Journal of Collective Bargaining in the Academy

Volume 11 *Some Impacts on Faculty: 50+ Years of Academic Collective Bargaining and Counting* Article 2

March 2020

Labor Unions and Equal Pay for Faculty: A Longitudinal Study of Gender Pay Gaps in a Unionized Institutional Context

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Cover Page Footnote

We are grateful for helpful feedback from Jasmine Kerrissey, Eve Weinbaum, Lori Reardon, and the Organization and Networks reading group.

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Introduction

Women faculty at doctoral granting universities are paid around 80% of what their men colleagues are paid (Newman, 2014). Women in higher education face disadvantage in various facets of their academic careers: they receive lower starting salaries (Freund et al., 2016; Porter et al., 2008), have a higher service workload (Babcock et al., 2017; Guarino & Borden, 2017; Misra et al., 2011; Pyke, 2011) get cited less (Fox, Whittington, & Linkova, 2017), and have a lower likelihood of receiving tenure and promotion than their male colleagues (Ginther & Kahn, 2004; Weisshaar, 2017).

Even though gender inequity in academia has multiple dimensions, academic institutions have mostly focused on understanding and addressing gender differences in salary. Many institutions across the United States conduct salary equity studies to find and address within-job salary discrimination and redress unequal pay. Most recent salary equity studies at universities in the United States find either a within-job salary gap for their faculty (Basri et al., 2015; Chen & Crown, 2018; Dickinson et al. 2019; UVA Faculty Salary Study Task Force, 2014) or no gender differences in pay (McAllister & Comstock, 2016; U.C. Davis Joint Administration-Senate Oversight Committee on Faculty Salary Equity Analyses, 2014; U.C. Riverside Salary Equity Study Committee, 2014; UCLA Senate-Administration Faculty Salary Equity Committee, 2016).

Yet, few studies have paid attention to the ways in which institutional labor contexts affect pay and gender inequity among faculty. Public universities with a unionized faculty provide an important organizational context within which gender inequities need further study. We conducted a salary equity study at a public university in the northeastern US as a case study to understand how gender pay gaps operate in a strongly a unionized faculty.

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Journal of Collective Bargaining in the Academy ISSN 1941-8043
Vol. 11, December, 2019 (March, 2020)

Using longitudinal models tracking the salary trajectories of full-time tenure-track faculty for 13 years, we find that women's salary growth outpaces men's, and women make more than men colleagues when they reach the full professor rank. This finding seems contrary to most university equity studies and may be connected to the strong union context. Yet, inequalities remain. Women are significantly underrepresented in positions of higher authority, including full professor rank, and certain high-paying fields remain extremely male dominated. Gender segregation by field and glass ceiling effects contribute the most to the overall pay gap between men and women. We argue that an institutional context that has strong enforcement of salary equity rules through a faculty union contributes to the reduction of individual level gender inequities in salary, but probably misses the larger context of inequities rooted in the gendered organization of higher education.

Previous Research on Gender Equity in Academia and the Role of Faculty Unions

Gender Inequity in Academia

Gender inequalities in pay and representation persist across academic institutions. Women get paid less than men at all ranks and women are severely underrepresented at the full professor rank, where men outnumber women two to one (Hatch, 2017). The justification for differences in pay that has long been touted is that men are more productive than women, which leads to higher pay; but the productivity difference argument has been disproven in studies that account for women's teaching load and institution type (Cole & Zuckerman, 1984; Long, 1992; Long & Fox, 1995). The representation gap is commonly explained by the "leaky pipeline" analogy, arguing that women's representation decreases along career stages from K-12, to undergraduate degrees to PhD graduates and then to faculty positions (Fox et al., 2017; Levenstein, 2015; Pell, 1996). The pipeline metaphor has been criticized for many reasons, including its inaccuracy in missing how scientists move between different kinds of organizations (and may come back to academia from industry for example), and its assumption of an individual choice model that does not account for how women are pushed out of science by discrimination and harassment (Smith-Doerr, 2011). Yet, besides women outpacing men in obtaining PhDs and entering academia as assistant professors, the representation gap at top academic ranks remains (Monroe & Chiu, 2010; Monroe et al., 2014). Unequal pay and underrepresentation of women is likely a product, in part, of gender biases that affect performance evaluations across the three main job duties of an academic: research, teaching, and service.

In research, women face biases in their work being selected for publication in top journals, in the likelihood of being cited, and in getting funding. The representation of women authors in top journals in political science lags behind their representation in the discipline as a whole (Breuning & Sanders, 2007). Women are less likely than men to publish in scientific areas where

research is particularly expensive (Duch et al., 2012; Larivière et al., 2013), which may be related to gender gaps in start-up packages. Editors and reviewers in economics apply higher standards for articles submitted by women than those of men (Hengel, 2017). Even in fields where the number of publications between men and women appear to be similar, gender inequities in first authorship and journal prestige remain across the natural sciences, social sciences, and humanities alike (West et al., 2013). Additionally, women receive less funding than men in biomedical fields (Ma et al., 2019), and women are assessed less favorably than their male colleagues in health related funding applications (Witteman et al., 2019).

