Gender Wage Gaps in STEM Disciplines

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Abstract

We use OLS and quantile decomposition methods to estimate gender salary gaps for faculty members in STEM departments at a public research university.

Our findings indicate that the gender wage gaps in STEM departments are significantly larger than that observed the university overall.

Our quantile decomposition analyses indicate that there are positive effects for women in top quantiles, but we find there is potential gender discrimination at the low end of the salary distribution among faculty members working in STEM departments:

- **Estimating effects for faculty members who earn relatively high salaries, we find positive unexplained wage effects for women, suggesting that highly paid female academics working in STEM departments are well rewarded by the competitive market for academics.**
- **However, when we focus on faculty members paid at the low quantiles of the salary distribution, we find there are significant unexplained differences between women and their White male peers. This suggests that female academics working in STEM departments are apparently not paid on par with their White male peers at the lower end of the salary distribution.**

Methods

There have been several studies of the gender wage gap in academia and in STEM disciplines (Ceci et al., 2014; Li and Koedel, 2017; Xu, 2008). However, few studies apply quantile decomposition analyses to examining the gender wage gap (Oaxaca and Ransom, 2002, 2003; Geisler and Oaxaca, 2005).

Study sample

- Data describing 575 tenured and tenure-track faculty members at a Midwestern university in 2016 (enrollment=20,000, 75% UG)
- Dependent variable: Monthly salary
- Regressors: gender, race and ethnicity, department, national average salary in discipline, work experience, rank, merit rankings, awards and salary adjustments

Table 1: Average Monthly Salary

		ALL		STEM - DHS		STEM - NSF	
	All	White Male	Female	White Male	Female	White Male	Female
Average Monthly Salary	$8755	$9082	$8321**	$9473	$8384**	$9300	$8366**
Salary Gap		$761		$1089		$934	
Number of obs	575	255	248	94	42	139	85
% of Faculty	100%	44.3%	43.1%	16.3%	7.3%	24.2%	14.8%

** P-value ≤ 0.05 for a two-tailed t-test of difference between white male and female faculty members.
* P-value > 0.05 and ≤ 0.10 for a two-tailed t- test of difference between white male and female faculty members group.

- The averages reported in Table 3 indicate that a lower percentage of faculty members in STEM departments are women.
- Average monthly salary is higher for faculty members working in STEM departments than for the entire sample.
- A higher average value is also observed in the national salary for faculty members in STEM disciplines (CUPA_D).
- For the restrictive definition of STEM disciplines (STEM-DHS), approximately 29% of faculty members work in STEM departments. For the broader definition (STEM-NSF), approximately 46% of faculty members work in STEM departments.
- Faculty members in STEM departments are more likely to be full professors and have longer years of employment at the university.
- Although faculty members in STEM departments are more likely to be awarded with professorships and receive salary adjustments, they are less likely to be in the higher quintiles of the college merit distributions.

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Findings

Earnings Regressions

Because monthly salary is skewed with a longer right-hand tail, we use the natural log of monthly salary as the dependent variable, which means that the estimates should be interpreted as the percentage impact on monthly average salary.

$$MORATE = \alpha + \beta 1FEMALE + \beta 2STEM + X'\delta + \varepsilon$$

Explanatory Variables (definitions and summary statistics provided in Tables 2 and 3 of paper)

- Experience measures:
  - Years at University (and squared value)
  - Years at prior academic institutions (and squared value)
  - Current rank
- Performance measures:
  - Merit quintile in college
  - Professorship
  - Salary adjustments
- Discipline-specific variables:
  - Average national monthly salary by discipline (weighted by department composition)
  - STEM-DHS (Department of Homeland Security definition)
  - STEM-NSF (National Science Foundation definition)
- Personal characteristics:
  - Sex
  - Race (Asian, Black)
  - Hispanicity
- Department control variables

Regression estimates indicate that on average being female does not have a statistically significant effect on monthly salary, other things equal. For the pooled sample of male and female faculty members, working in a STEM-DHS department has a negative impact on monthly salary, but the effect for working in a STEM-NSF department is not statistically significant.

When department control variables are added, both STEM-DHS and STEM-NSF have significant negative effects for the pooled sample. This is driven by a strong negative effects for female faculty members.

Decomposition Analyses

The estimates from the decomposition analyses are reported in Table 5 for regressions at the mean as well as the 10th, 25th, 50th (median), 75th, and 90th quantiles of the salary distribution. The estimates reported in Table 5 have been transformed to represent the effect on *unlogged* monthly salary. Decompositions are provided between White male and female faculty members for the pooled sample of all faculty members, as well as the two subsets STEM departments.

