Gender Discrimination in Salary Setting: a Case Study from a US Medical School

Ngoc Duong, Bingkun Luo, Junxian Chen, Mengjia Lyu

Abstract

Background: A case arose in the United States District Court of Houston a few years ago in which the plaintiff accused Houston College of Medicine of gender-based pay discrimination.

Objective: This report aims to analyze the data provided in the lawsuit to investigate the validity of the claim of gender discrimination in setting salaries and promotions.

Methods: A multiple linear regression model was fitted and adjusted association between gender and salary was evaluated. An interaction term between gender and experience was also included to see if experience modified the effect of gender on salary. Stratification analyses were then performed.

Results: Accounting for all confounders, the difference in salary between male and female doctors at the college was statistically significant, supporting the plaintiffs' claim. The interaction term, however, suggested this cross-gender salary gap got bridged as the number of years of experience increased.

Keywords: lawsuit, gender discrimination, unequal pay, health science, regression model for associations.

---

1. Introduction

The Equal Pay Act of 1963 has made it a federal law that salary scales for identical work must be the same regardless of the gender of the employee.[1] However, gender discrimination in setting salaries still exists in many fields including healthcare and academia. According to a national survey in 2012, male physicians in the US were paid significantly higher compared to female co-workers after adjusting for relevant factors.[2] Another study in 2010 on 50 universities whose medical schools received the largest amount of funding from the NIH found female faculty in the life sciences earned approximately $13,226 less on average every year than their male colleagues.[3]

More arguments regard to gender discrimination in salary and promotion appeared in the academy and indicated such unequal treatment is not rare. A few years ago, a case arose under Title VII of the Civil Rights Act of 1964, 42 U.S.C. 200e et seq at the United States District Court of Houston, in which the plaintiffs, consisted of female doctors at Houston College of Medicine, claimed potential discrimination against women in salary setting existed in the college and a set of data were presented to support their claim.

In order to address the main issue, this report used the data provided by the plaintiffs in the lawsuit to conduct statistical analyses. Descriptive statistics regarding the data were generated and a multiple linear regression model showing the relationship between gender and salary was obtained. Based on the results of the descriptive statistics and regression model, we concluded that male doctors at the Houston College of stuff had significantly higher salaries than their female counterparts and the plaintiffs' claim was supported by the data they provided.

2. Methods

2.1 Data exploration and description

The data provided by the plaintiffs in this lawsuit contained information of salaries in 1994 and 1995, gender, department affiliation, clinical/research emphasis, board certification status, experience, rank, and publication rate. In the original dataset, there were 9 variables (four continuous and five categorical) and 261 observations without missing values. Baseline characteristics of the study sample, stratified by gender, were presented in Table 1. Our primary outcome, salary, ranged from 34,514.00 to 339,664.00 for females and from 52,582.00 to 472,589.00 for males across both years. Higher mean and median values of salaries in males compared to females can be noticed in both 1994 and 1995.

Density plots indicate strong positive skewness in the outcome variable -- salary -- for both years (Figure 1). Therefore, log-transformation was applied to make the variables more normally distributed and facilitate model building process. Distributions of salary for both years post-transformation were shown in Figure 2 and Figure 3. Boxplots investigating the crude relationships between (log-)salary and each covariate were shown in Figure 4 and Figure 5. Higher overall level in male doctors’ salary can be noticed in variable ‘Gender’, suggesting a crude significant discrepancy in salary between male and female. ‘Department’, ‘Rank’, ‘Clinical Emphasis’, ‘Certification’, and ‘Experience’ also seemed to be associated with (log-)salary.

2.2 Statistical Analysis

We started off with simple linear regression models to look at the crude association between gender and salary for the years 1994 and 1995. We then proceeded with the bivariate models by introducing each of the other independent variables into the simple regression model. We identified those that rendered the adjusted coefficient of gender to be different by more than 10% from the crude association as confounders. These confounders (department affiliation, clinical/research emphasis, board certification status, years of experience since obtaining MD degree, and faculty rank were identified as confounders) were then included together with gender in an expanded multiple regression model.