Teaching and service are also locations for gender gaps in academia. In teaching, women faculty are evaluated more harshly by students. Students give lower evaluation ratings to women faculty than men faculty in identical courses (Basow, 1995; MacNell et al., 2015) . Women faculty do not only receive lower average student evaluations but they are evaluated on different criteria since gendered expectations of women faculty to be caring and friendly result in students focusing more on their personality than on their teaching ability or competence (Miller & Chamberlin, 2000; Mitchell & Martin, 2018). Women faculty perform a disproportionate share of service, mentoring, and administrative tasks (Guarino & Borden, 2017; Misra et al., 2011; Pyke, 2011, 2015). As women are assigned more time to these tasks, which are generally undervalued in academia, men are able to devote more time to research and grant writing (Pyke 2011; Vesterlund et al., 2017). The gender imbalance in service work is particularly pronounced at the associate level resulting in inequities in the time it takes for women to get promotion to full (Misra et al. 2011). The over-recruitment of women in service committees is not a product of women faculty's preferences to perform these tasks, but of bias in the expectations and pressure for women to spend more time on them (Misra et al., 2011; Pyke, 2015).

In terms of pay, faculty in female dominated fields experience a wage penalty, controlling for various labor market conditions and human capital differences (Bellas, 1994). However, disciplinary field level differences, while shaping organizational variation in gender pay gaps, do not fully capture the effects of organizational decisions and practices that result in women's lower pay (Smith-Doerr et al. 2019). The significance of organizational variation to pay gaps makes it important to know more about the specific conditions, including labor union strength, in higher education organizations.

These structural gender inequities in academic careers found in the research literature led us to hypothesize that women would make less than their men counterparts in the same rank and field.

Faculty Unions and Salary Equity

Approximately 27% of all faculty in the U.S. were represented by collective bargaining agreements in 2012 (Berry & Savarese, 2012; Sproul et al., 2014). That percentage is likely higher now as the number of unions continued rising in higher education through 2016 (Herbert, 2017). Faculty unions represent the faculty in a broad set of issues when negotiating contracts. Even though salary negotiations gather lots of attention, unions in higher education also get involved in negotiating work conditions related to reappointment, tenure and promotion policies, grievance procedures, coarse load, office space, and distribution of service assignments (DeCew, 2003).

The effects of faculty unions on overall salaries has been studied and generally find either a small positive impact on salaries (Ashraf, 1992, 1997; Barbezat, 1989; Benedict, 2007; Monks, 2000; Porter, 2013) or no significant impact (Hosios & Siow, 2004; Kesselring, 1991; Rees, 1993). However, scholars have paid much less attention to the relationship between faculty unions and gender salary equity.

The few empirical studies on this topic show that unions may have an impact on a number of factors that affect salary equity in academia: reduction in salary variability by field, hiring and retention of women faculty, and the tenure and promotion process. Unionized universities have overall lower salary differences among fields (Rhoades, 1993). Underrepresentation of women in STEM fields, fields that typically pay the highest overall salaries, accounts for a large proportion of gender pay inequities in academia. Thus, smaller variations in average salaries by field reduce overall gender pay gaps in unionized contexts (May, Moorhouse, & Bossard, 2010).

Unions have a positive impact on the hiring and retention of women faculty (May, Moorhouse, & Bossard 2010). The largest effects of unions on women's representation happen at the associate rank, perhaps as a result of the focus by unions on policies to standardize tenure and promotion processes (May, Moorhouse, & Bossard 2010; Rees 1993). Unions have historically focused on streamlining and providing clarity to the tenure processes at public universities (Aper & Fry, 2003). The formalization of tenure and promotion procedures are particularly important for women faculty since studies show that loose tenure policies disproportionately benefit men (Trower & Bleak, 2004).

Unionization may be correlated with other variables that impact faculty salaries. For instance, unionization increases faculty influence in decision-making regarding pay and other employment benefits (DeCew, 2003; Porter, 2013). Unions also improve collegiality between faculty members and provide a more level position for communication with administrators (DeCew 2003). Public universities and colleges with unionized faculty improve efficiency (core

expenses per degree and completion) and effectiveness (number of degrees and completions per 100 full-time students) (Cassell & Halaseh, 2014).

We present a gender equity study in a particular context: a university with a strong and long-standing faculty union. The faculty at this university have been unionized since 1976. Since its creation, the faculty union and the university administration have worked closely to develop a series of policies to address inequities among the faculty. Equity pay increases implemented since 2007 explicitly *address* unequal pay for faculty in the same rank in the same department. Other union-backed policies like semester-long parental leaves, child care assistance, and partner hires were also explicitly designed to reduce gender-based inequities at the university. Based on the precedent literature, we hypothesize that this strong faculty union context will result in a small initial gender gap in pay, and that the gap will decrease in size over time among faculty who remain in this university context.

Data and Methodology

Following the existing literature on salary equity in academic institutions, we use multivariate regression and regression decomposition to investigate within-job discrimination(Becker & Toutkoushian, 2003; Rosser & Mamiseishvili, 2014). We also offer a new methodological contribution to this literature by studying dynamic differences in faculty salaries using a longitudinal approach. This approach allows us to examine how salaries change over the course of an individual's academic career through the typical process of tenure and promotion.