Table 5: Quantile Oaxaca Decompositions of Monthly Faculty Salary by Gender and STEM Field[1]

	Percent Effects at Quantiles					
	10th	**25th**	**median**	**mean**	**75th**	**90th**
FEMALE (vs. White male) ALL (obs=503)						
% Difference	+ 5.92**	+ 6.31**	+ 9.98**	- 9.32**	+ 11.86**	+ 9.08*
% Explained	+ 8.43**	+ 10.67**	+ 13.28**	- 12.27**	+ 13.39**	+ 11.51**
% Unexplained	- 2.51	**- 4.35****	- 3.30	+ 2.63*	- 1.53	- 2.44
FEMALE (vs. White male) STEM-DHS ONLY (obs=136)						
% Difference	+ 5.09*	+ 6.40**	+ 8.97**	- 11.60**	+ 14.81**	+ 21.06*
% Explained	+ 9.07**	+ 9.20**	+ 11.73**	- 12.06**	+ 8.27**	+ 12.99**
% Unexplained	**- 3.98****	- 2.80	- 2.76	+ 0.41	**+ 6.54****	**+ 8.07****
FEMALE (vs. White male) STEM-NSF ONLY (obs=224)						
% Difference	+ 3.59**	+ 6.05**	+ 12.00**	- 10.45**	+ 13.44**	+ 12.76**
% Explained	+ 5.84**	+ 8.20**	+ 10.35**	- 9.74**	+ 8.18**	+ 9.47**
% Unexplained	- 2.25	- 2.16	- 1.65	+ 0.65	**+ 5.26****	+ 3.30

[1] Standard errors are bootstrapped with reps=100. Percentage is white male minus female. The White male category includes all non-Asian, non-Black, and non-Hispanic male faculty members and is predominantly individuals identified as White.
** P-value ≤ 0.05
* P-value > 0.05 and ≤ 0.10

First row: percent differences in average monthly salary between White male and female faculty members predicted by the models.
Second row: percent differences in monthly salary between White male and female faculty members attributed to the explanatory variables of the model.
Third row: percent differences not attributable to the explanatory variables. If statistically significant, these effects indicate potential salary discrimination.

- STEM-NSF: We observe a statistically significant negative effect due to unexplained factors for female faculty members at the 25th quantile of the salary distribution and a positive effect at the 75th quantile.
- STEM-DHS: We observe a statistically significant negative effect due to unexplained factors for female faculty members at the 10th quantile of the salary distribution and statistically significant positive effects at the 75th and 90th quantiles of the salary distribution.

Conclusions

This study examines the academic gender wage gap in STEM departments at a public research university. We estimate earnings regressions for female and male faculty members for the university as a whole as well as for those working in STEM departments. Controlling for productive characteristics and field salary differentials, we perform mean and quantile decomposition analyses of the male-female wage gaps to estimate potential wage discrimination in STEM departments.

Our findings indicate that the gender gap in STEM departments is significantly larger than that observed for non-STEM departments. Our quantile analyses indicate that there are positive effects for women in top quantiles, but we find there is potential gender discrimination at the low end of the salary distribution among faculty members working in STEM departments. This suggests that highly paid female academics working in STEM departments are well rewarded by the competitive academic market but female academics are apparently not paid on par with their White male peers at the lower end of the salary distribution. One possible explanation is that some of the women in these positions were 'spousal hires' who are tied to the local labor market by their partners' employment at the university and therefore subject to monopsonistic wages.

Like many studies of academic salaries, this research is limited by the lack of strong productivity measures. The use of merit ratings is limited by the lack of standardization across units. While some of this is inherent because of differences in productive output across disciplines, the implementation of merit rating also appears to vary across departments and colleges. This makes it difficult to construct useful measures of merit for understanding the relationship between productivity and current salary. We found that there is little other information available describing the productivity of faculty members. To the extent that such factors are missing from our data, the estimated effects of unexplained factors that we attribute to potential discrimination may in part be due to this omitted information.

The findings reported in this paper suggest the importance of examining more than the mean gender wage gap when assessing potential discrimination in academia. Clearly, even when mean decomposition analyses suggest the absence of gender wage gaps, there may be statistically significant quantile effects indicating potential gender discrimination in monthly salary. Findings of this research suggest that potential salary discrimination is present in STEM disciplines and indicate that an area for investigation for this university. Further research performing quantile analyses using nationally representative data is needed to confirm the findings reported here for a more representative sample of faculty and the need for broader policy action.

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