Stepwise regression (backward) with AIC as the criterion did not suggest leaving out any covariate. Automatic procedure (both forward and backward elimination based on p-value) recommended a reduced model without “publication rate”. After conducting a partial F-test, we removed “publication rate” to obtain our final model. Observing that the rate of change in (log-)salary among female medical faculty increased compared to that of male faculty for every additional year of experience (Figure 5), we decided to investigate whether the linear association between gender and salary levels was different by experience.

2.3 Stratification analysis

Given the interaction term between gender and experience is statistically significant, we conducted a stratification analysis. We dichotomized the continuous variable “experience” into low-experience and high-experience groups using the median (9 years) as the cut-off point. After stratifying the original sample by experience level, multivariate linear regression models were re-run among each stratum to obtain the adjusted association between gender and (log-)salary for both years.

2.4 Model diagnostics

Our model performed well with assumption diagnostics (Figure 7). The plot of residuals versus predicted values showed residuals were not too far away from 0, indicating the linearity assumption was met. There was no significant pattern in the spread of residuals so homoscedasticity assumption also held. QQ-plot showed residuals lie mostly on the theoretical quantile line, thus satisfying the normality assumption. Scale-location plot (square rooted standardized residual vs. predicted value) confirmed our model satisfied the homoscedasticity assumption. Test for multicollinearity also indicated that no covariate was highly correlated with others, so multicollinearity was not an issue in the final model.

3. Results

Our final multiple linear regression model (Table 3) showed significant positive adjusted associations between gender male (compared to reference group -- female) and log-transformed salary for both years 1994 and 1995, controlling for clinical emphasis, board certification and number of years since obtaining their MD degree.

The adjusted R-squared for the model is 93.77% for the year 1994, and 93.78% for the year 1995, indicating our models explained most variability in the outcome variable -- (log-)salary. As suggested by the statistically significant gender-experience interaction term (Table 3), there were differences in the effects of gender on salary between the less experienced (N = 139) and more experienced groups (N = 122). Our stratification analysis (Table 4) showed that the increase in salary among male physicians compared to their female colleagues was less pronounced in the more experienced group (indicated by non-significant effect of gender), suggesting experience, expressed in number of years since obtaining MD degree, could attenuate the effect of gender on salary.

4. Discussion

Our analysis shows that at baseline (without any years of experience), male faculty at the University of Houston earned roughly 14% more than their female colleagues, adjusting for rank, clinical/research emphasis, certification status, and department. This substantiates the claim by the plaintiffs in this lawsuit. For each additional year of experience, however, this difference in salary between male and female doctors decreased by roughly 10%, adjusting for other covariates. Our model achieves high internal validity, and while this does not directly imply high external validity, our results do contribute to the growing documentation of gender-based salary discrimination in academia, especially in fields that actively address gender equality like science and medicine. Furthermore, it is also worth noting that female physicians/medical faculty in our study caught up over time — effectively closing the gender pay gap within the experienced stratum, indicated by the insignificant adjusted associations between gender and salary for both years (as denoted by model 5 and 6 in Table 4).

5. Conclusion

Through this study, we discovered a significant positive association between being male and salary among physicians who served as faculty at Houston College of Medicine, adjusted for specialties, nature of position, rank, and qualifications. The finding is based on the data provided in the lawsuit and it supports the main claim of the plaintiffs that gender discrimination in setting salaries existed. However, the effects are only significant in the less experienced subset of the sample compared to the more experienced one. This signifies the reality of gender-based salary discrimination at the college, as well as the role experience plays in modifying this relationship. Our findings are not all too surprising considering how widespread and systematic gender discrimination in setting salaries and promotions is in academia and medicine,[4] and despite all the systemic and structural discrimination, female doctors/medical professors at the college seemed to prove themselves and catch up in salary after about 9 years of experience (post medical school).

References

[1] US Equal Employment Opportunity Commission. (1963). The equal pay act of 1963. US EEOC, Washington, DC.