Multivariate Regression and Regression Decomposition Models

Differences in faculty salaries are a result of several factors, some pertaining to characteristics of the individual and some related to structural or institutional bias. A multivariate regression approach allows us to control for numerous influences that might be associated with salary and gender—such as college, rank, the number of years employed at the university, and research productivity — in order to isolate the effect of gender on salary. We conceptually estimate an individual *i*'s salary using the linear equation:

$$\log(Salary)_i = \alpha + \beta_1 x1_i + \beta_2 x2_i + \beta_3 x3 + \varepsilon_i$$

where $x1$ is a vector of observed personal characteristics, $x2$ a vector of unobserved personal characteristics, and $x3$ is a vector that accounts for unobserved structural and institutional factors that affect a person's salary. Differences in salary that are a result of pure random variation uncorrelated with any of the other three sets of factors are captured by an error term ε,

and α is a constant term. The coefficients—represented by the different β s in the equation—are estimates of the effect of these different factors on income.

We use Ordinary Least Squares (OLS) regression to measure the net effect of gender on salary. We take a nested and sequential model building approach that begins with a simple model that considers only the effect of gender on salary. We then incrementally add more observed characteristics to our baseline model, allowing us to determine how these other factors alter the observed relationship between gender and salary. Below we present results on the following five models:

Model 1 includes only a dummy variable for gender that indicates whether tenure track faculty member is a woman (*Female*). Model 2 adds controls for race, measured as two dummy variables, one indicating whether the faculty was Asian (*Asian*) a second that identifies whether the faculty is a member of an underrepresented minority group such as African American, Hispanic, Native American, or Multiracial (*Minority*).[5]

In Model 3 we add controls for experience at the university, highest degree attained, and research productivity. To measure experience at the university we control for whether the faculty member held an administrative position (*Administrative Position*), was a department head (*Department Head*), and the number of years the faculty has been at the university (*Years From Fire*). To measure highest degree attained, we include dummy variables that indicate a law degree (*Law Degree*), a doctoral degree (*PhD*), or another degree (*Other Degree*), and we use master's degree as the reference category. To approximate research productivity, we include the number of grants awarded in 2015 (*Number of Grants*).[6]

Model 4 accounts for rank (*Associate Professor* and *Full Professor*) using assistant as the reference category. Model 5 adds controls for college, including Education, Public Health, Social and Behavioral Science (SBS), Natural Sciences (CNS), Engineering and Computer Science (Engineering/CS), the School of Management (Management) and Other College using the College of Humanities and Fine Arts as the reference group.

[5] The small number of Native American, Hispanic, African American, and Multiracial faculty did not allow us to estimate effects of these racial categories separately.

[6] We recognize that the number of grants is an imperfect measure of research productivity. Grants differ greatly in terms of amount and duration, prestige of the funding entity, and by differences in the availability of grants in different disciplines and sub-disciplines. Furthermore, grants data provided by the university do not cover all grants and contracts, especially smaller external and internal awards. Despite these limitations, and lacking better alternatives, we believe that the number of external grant awards does provide a general indicator of which faculty are active in external research. We also tried lagging the grants variable by one and two years, but the effects were similar.

Our analyses are conducted on the 1,097 full-time tenure-track faculty who worked at the university in 2015.[7] The dependent variable (log *salary*) is measured in natural logarithms, to help normalize the distribution of salaries. All salaries are measured in full-time equivalents to account for salary differences among faculty working on a part-time basis during 2015.

After the OLS models, we ran a Blinder-Oaxaca (B-O) regression decomposition based upon the same specification used for Model 5, which includes the full set of controls (race, rank, college, degree, etc.) The Blinder-Oaxaca decomposition technique investigates whether wage gaps are due to groups having different wage-related characteristics, or whether they receive different returns for those characteristics. For example, the B-O models assess whether women faculty receive the same return for experience as men faculty.

Longitudinal Models

The longitudinal approach adds a time-dimension to our analyses in which individual faculty member variables are measured repeatedly each year they are employed at the university. Specifically, we use a random-effects model that accounts for the repeated measurement of individuals, while allowing for both time-variant and time-invariant explanatory variables, such as gender.[8] The estimating equation is:

$$y_{it} = \mu_t + \beta x_{it} + \gamma z_i + \alpha_i + \varepsilon_{it}$$

where: μ is an intercept term allowed to vary with time, β is a vector of coefficients representing the effects of time- and person-variant attributes (x_{it}), γ is a coefficient vector to capture the effects of the time-invariant attributes (z_i), ε_{it} is a random distribution term, and αi as a normally-distributed random variable for each individual that is assumed independent of x_{it}, z_i, and ε_{it}. The inclusion of α_i accounts for the within-person correlation in the repeated measurements of the dependent variable, and adjusts the standard errors accordingly. As before, our dependent variable is the natural log of each faculty member's annual baseline salary, inflation-adjusted to 2015 dollar values. The interpretation of coefficients is similar to a standard cross-sectional OLS regression as the percent change in annual salary per unit change in each independent variable.

[7] The approach presented in this section only examines faculty attributes as measured in 2015 and does not account for historical processes that might have led to current salary levels. For results on longitudinal analyses using data between 2003 and 2015, see section VI.

[8] Repeated measurement of the same individuals violates the independence assumption of standard (OLS) regression models and leads to misleading statistical significance tests. Maximum likelihood estimates with random effects accounts for the non-independence of individuals measured over time.

