patents	0.41	1.67	0	15
Course sections	2.44	1.56	0	20
Funded research	0.4	0.49	0	1
Full professor	0.31	0.46	0	1
Associate professor	0.43	0.5	0	1

Table 2. Variance components for faculty salary

	Variance	Proportion of variance explained
Between institutions	0.029	0.155
Between disciplines	0.018	0.095
Between cells	0.141	0.750

Table 3. Results of the within cell models of the natural log of faculty salary

	Female only			Demographic			Human capital			Rank		
	b		SE	b		SE	b		SE	b		SE
Intercept	11.052	**	0.017	11.054	**	0.017	11.072	**	0.013	11.071	**	0.013
Female	-0.140	**	0.010	-0.129	**	0.010	-0.058	**	0.009	-0.045	**	0.009
Asian Pacific American				-0.067	**	0.018	-0.021		0.016	-0.014		0.016
African American				-0.059	*	0.023	-0.011		0.020	-0.004		0.020
Latino/a				-0.057	**	0.021	-0.015		0.019	-0.002		0.018
Other race/ethnicity				-0.009		0.034	-0.002		0.031	0.010		0.030
Spouse				0.075	**	0.011	0.035	**	0.010	0.028	**	0.010
Children				-0.024	**	0.009	0.013		0.009	0.009		0.008
Doctoral degree							0.127	**	0.016	0.071	**	0.016
1st professional degree							0.304	**	0.029	0.243	**	0.028
Experience							0.014	**	0.002	0.006	**	0.002
Experience squared							0.000	**	0.000	0.000		0.000
Seniority							0.003	+	0.002	-0.004	*	0.002
Seniority squared							0.000		0.000	0.000		0.000
Age							0.011	*	0.005	0.004		0.005
Age squared							0.000	+	0.000	0.000		0.000
Union member							0.000		0.013	0.009		0.013
Articles							0.002	**	0.000	0.002	**	0.000
Books							0.001		0.001	0.000		0.000
Patents							0.005	+	0.002	0.005	*	0.002
Course sections							-0.035	**	0.003	-0.029	**	0.003
Funded research							0.049	**	0.009	0.043	**	0.008
Full professor										0.309	**	0.015
Associate professor										0.125	**	0.012
Variance components												
Variance between institutions	0.028	**		0.028	**		0.013	**		0.013	**	
Between institutions explained	0.028			0.039			0.543			0.545		
Variance between disciplines	0.015	**		0.016	**		0.010	**		0.011	**	
Between disciplines explained	0.142			0.132			0.420			0.397		
Variance between cells	0.138			0.137			0.111			0.105		
Between cells explained	0.025			0.034			0.211			0.257		

Note: $^{**}p<.01$, $^{*}p<.05$, $^{+}p<.10$

Table 4. Results of the full models of the natural log of faculty salary

	Proportion female			Aggregates			Full		
	b		SE	b		SE	b		SE
Intercept	11.068	**	0.013	11.054	**	0.012	11.055	**	0.012
Institutional characteristics									
Percent female	-0.003	**	0.001	0.000		0.001	0.000		0.001
Average articles				0.003	**	0.001	0.003	**	0.001
Average course sections				-0.057	**	0.009	-0.056	**	0.009
Percent with funded research				0.102	**	0.038	0.129	**	0.037
Private							0.046	**	0.013
Master's							0.020		0.018
Bachelor's							-0.029		0.022
Union							0.045	**	0.016
Disciplinary characteristics									
Percent female	-0.100	+	0.061	-0.051		0.067	-0.047		0.067
Average articles				0.003	*	0.001	0.003	*	0.001
Average course sections				-0.008		0.032	-0.008		0.032
Percent with funded research				0.127	+	0.116	0.120	+	0.115
Individual characteristics									
Female	-0.041	**	0.009	-0.043	**	0.009	-0.042	**	0.009
Asian Pacific American	-0.013		0.016	-0.013		0.015	-0.013		0.015
African American	-0.001		0.020	-0.002		0.019	-0.003		0.019
Latino/a	-0.001		0.018	0.002		0.018	0.001		0.018
Other race/ethnicity	0.011		0.030	0.013		0.030	0.012		0.030
Spouse	0.028	**	0.010	0.029	**	0.010	0.028		0.010
Children	0.008		0.008	0.007		0.008	0.007		0.008
Doctoral degree	0.069	**	0.016	0.057	**	0.016	0.058		0.016
1st professional degree	0.242	**	0.028	0.231	**	0.028	0.233		0.028
Experience	0.006	**	0.002	0.006	**	0.002	0.006		0.002
Experience squared	0.000		0.000	0.000		0.000	0.000		0.000
Seniority	-0.004	*	0.002	-0.005	**	0.002	-0.005		0.002
Seniority squared	0.000		0.000	0.000		0.000	0.000		0.000
Age	0.004		0.005	0.005		0.005	0.005		0.005
Age squared	0.000		0.000	0.000		0.000	0.000		0.000
Union member	0.015		0.012	0.023		0.012	0.006		0.014
Articles	0.002	**	0.000	0.001	**	0.000	0.001		0.000
Books	0.000		0.000	0.000		0.000	0.000		0.000
Patents	0.005		0.002	0.005		0.002	0.005		0.002
Course sections	-0.029	**	0.003	-0.020	**	0.003	-0.020		0.003
Funded research	0.041	**	0.008	0.034	**	0.009	0.033		0.009
Full professor	0.308	**	0.015	0.315	**	0.015	0.313		0.015
Associate professor	0.124	**	0.012	0.124	**	0.012	0.124		0.012
Variance components									
Variance between institutions	0.012	**		0.006	**		0.005	**	
Between institutions explained	0.591			0.788			0.813		
Variance between disciplines	0.010	**		0.009	**		0.009	**	
Between disciplines explained	0.424			0.483			0.487		
Variance between cells	0.105			0.105			0.105		
Between cells explained	0.256			0.257			0.256		

Note: **p<.01, *p<.05, +p<.10

Table 5. Correlations between female representation in disciplines and institutions and group-level characteristics

	Percentage female	
	Institution	Discipline
Institutional characteristics		
Average articles	-0.358 **	
Average course sections	0.079	
Percentage with funded research	-0.219 **	
Private	-0.027	
Master's	0.289 **	
Bachelor's	0.086 +	
Union	0.087 +	
Disciplinary characteristics		
Average articles		-0.515 **
Average course sections		0.307 **
Proportion funded research		-0.442 **

Note: **p<.01, *p<.05, +p<.10