[2] Jagsi, R., Griffith, K. A., Stewart, A., Sambuco, D., DeCastro, R., & Ubel, P. A. (2012). Gender differences in the salaries of physician researchers. JAMA, **307**(22), 2410-2417.

[3] DesRoches, C. M., Zinner, D. E., Rao, S. R., Iezzoni, L. I., & Campbell, E. G. (2010). Activities, productivity, and compensation of men and women in the life sciences. Academic Medicine, **85**(4), 631-639.

[4] Morgan, A.U., Chaiyachati, K.H., Weissman, G.E. et al. J Gen. Intern. Med. (2018) **33**: 966.

[5] Association of American Medical Colleges. “Women in American Academic Medicine Statistics 2002–2003.” Retrieved from http://www.ama-assn.org/ama/pub/ category/12919.html.

Appendix

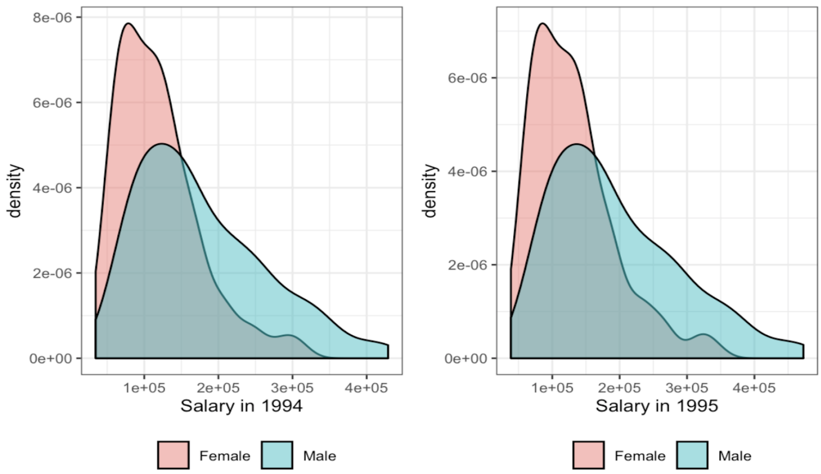

Figure 1: Distributions of the crude outcomes

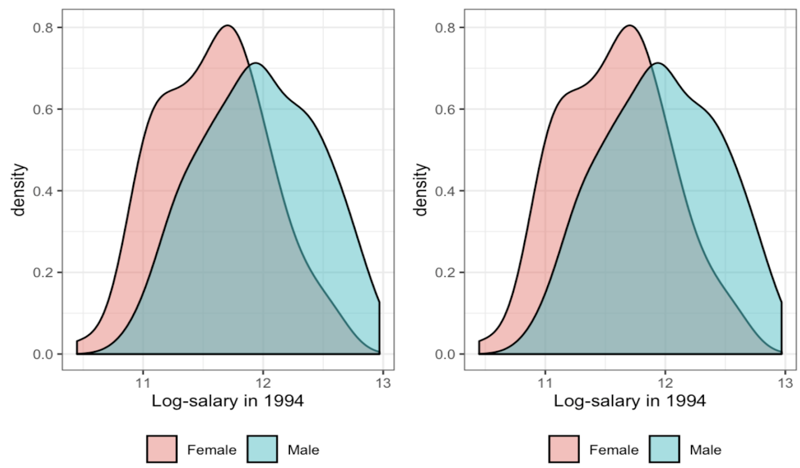

Figure 2: Distributions of the outcomes after log-transformation

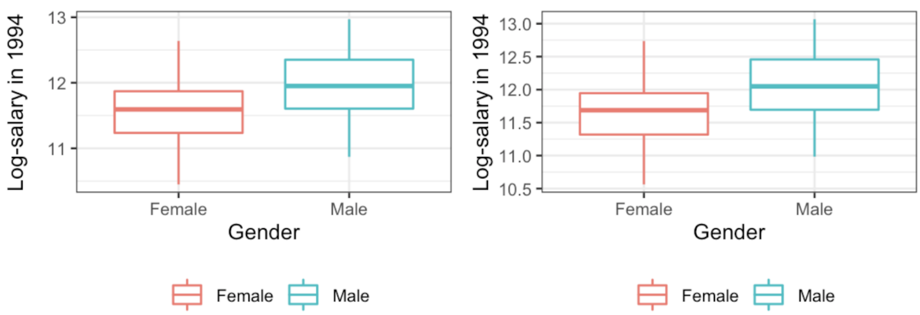

Figure 3: Boxplots for log-transformed salary in 1994 and 1995 by gender

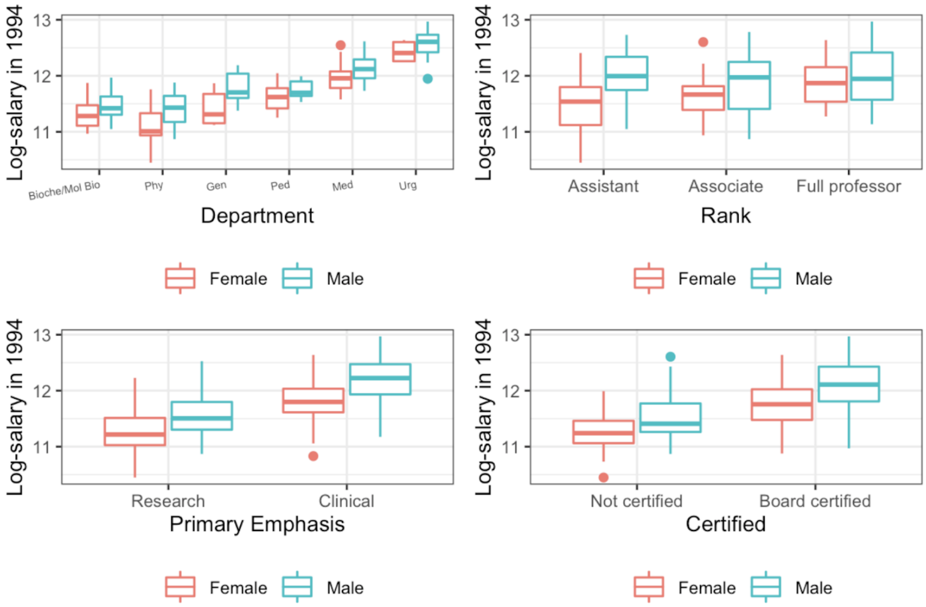

Figure 4: Distributions of log-transformed salary by gender versus the four categorical variables: Department, Rank, Clinical Emphasis, Board Certification

