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The Gender Pay Gap in Academia: Evidence from The Ohio State University

Joyce J. Chen* and Daniel Crown
The Ohio State University

Abstract:
We utilize human resources data from The Ohio State University to assess the gender wage gap. We find a persistent gap of 11% among regular, tenure-track faculty, after accounting for fiscal year, ethnicity, clinical appointments, experience, and department. While the presence of a statistically significant gender wage gap is robust, the magnitude of the gap varies substantially depending on how the sample of interest is defined. In assessing gender wage gaps, researchers and universities must be attentive to issues of attrition and classification. Transparency about how estimates are affected by sample exclusions and variable definitions will yield insight into possible sources of gender bias.

JEL codes: J16, J31, J71
Keywords: gender; pay gap; discrimination; higher education

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1. Introduction.

As of 2016, the US gender pay gap remained at 20%. Even accounting for differences in education, work experience, occupation, and collective bargaining coverage, the gap remains substantial with women earning 8.4% less than men (Blau and Kahn, 2017). Moreover, progress on narrowing the gender pay gap has stalled and possibly even begun to reverse (AAUW, 2018). Universities are no exception when it comes to the gender pay gap. Male full professors at US institutions earned 15% more than female full professors in 2014 (Hatch, 2017), while UK universities had a gender gap of 10.5% across ranks in 2015-16 (Holmes, 2017). So-called "leaky pipelines" have been observed in many disciplines, with higher exit rates among women beginning as early as the undergraduate level (Allen-Hermanson, 2017; Levenstein, 2015). There is also evidence of entrenched barriers unique to academia. Women are held to higher standards in the peer review process (Hengel, 2017). Co-authored publications are more heavily discounted for women (Sarsons, 2017). Gender-neutral "clock-stopping" policies (which extend the probationary period for child birth/adoption) reduce the likelihood that women receive tenure, relative to their male counterparts (Antecol *et. al.*, 2018).

In this paper, we utilize salary and human resources data from The Ohio State University, covering the period 2006-2016, to estimate the gender wage gap. We find a substantial and robust gender wage gap of 11% in our preferred specification controlling for experience, clinical appointments, fiscal year, and department fixed effects. We also estimate a within-rank gender wage gap of 5.2%. While differences in faculty rank justify differences in pay, controlling for faculty rank will understate the wage gap when gender gaps also exist in the promotion and tenure process. A secondary goal of this paper is to highlight the issues that need to be addressed when using human resources data from academic institutions as well as the importance of

variable definition and sample selection. We show that decisions regarding the treatment of multiple appointments, part-time appointments, and non-academic appointments can have significant impacts on the estimated gender wage gap.

The remainder of the paper will proceed as follows. The next section will provide a brief overview of the existing literature on the gender wage gap in academia. Section 3 will discuss the data sources used in the analysis and descriptive statistics. Section 4 will introduce the empirical framework. Section 5 will present and interpret the results, and finally, Section 6 will conclude.

2. Previous Research on the Gender Wage Gap in Academia

The gender wage gap has fallen considerably over the past 40 years, but convergence in wages has been much slower among high-skilled workers (Kassenboehmer and Sinning, 2014; Blau and Kahn, 2017). This trend is in opposition to women's educational attainment outpacing that of men in recent years (Goldin et al., 2006) and rising levels of work experience and representation of women in high-skilled and traditionally male-dominated occupations (Blau and Kahn, 2017). To better understand the remaining gap among high-skilled workers, researchers have increasingly studied specific fields or occupations that provide new insights into the explanations and potential solutions for the remaining gender wage gap.[1]

Academia provides a unique setting to study gender wage inequality because academics are a relatively homogenous group, both in terms of their education and training, and in the performance of tasks within an occupation. While the qualifications and valuation of job-specific tasks may vary across fields, the majority of assistant professors have attained a doctoral degree,