The time-invariant variables (z_i) are attributes that may differ across individuals but do not change over time. The primary time-invariant measure is a dummy variable indicating whether the faculty member is a woman (*Female*). Model L3 includes time-invariant measures capturing salary differences by College. We include the same college dummy variables as we did in the OLS models.

The remaining variables are all time-variant measures – they can potentially change over time. They include: Years at the University (*Years from hire*), an interaction between female and years at the university (*Female*Years from Hire*) a dummy variable for *department head (Department Head), Rank (Associate Professor and Full professor with Assistant as the reference category)*, interactions between female and rank *(Female Associate Professor and Female Full Professor*), years spent in the associate rank *(Years from Associate),* and an interaction between female and years in associate rank *(Female*Years from Associate).*

Because we are attempting to simulate the typical process of tenure and promotion, we include only full-time tenure track faculty hired at the rank of assistant professor on or after 2003. We have no information prior to this year, and thus cannot reconstruct the employment or salary history of faculty before this period. We also exclude those employed at the university for two years or less because they lack a sufficient employment history to track the year-to-year changes in their salary. Most of these are recent hires (hired after 2013). In addition, we exclude senior faculty hires (i.e. those hired at the rank of associate or full professor) over concerns that the recruitment of a relative few highly paid faculty members might distort salary trends that were more typically of tenure track faculty. Our final dataset includes 3,500 observations, covering 501 tenure-track faculty consisting of 240 women and 261 men.

Results

Pay Gaps Before and After Controls

There are substantial pay gaps by gender before adding controls for rank and college. Table 1 presents the results of the OLS regression models for all tenure track faculty employed at the university during 2015. According to the baseline results provided in Model 1, women made 16.2% less than their men counterparts in 2015, without controlling for other possible factors. Adding race reduces the gender gap, but only slightly to 15.8% (Model 2).

Adding controls for rank, experience, and productivity in Model 3 significantly decreases the gender gap in pay. Including rank dummy variables in Model 4 reduces the gender salary gap even further, from 8.3% to 4.9% (Model 4, Table 1). Yet the gap remains statistically significant. Finally, adding college as an approximation of field in Model 5 reduces the gender difference in

salary to 1.4%, which is no longer statistically significant at conventional confidence thresholds. Together the variables included in Model 5 explain 79% of the total variation in faculty salaries, leaving only 21% of the possible variance in salary unexplained. Although not an explicit focus of this study, we also find that members of under-represented minority groups earn an average of 4.6% less than white faculty.

When we move from OLS models to the Blinder-Oaxaca decomposition models, we see further evidence that women receive the same returns to rank, and experience as men in a unionized environment. The regression decomposition shows a difference of 16.2% between men and women, consistent with our baseline estimates from Model 1 (Table 2). Of that mean difference, 14.9 percentage points are explained by differences in experience and rank. In other words, most of the total difference in average salaries between men and women would disappear if women had similar characteristics to men in terms of rank, college, administrative positions, number of years at the university and number of grants awarded. Of course, the fact that on average, women faculty do not have the same opportunities to attain higher rank and administrative positions is part of the gender (in)equity context. Still, for women faculty who are able to move up, it appears there is not a salary gap. The coefficient and interaction effects were not significant, which suggests that a within-job pay gap is an unlikely explanation for the difference in salaries between men and women faculty in 2015.

Table 1
OLS Regression Results for Faculty Pay Gaps, 2015

	Model 1	Model 2	Model 3	Model 4	Model 5
Female	-0.162***	-0.157***	-0.085***	-0.049***	-0.014
	(0.018)	(0.018)	(0.014)	(0.011)	(0.009)
Race (Omitted: White)					
Asian		-0.072**	0.019	0.031*	0.005
		(0.026)	(0.020)	(0.016)	(0.013)
Minority		-0.143***	-0.083***	-0.071***	-0.046**
		(0.029)	(0.023)	(0.018)	(0.015)
Administrative Position			0.488	0.342	0.303***
			(0.035)***	(0.028)***	(0.026)
Department Head			0.228***	0.115***	0.096***
			(0.032)	(0.026)	(0.021)
Years From Hire			0.012***	0.002**	0.002**
			(0.001)	(0.001)	(0.001)
Degree (Omitted: Masters)					
Law Degree			0.152	0.104	-0.193**
			(0.098)	(0.077)	(0.063)
PhD			0.139***	0.102***	0.028
			(0.033)	(0.026)	(0.022)
Other Degree			-0.010	-0.011	0.002
			(0.163)	(0.129)	(0.103)
Number of Grants			0.024***	0.015***	0.012***
			(0.005)	(0.004)	(0.003)
Rank (Omitted: Assistant)					
Associate				0.180***	0.184***
				(0.016)	(0.013)
Full				0.466***	0.472***
				(0.019)	(0.015)
College (Omitted: Humanities and Fine Arts)					
Education					0.013
					(0.021)
Public Health					0.021
					(0.019)
SBS					0.079***
					(0.015)
CNS					0.086
					(0.013)***
Engineering/CS					0.190***
					(0.017)
Management					0.453***
					(0.020)
Other College					0.123*
					(0.049)
Intercept	11.71***	11.74***	11.34***	11.26***	11.23***
	(0.012)	(0.013)	(0.035)	(0.028)	(0.022)
R^2	0.07	0.09	0.47	0.67	0.79
N	1,097	1,097	1,097	1,097	1,097

* $p<0.05$; ** $p<0.01$; *** $p<0.001$ based on a two tailed test. Standard Errors in Parentheses.
Note: *Other College* includes faculty not hired as part of an established academic college.
The majority of tenure-track faculty in the *"Other College"* hold administrative positions.