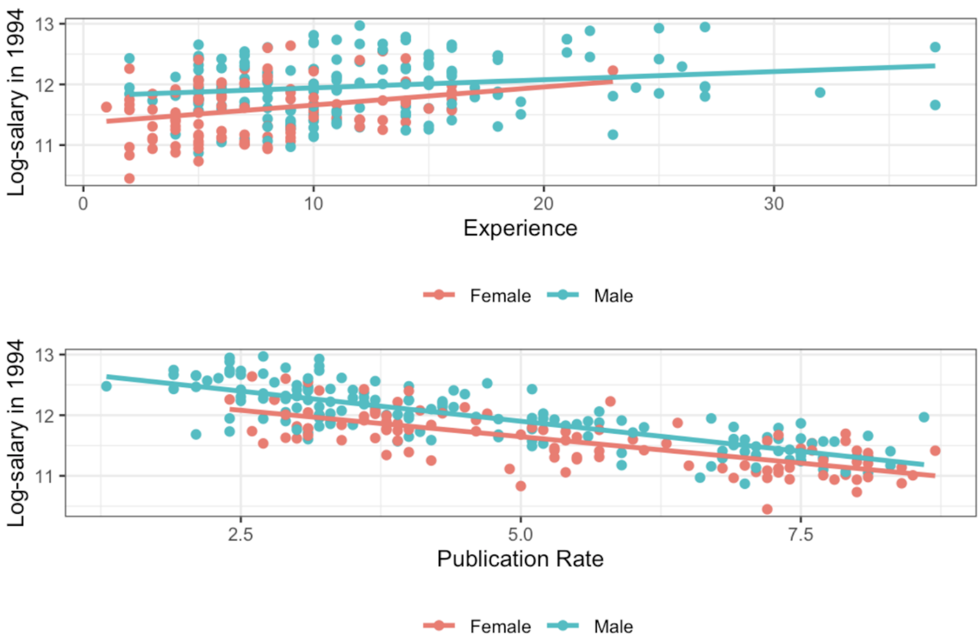

Figure 5: Distributions of the two continuous variables (Experience, Publication Rate) versus log-transformed salary by gender