[1] For example, studies of business executives (Bertrand and Hallock, 2001; Bertrand et al., 2010; Gayle et al., 2012), lawyers (Noonan et al., 2005), academics (Blackaby et al., 2005; Ehrenberg et al., 2012), and pharmacists (Goldin and Katz, 2016).

and their work involves teaching a specified number of courses, various service duties to the department or institution, and conducting and publishing independent research. This relative homogeneity presents a unique advantage for studying gender wage inequality among academics. However, despite a relatively well-defined path to promotion, there remains a substantial wage gap, and, as documented in Economics, persistent gaps in the promotion rates of male and female academics (Dynan and Rouse, 1997; Ginther and Kahn, 2004; Hatch, 2017; Kahn, 1993; McDowell et al., 1999, 2001). Much of the existing literature has studied the role of promotion in driving gender wage inequality because differences in the rate of promotion between men and women has significant implications for the wage discrepancies observed in the humanities (Ginther and Hayes, 2003). For example, the wage gap may increase if women spend more years in lower ranks relative to comparable male academics (Ginther and Kahn, 2004).

In theory, promotion should be based on observable measures of job performance in teaching, research, and service. However, underlying biases among evaluators may contribute to the discrepancy in rates of promotion between women and men. Randomized experiments have shown that underlying biases of students, revealed through course evaluations, lead to women instructors receiving lower ratings than men (MacNell et al., 2015; Boring, 2017). There may also be biases in the evaluation of research output. Research has found that manuscripts authored by female academics undergo a more discriminatory peer review process, with female-authored papers spending roughly 6 months longer under review, despite scoring higher across different measures of 'readability scores' (Hengel, 2017). Hengel (2017) also finds that co-authored research with women is perceived as less valuable compared to that of men.

An alternative explanation for the gap in promotion rates is that female assistant professors may devote significant time during their tenure-track years towards child care rather

than research, and thus have less competitive tenure portfolios compared to their male peers. Evidence supporting this possibility is that the observed gender gap in promotion is larger for academics with children (Mason and Goulden, 2002). One policy that has been implemented to alleviate this gap is to grant academics who have a child an additional year of eligibility before being evaluated for tenure. The specific rules governing these policies vary across institutions. In some cases eligibility may be limited to only female faculty, or in the case of 'gender-neutral' policies, may allow both men and women who have a child to utilize this policy. Offering such extensions on a gender-neutral basis could disproportionately help women by reducing gender disparities in childcare and removing the stigma of taking an extension. However, recent evidence has shown that such policies actually harm female academics by providing men with additional time that is used for publishing papers in high quality journals rather than for providing child care (Antecol et al., 2018). Thus, rather than providing additional time to reach a given threshold of research output, the policy may make it harder to obtain tenure by raising the minimum threshold required for promotion.

Another possible mechanism to alleviate the promotion gap is to ensure a more equitable representation of genders within male-dominated fields and among scientific committees that decide tenure evaluations. Increasing representation in male-dominated fields may help alleviate the leaky-pipeline effects, where female students drop out of fields that lack female peers and mentors. Recent research has shown that women who enter departments with a greater share of female student peers are more likely to graduate on time (Hale et al., 2014; Bostwick and Weinberg, 2018). Ensuring representation of female peers on committees that conduct promotion evaluations may help alleviate the gender promotion gap. Evidence from randomly selected committees in Italy and Spain has shown that increasing the female representation on committees

does not increase the number of female candidates who are granted promotion from associate to full professor, but when an additional female evaluator is added to the committee, male evaluators decide less favorable outcomes for female candidates (Bagues et al., 2017). Increasing the representation of female presidents and administrators may also increase the share of newly hired female faculty (Ehrenberg et al., 2012).