Table 2
Blinder Oaxaca Regression Decomposition Results, 2015

Male mean log salary	11.718
	(0.012)***
Female mean log salary	11.557
	(0.013)***
Difference	0.162
	(0.018)***
Endowments	0.149
	(0.017)***
Coefficients	0.014
	(0.010)
Interaction	-0.002
	(0.008)

** p<0.05; ** p<0.01; *** p<0.001, based on a two tailed test.*

Examining Gender Gaps Over Time: Longitudinal Analysis Results

Our first longitudinal model measures how salaries differ for women tenure track faculty compared to their male counterparts, controlling for rank and whether serving as Department Head or Chair (Table 3, Model L1). On average, women earned $4,325 less than men during their first year at the university, absent controls for college.[9] There is no significant difference in the rate of salary growth for women and men, as indicated by the small and insignificant parameter estimate on the "*Female*Years from hire*" variable.

[9] Because the model is estimated using log salary as the dependent variables, we first take the anti-log to convert the coefficients into dollar units.

Table 3

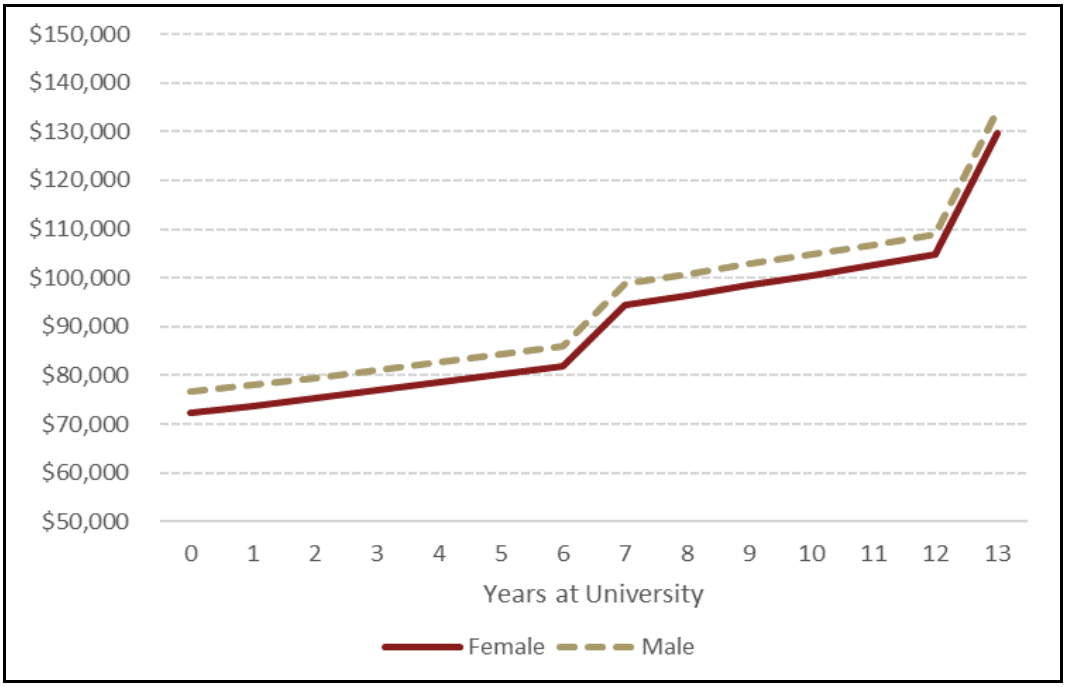
University-wide, Longitudinal Analysis of Logged Tenure-Track Faculty Salaries, 2003-2015

	Model L1	Model L2	Model L3
Female	-0.058***	-0.048***	-0.010
Years from hire	0.019***	0.017***	0.0170***
Female*Years from hire	0.002	-0.001	-0.0000
Department Head	0.060***	0.050***	0.050***
Rank (Omitted: Assistant)			
Associate Professor	0.122***	0.096***	0.096***
Full Professor	0.314***	0.346***	0.349***
Female Associate Professor		0.003	0.003
Female Full Professor		0.069***	0.069***
Years from Associate		0.019***	0.019***
Female*Years from Associate		0.006**	0.006***
College (Omitted: Humanities and Fine Arts)			
Education			-0.012
Engineering and Comp. Sci.			0.309***
CNS			0.145***
Management			0.696***
Public Health			0.058***
SBS			0.157***
Intercept	11.246***	11.247***	11.092***
N	501	501	501
Max Obs per Subject	13	13	13
-2 Log Likelihood	-10146.3	-10514.9	-11215.9
AIC (Smaller is Better)	-10124.3	-10484.9	-11173.9
AICC (Smaller is Better)	-10124.2	-10484.8	-11173.6
BIC (Smaller is Better)	-10077.9	-10421.7	-11085.3

* $p<0.05$; ** $p<0.01$; *** $p<0.001$, based on a two-tailed test

Figure 1 is a graphical depiction of the longitudinal results in Model L1. We use the estimated coefficients to predict how the salaries of male and female faculty change over time. For graphing purposes, Figure 1 assumes a promotion to associate professor in year 7, and a promotion to full in year 13. Women have lower starting salaries, but the year-to-year change in their salary is similar to men. However, this model does not allow for possible gender differences in salary changes due to promotion nor does it control for salary differences by college. The next two models add these controls.