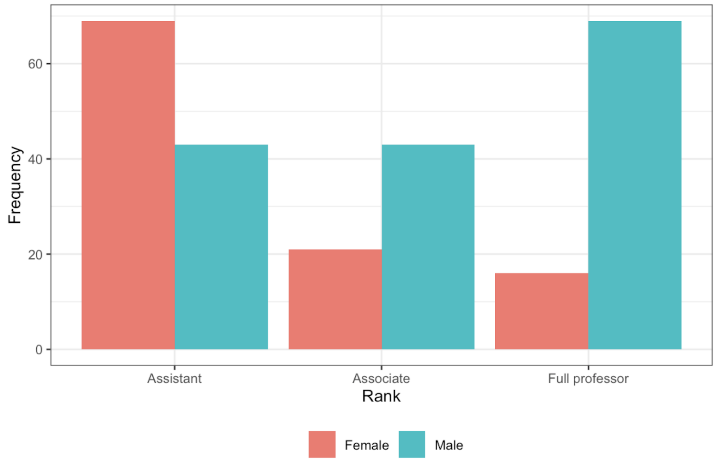

Figure 6: Frequency of different rank by gender

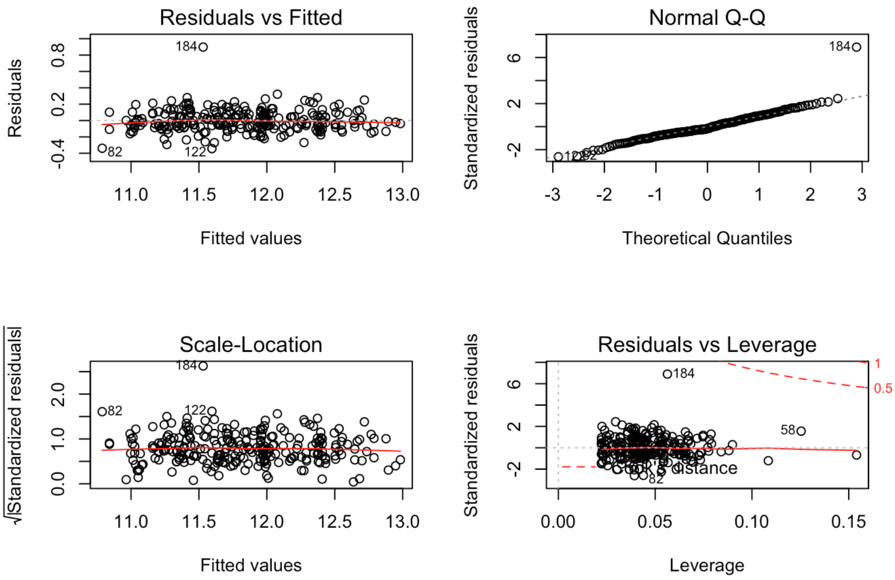

Figure 7: Diagnostic Plots for our Final Regression Model

Table 1. Statistical summary table by gender

	Female (N=106)	Male (N=155)
Department		
- Biochemistry/Molecular Biology	20 (18.87%)	30 (19.35%)
- Physiology	20 (18.87%)	20 (12.90%)
- Genetics	11 (10.38%)	10 (6.45%)
- Pediatrics	20 (18.87%)	10 (6.45%)
- Medicine	30 (28.30%)	50 (32.26%)
- Urgery	5 (4.72%)	35 (22.58%)
Primary Emphasis		
- Research	46 (43.40%)	55 (35.48%)
- Clinical	60 (56.60%)	100 (64.52%)
Certified		
- Not certified	36 (33.96%)	37 (23.87%)
- Board certified	70 (66.04%)	118 (76.13%)
Publication Rate		
- Mean (SD)	5.35 (1.89)	4.65 (1.94)
- Median (Q1, Q3)	5.25 (3.73, 7.27)	4.00 (3.10, 6.70)
- Range	2.40 - 8.70	1.30 - 8.60
Experience		
- Mean (SD)	7.49 (4.17)	12.10 (6.70)
- Median (Q1, Q3)	7.00 (5.00, 10.00)	10.00 (7.00, 15.00)
- Range	1.00 - 23.00	2.00 - 37.00
Rank		
- Assistant	69 (65.09%)	43 (27.74%)
- Associate	21 (19.81%)	43 (27.74%)
- Full professor	16 (15.09%)	69 (44.52%)
Salary in academic year 1994 (sal94)		
- Mean (SD)	118871.27 (56168.01)	177338.76 (85930.54)
- Median (Q1, Q3)	108457.00 (75774.50, 143096.00)	155006.00 (109687.00, 231501.50)
- Range	34514.00 - 308081.00	52582.00 - 428876.00
Salary after increment(sal95)		
- Mean (SD)	130876.92 (62034.51)	194914.09 (94902.73)
- Median (Q1, Q3)	119135.00 (82345.25, 154170.50)	170967.00 (119952.50, 257163.00)
- Range	38675.00 - 339664.00	58923.00 - 472589.00

Table 2. Crude and Adjusted Association between Gender and log-salary