To increase the representation and subsequent success of traditionally underrepresented group, many professional organizations have organized workshops and mentoring programs. Evidence on the advisor-PhD student relationship has found that female doctoral students studying in STEM fields with female advisors have greater publishing success (Pezzoni et al., 2016; Guale and Piacentini, 2017). In economics, the American Economics Association's Committee on the Status of Women in the Economics Profession (AEA CSWEP) mentoring program has been shown to increase publications and grant funding for women (Blau et al., 2010). Mentoring may facilitate the transfer of tacit knowledge and extend the professional network of female academics, leading to a larger pool of collaborators, and potentially greater research output. It has been observed that male and female economists differ in their breadth of collaborators, with female economists collaborating with fewer coauthors, and working more intensively with the same coauthors (Ductor et al., 2018). To the extent that coauthoring increases research productivity (Ductor, 2015), mentoring programs may increase the research output of female academics through more productive research collaborations.

However, despite the large literature studying gender wage inequality, studies are frequently limited in their scope due to data availability – for example, by studying one field or one occupation. Moreover, there are many practical issues that researchers must overcome in studies that rely on personnel records. In this paper, we hope to contribute to the literature by

studying gender wage inequality within a large public university. We also take a closer look at data anomalies common in academia – such as multiple appointments, non-academic appointments, and less than full-time appointments – and provide an empirical assessment of how the treatment of these cases affects estimated gender wage gaps.

3. Data

Our analysis uses personnel records from The Ohio State University from 2006-2016, including annual information on each employee's salary, their gender, age, faculty rank, years of service within a rank, start year at the institution, full-time equivalency (FTE) status, and tenure status. In total, we follow roughly 23,000 faculty members for an average spell of about 4 years. In preparing the data for analysis, several decisions must be made to simplify the intricacies of the raw personnel records into a tractable dataset. We will explain each step in detail and highlight the impact of these decisions on the estimated gender wage gap throughout the paper.

First, many faculty members do not hold a full-time appointment in a single department. In our sample, roughly 27% of faculty, hold dual appointments across multiple units. The majority of these are medical faculty, who hold both clinical and academic appointments. Excluding faculty with clinical appointments, only 9.8% have joint appointments. The most common joint appointment in our data is a 50-50 split but a range of combinations are observed. As a researcher, there is no a priori guidance as to how one should assign these individuals to a department. For example, each individual-department spell could be treated as an observation. Alternatively, each faculty member could be assigned only to the academic department in which he/she holds the largest appointment.

Ideally, each individual would be assigned to the department responsible for performance evaluation and salary adjustments but, in practice, this is difficult to determine. Even when the

"tenure initiating unit" (TIU) can be identified, it is common for other units to submit feedback as official components of the dossier for performance and tenure evaluation, suggesting that pay disparities should not be solely attributed to the TIU. The presence of faculty members in medical fields further complicates this decision, as those with joint appointments are likely quite different than those with only clinical or only academic appointments. In our preferred specifications, we choose to retain only one observation per person and assign the individual to the unit in which he/she holds the maximum appointment (by FTE). In the case of split clinical-academic appointments, we only consider the faculty member's academic appointment.[2]

A second issue is that many academics do not hold a full-time (FTE = 100%) position. Some academics may choose to work less than full-time, and in the context of split appointments, some positions do not add up to a full-time FTE. In these instances, the researcher must decide how to handle the variables of interest. To correct for less than full-time salaries and years of experience, one may consider inflating less than full-time salaries to be comparable to that of a full-time employee's. Moreover, the years of experience will be overstated for part-time employees, and should be deflated. In all specifications, we inflate the annual salary by multiplying the annual salary reported for the majority appointment by (1/FTE), where FTE is the fraction of the full-time appointment. For years of experience, we multiply by FTE to correct for the overstatement of experience for less than full-time faculty members.

Table 1 displays summary statistics for the 3,891 faculty members in our dataset in the year 2016.[3] Without controlling for any individual or department characteristics, female academics earn about $36,700 less than male academics per year. Women academics are also 3

[2] In the case of 50-50 academic appointments (only 387 individuals in the entire sample period), one is chosen randomly. We test the sensitivity of our findings to this assumption in the following section.