Figure 1
Predicted Annual Salaries by Gender and Year
(Visualization of Table 3, Model L1 Results)



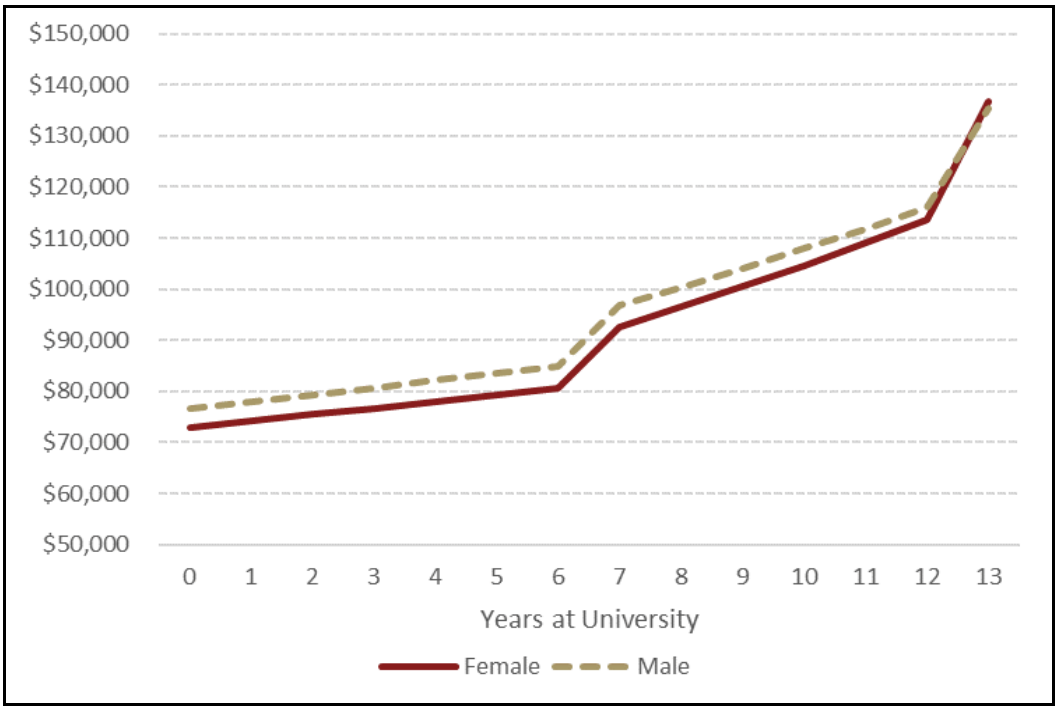
Our second longitudinal model (Model L2) allows for possible gender differences following a promotion to Associate or Full professor. We also account for possible differences in the rate of yearly salary growth among assistant and associate professors.[10]

Allowing for gender differences associated with rank reduces the initial salary gap from $4,325 to $3,606, but it remains significant (Table 3). Men and women have a similar rate of salary growth as assistant professors, as indicated by the small and insignificant coefficient on

[10] Because the dataset only includes faculty hired in 2003 or later, there is not a sufficient time-span to estimate separately the annual salary growth following a promotion to full professor. These effects are captured by the *Full Professor* dummy variable, but we are not able to distinguish the one-time salary increase due to promotion for the annual rate of change.

the *Female*Years from hire* variable. Women and men also receive a similar salary bump when promoted to associate (*Female, Associate Professor*). However, women associate professors have a faster rate of salary growth than their men colleagues do, as indicated by the positive and significant coefficient on the *Female*Years from Associate* variable. Furthermore, women who are promoted to full professor appear to receive a significantly larger one-time increase than their male counterparts (*Female, Full Professor*). Together, the faster rate of increase as associates and the higher salary with a promotion to full professor help to reduce the gender salary gap among senior faculty (Figure 2).

Figure 2
Predicted Annual Salaries by Gender and Year, allowing for Gender Differences by Rank (Visualization of Table 3, Model L2 Results)