	Year 1994		Year 1995	
Crude Model	Coefficient		Coefficient	
	0.386		0.384	
Bivariate Model				
Confounder	Coefficient	Percent Δ	Coefficient	Percent Δ
Department	0.206	-46.63%	0.204	-46.88%
Clinical	0.338	-12.44%	0.336	-12.50%
Certification	0.334	-15.57%	0.332	-13.54%
Publication Rate	0.253	-34.46%	0.25	-34.90%
Experience	0.309	-19.95%	0.307	-20.05%
Rank	0.351	-9.10%	0.348	-9.38%

Note: All coefficients here are for Gender term.

Table 3: Regression Results

	Dependent variable: Ln(salary)	
Model	Year 1994 (1)	Year 1995 (2)
Gender	0.130*** (0.069, 0.191)	0.128*** (0.067, 0.189)
Department		
Physiology	-0.166*** (-0.213, -0.118)	-0.164*** (-0.212, -0.117)
Genetics	0.191*** (0.132, 0.250)	0.189*** (0.130, 0.248)
Pediatrics	0.215*** (0.156, 0.273)	0.222*** (0.164, 0.281)
Medicine	0.547*** (0.499, 0.595)	0.547*** (0.499, 0.594)
Surgery	0.938*** (0.880, 0.995)	0.942*** (0.884, 0.999)
Clinical Emphasis	0.205*** (0.169, 0.240)	0.211*** (0.176, 0.247)
Board Certified	0.184*** (0.150, 0.219)	0.180*** (0.146, 0.215)
Experience	0.028*** (0.022, 0.034)	0.028*** (0.022, 0.034)
Faculty Rank		
Associate	0.117*** (0.078, 0.156)	0.119*** (0.080, 0.158)
Full	0.207*** (0.164, 0.250)	0.209*** (0.166, 0.252)
*Gender*Experience*	-0.012*** (-0.018, -0.006)	-0.012*** (-0.018, -0.006)
Constant	10.857*** (10.799, 10.914)	10.948*** (10.890, 11.005)
Observations	261	261
Note:		*** p<0.01, ** p<0.05, * p<0.1

Omitted/Reference groups:
Gender: Female; Department: Biochemistry/Molecular Biology;
Clinical: Primarily research emphasis, *Certified:* Not board certified;
Rank: Assistant professor.