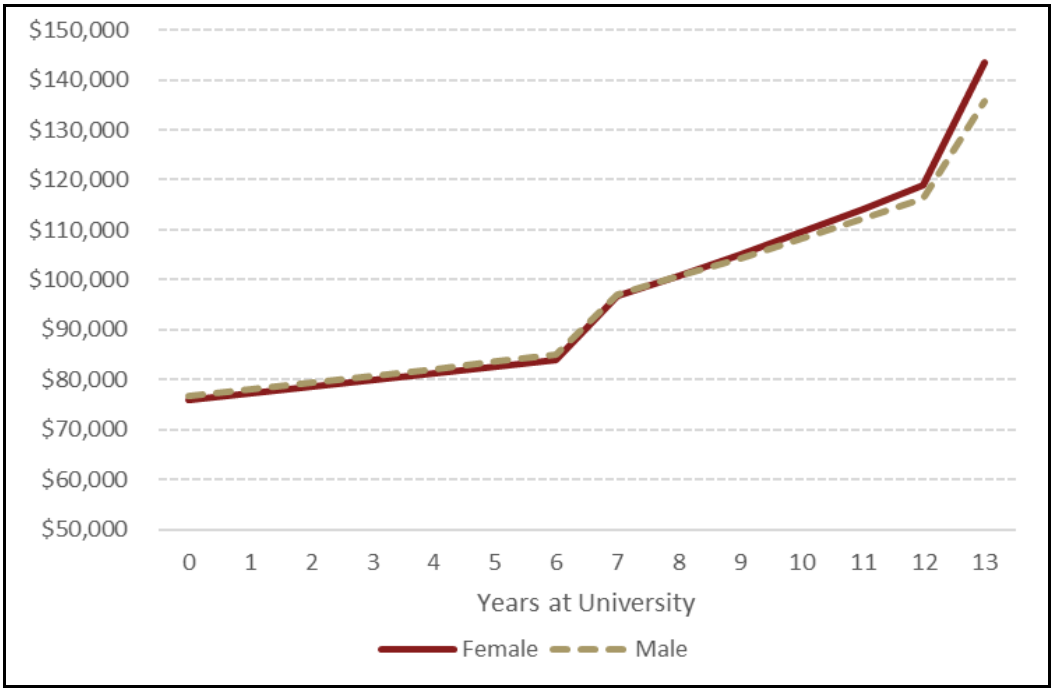


Our final University-wide model (Model L3) controls for salary differences associated with the faculty-members' college. When we account for college-level differences, the initial gender wage gap nearly disappears and is no longer significant at conventional levels of confidence (Table 3). This suggests that much of the university-wide wage gap is due the gender imbalance of faculty across colleges. Women are underrepresented in colleges—namely Management, Engineering, Natural Sciences, and Information and Computer Science—that offer higher starting salaries. Even with the college-level controls, the relatively faster rate of salary growth among women associate professors and the larger rise in salary with a promotion to full professor remain significant, and as can be seen in Figure 3. Women full professors who have

worked at the university for over 12 years get paid higher salaries than their male counterparts in the same college.

Figure 3

Predicted Annual Salaries by Gender over time, allowing for Gender Differences by Rank with College-level Controls (Visualization of Table 3, Model L3 Results)



Discussion

Consistent with other research on gender gaps in higher education, we find that the university has an overall average salary gap between men and women full-time tenure-track faculty. Women faculty make 83.8 cents for every dollar their male counterparts make However, this pay gap is not due to within-job discrimination—women faculty at the same rank and college as men coworkers do not experience a pay gap. An unexpected finding from our longitudinal analyses is that women have lower starting salaries at their time of initial hire, but when controlling for college, women's average salary grows faster than men's as they ascend in rank.

A reduction in pay inequity may be explained by the implementation of a union-backed policy: equity pay increases. Equity pay increases at this university have the goal of correcting inequitable differences in pay and reducing faculty salary compression and became effective at this university in fall 2007. Departmental personnel committees can recommend pay increase in three scenarios: when someone's salary is lower than the most recent starting salary in their department for the same or lower rank; when, at the end of the third year someone's salary is

below the median salary for the rank in his or her department; and when someone's salary, at any time, is below the median salary for the rank in his or her department and is below salaries of those with comparable years of service and/or achievement in the department. Each college at the university during this time period had a pool of $200,000 to address unequal pay through the equity process. Recent negotiations of the union with the administration since 2015 have strengthened the equity pay process (faculty and committees no longer have to nominate faculty equity raises, they will be more automated based on the data) and increased the dollar amount available for pay equity granted through this process.

Despite the lack of available data on the use of equity pay adjustments across colleges at the University, the president of the faculty union frequently cited this policy as a landmark policy that has increased equity on campus (Interview with Union President in October 2017). Additionally, the union has promoted a series of policies to address gender inequities in academia. The university was a pioneer in establishing automatic delays in the tenure clock for faculty who take parental leave and is currently in the 90th percentile of public research-intensive universities for having policies that make raising children compatible with tenure track obligations. It also has a partner employment policy to support dual career families, a policy that research has shown has an equity component because more women scientists have academic partners than men scientists (Monroe et al., 2014; Schiebinger et al., 2008). A related salary policy that prevents the widening of the gender gap at hire we observe in our data is the way in which promotion salary increases are awarded. The faculty union negotiates a straight dollar amount that all faculty receive with promotion, regardless of their base salary. Using an equal dollar amount instead of a percent increase in salary helps contain the widening of gender pay gaps as people get promoted. While equity pay increases have helped reduce within-job pay differences, all of our models show that the university-wide gender pay gap of 16.2% is explained by two institutional trends related to underrepresentation of women. First, women are underrepresented at the full Professor rank. Second, women comprise very small numbers of the total faculty in the colleges that have the highest average salaries, namely Computer Science, Management, Engineering, and Natural Sciences (the latter two are also among the largest colleges in faculty numbers).