*Confidence intervals depicted in parentheses.

Table 4: Post-stratification Regression Results

	Dependent variable: Ln(salary)			
	Low Experience		High Experience	
	Year 1994	Year 1995	Year 1994	Year 1995
Model	(3)	(4)	(5)	(6)
Gender	0.074***	0.071***	0.006	0.004
	(0.027)	(0.027)	(0.033)	(0.033)
Department				
Physiology	-0.231***	-0.224***	-0.132***	-0.137***
	(0.047)	(0.047)	(0.041)	(0.042)
Genetics	0.199***	0.197***	0.165***	0.163***
	(0.057)	(0.058)	(0.054)	(0.054)
Pediatrics	0.231***	0.241***	0.133**	0.137**
	(0.057)	(0.058)	(0.053)	(0.053)
Medicine	0.583***	0.585***	0.495***	0.492***
	(0.051)	(0.051)	(0.040)	(0.041)
Surgery	0.953***	0.959***	0.916***	0.918***
	(0.060)	(0.061)	(0.049)	(0.049)
Clinical Emphasis	0.165***	0.173***	0.218***	0.223***
	(0.036)	(0.036)	(0.031)	(0.031)
Board Certified	0.152***	0.147***	0.249***	0.248***
	(0.031)	(0.031)	(0.033)	(0.034)
Faculty Rank				
Associate	0.145***	0.147***	0.131***	0.139***
	(0.032)	(0.032)	(0.046)	(0.046)
Full	0.277***	0.284***	0.238***	0.244***
	(0.043)	(0.043)	(0.044)	(0.044)
Constant	11.028***	11.118***	11.184***	11.272***
	(0.038)	(0.039)	(0.049)	(0.050)
Observations	139	139	122	122
R^2	0.920	0.920	0.927	0.926
Adjusted R^2	0.914	0.913	0.920	0.919

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Omitted/Reference groups: Gender: Female;
Department: Biochemistry/Molecular Biology;
Clinical: Primarily research emphasis, *Certified:* Not board certified;
Rank: Assistant professor.

*Standard errors depicted in parentheses.

Supplement

When determining potential confounders during statistical analysis, we found that the association between gender and salary, adjusted for "faculty rank" only changed by 9.4% (Table 2). However, we decided to include "rank" as a confounder in the expanded model since it satisfies the condition of a confounder and has been documented:

1) Female doctors are less likely to be full professors [citation] (this was also the case in our sample, as seen in Figure 6), indicating gender is associated with rank.
2) Full professors get paid more, indicating rank is associated with salary
3) Gender does not independently determine rank (rank does not lie in the causal pathway)

We used the same process to qualitatively check if other confounders (as suggested by the data) satisfy the conditions of a confounder.

Sensitivity Analysis

Although there are no influential points in the dataset, we consider observations 184, marked in our model diagnostics, as a potential outlier. We conducted a sensitivity analysis, leaving the observation out and refitted the final multiple regression models. We discovered that taking out the observation would have an effect on the adjusted association between salary and gender in the original analysis.

After we removed the outlier, we found that the adjusted association between salary and gender reduced to 0.099, indicating male doctors at the school made 10% (as opposed to 14% in the original analysis) more than their female colleagues, controlling for other variables. We discovered that observation 184 represents a male doctor whose salary is exceptionally high given low experience, which leads to the overall increases in the average salary among male doctors.

Additional Notes

Another aspect of the lawsuit was discrimination in deciding promotions among medical faculty at the school. We can see that this is the case since although there are more female assistant professors, the number of male professors is significantly larger than that of female at the full professor rank (Figure 6). This has also been shown by the Association of American Medical Colleges, 2003. Specifically, in 2003, women in medical schools constituted only 11 percent of full professors and 13 percent of associate professors.[5]