The underrepresentation of women at the full rank suggests there may be unaddressed institutional inequities in the tenure track process. A study with data collected at the same university in 2008 and 2009 found that women took longer than men to be promoted to full professorship (Misra et al. 2011). Structural factors of gendered work in academia like higher teaching and service demands for women as well as higher care burdens were identified as the causes for slower promotion. Since 2009, the percentage of full professors that are women grew by only three percentage points from 26% to 29%, while the proportion of women with PhDs

grew across almost all of the fields—so promotion is not happening at the rate of available faculty representation.

The stubbornly low number of women full professors may indicate the persistence of factors that slow down the promotion of women from associate to full. Our findings confirm what previous researchers have found: The largest effects of unions on women representation happen at the promotion to associate rank because of some focus on the tenure process. However, lack of attention to the promotion from associate to full results in long lasting underrepresentation of women at that rank (May, Moorhouse, and Bossard 2010; Rees 1994). Additional study is clearly needed, and universities can help by forming task forces, commissioning internal studies, and by allowing researchers access to administrative payroll and grants data. Shining a light on these remaining sources of disparity may also encourage academic leaders like Chairs and Deans to seek parity more consciously when assigning administrative and service loads, and when recognizing a wider range of contributions of faculty to the university beyond research. Unions can also play a more proactive role by advocating for policies and programs that offer service and teaching releases for associate professors seeking promotion to full.

In addition to problems of gender parity in rank, women's representation across fields is another stubborn problem in the academy. In our study, women comprised less than a third of all faculty in Computer Science, Engineering, and Natural Sciences, and around a third of all faculty in Management. The slow growth in the proportion of women in these four colleges shows organizational level inequalities that are particularly stark in Engineering and Computer Science. The proportion of women in the Management college, rose from 21% in 2003 to 34% in 2015, the share of female faculty in the Natural Sciences rose from 16% in 2003 to 30% in 2015. But the proportion of women in Engineering is just 2.6 percentage points above its 2003 value, and in Computer Science, the proportion of women declined since 2012 and is now 5.2 percentage points below its 2003 level. Under-representation of women in Computer Science, Management, Engineering, and Natural Sciences, is sometimes attributed to the low national availability of women with doctoral degrees in those fields; however, 20 out of 53 departments across the university are underutilizing the pool of available women with a doctoral degree in those fields (Misra et al. 2011).[11]

Our findings about how women full professors out-earn their men colleagues is a puzzling one. It could be a product of selection mechanisms in which women who make full professor outperform men by having relatively better research, publication, and grant records and thus

[11] Underutilization happens when the workforce composition of a department is less than 80% of the availability estimate and there is a one-person or greater shortfall in the respective job group

attain higher salaries due to retention offers, merit bonuses and/or other salary negotiations. We had access to some pilot data that suggested these results are not likely due to women receiving an exceptional number of external offers and university counter-offers. If women who are staying at the University have better research, publication, and grant records than their male counterparts, they could be getting more job offers outside of the university. However, an analysis of retention offers at the university shows that men obtained 62% of all retention offers between 2002 and 2015 while women received 38%. This lack of outside offers for high achieving women professors could be due to the gender discrimination processes that occur for women academics with men partners; search committees typically assume partnered women are 'unmovable' (Rivera 2017). At our case university, men with outside offers received an offer to stay at the university that increased their pay by 14.3% on average, while women received counter-offers that increased their pay by 13.1%. Therefore, retention offers likely are not driving the reduction in the gender pay gap after promotion to full.

It is important to note that even when we do not find a within-job gender pay gap we still found a statistically significant difference in pay between white faculty and faculty from underrepresented racial and ethnic groups. Further investigation to understand the sources of this gap and the failure of equity pay increases to eliminate it is imperative. While the focus of this study is on gender inequity, that finding shows the importance for both the faculty union and university administrators to pay special attention to pay and representation gaps by race, and furthermore, to existing inequities at the intersection of gender and race.

Conclusion

On its own, this study cannot provide definitive evidence of the effects of strong faculty unionization. However, in the context of a burgeoning literature--both published in journals and university released reports—we can see that most other campuses in the US reporting on faculty salaries do not have strong faculty labor unions. This university's faculty union contract is notable for the inclusion of equity policies. Rhoades (1998) found that faculty union contracts often included merit salary structure adjustments and sometimes market adjustments, but that equity adjustments were the least common across faculty unions in the US. As such, this university case study provides an important contribution. It shows that an institutional context that has strong enforcement of salary equity rules, monitored by the union, ends up supporting individual level equity and reducing the gender pay gap. However, the focus on individual salaries misses the larger context of inequities rooted in the gendered organization of higher education.

To make more systemic change in gender equity, faculty labor unions would need to focus on changing the gendered biases of what many present as "objective" criteria for hiring, granting

tenure, and promotion. Faculty unions could draw on behavioral economic and social psychology research that shows how interventions may reduce unconscious and conscious biases (Bohnet, 2016). Interventions such as creating and displaying faculty workload in dashboards combined with workshops on implicit bias improved perceptions of workplace equity (O'Meara et al., 2018). Reducing the gender segregation (and valuation) by field is a larger problem in science that goes beyond any one institution's purview; however, an institutional approach that fosters interdisciplinary collaboration may offer some promising inroads (Misra et al., 2017; Smith-Doerr & Croissant, 2016).

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