[3] We present descriptive statistics for one year of the sample to avoid conflating differences between men and women with changes in the composition of the sample over time.

years younger, have 2 years fewer experience in their respective faculty ranks, and have 2 years less overall experience at the institution than men. We find no significant difference in the instance of part-time versus full-time appointments. Finally, while 54% of men have achieved tenure in 2016, only 41% of women hold tenured appointments.

Table 1: Summary Statistics (Overall)

	Male	Female	Difference (Male - Female)
Annual Salary	161450.97	124735.72	36715.24***
Age	51.45	48.40	3.05***
Years in Rank	7.79	5.56	2.23***
Institution Experience	12.68	10.37	2.31***
FTE	0.87	0.88	-0.01
Tenured	0.54	0.41	0.13***
Observations	2327	1564	3891

Notes: Results are the difference in means for male and female academics overall in the year 2016. Data on annual salary, age, years in rank, experience, FTE, and tenure status are sourced from personnel records from The Ohio State University.

We next analyze these differences within faculty ranks to get a better understanding of how the wage and promotion gaps arise throughout an academic's career. Table 2 shows the summary statistics within each faculty rank. Across all ranks, women in our sample earned $28,000-32,000 less than men in 2016, within the same rank. Female assistant professors are not statistically significantly different in age, years of experience, or years in rank. However, female assistant professors hold slightly higher FTE appointments than male assistant professors. Male associate professors have approximately 2 years more experience within rank, and 1 more year of institution-specific experience than women. Similarly, among full professors, women are, on average, 1 year younger and have spent 2.7 fewer years within the full professor rank. However, these differences in age and experience are unlikely to fully explain such large pay gaps, given that salary adjustments within rank rarely exceed 5%. The data for assistant professors are

Table 2: Summary Statistics (by Rank)

	Assistant Professor			Associate Professor			Full Professor		
	Male	Female	Difference (Male - Female)	Male	Female	Difference (Male - Female)	Male	Female	Difference (Male - Female)
Annual Salary	150421.11	119078.59	31342.52***	139182.69	110449.78	28732.91***	188109.54	156871.99	31237.55***
Age	39.11	39.65	-0.54	49.78	48.94	0.85	57.86	56.40	1.45**
Years in Rank	3.18	3.62	-0.44	7.84	5.88	1.97***	9.75	7.03	2.72***
Institution Experience	5.90	5.90	-0.01	13.79	12.49	1.30**	17.83	17.08	0.74
FTE	0.78	0.81	-0.03**	0.90	0.93	-0.04**	0.92	0.93	-0.01
Tenured	0.02	0.02	-0.00	0.72	0.72	-0.00	0.87	0.83	0.04*
Observations	776	743	1519	669	464	1133	880	348	1228

Notes: Results are the difference in means for male and female academics, separately by faculty rank, for the year 2016. Data on annual salary, age, years in rank, experience, FTE, and tenure status are sourced from personnel records from The Ohio State University.

consistent with women receiving lower starting salaries, perhaps due to differences in negotiation (Leibbrandt and List, 2014). Moreover, differences in starting salaries appear to be slow to dissipate, if at all, given that the absolute pay gap is very similar across ranks.

We next examine how the share of female faculty varies across colleges within The Ohio State University, and across faculty rank. The college with the greatest share of female faculty members is the College of Nursing, which also has the largest share of female faculty across all ranks. The second highest is the College of Social Work, with 73.2% female faculty members.

Table 3: Share of Female Tenure-Track Faculty by College and Rank

College Name	Overall	Assistant Professor	Associate Professor	Full Professor
Nursing	94.6%	92.9%	93.0%	100.0%
Social Work	73.2%	69.4%	78.6%	59.5%
Office of Academic Affairs	55.2%	61.4%	60.4%	37.1%
Education and Human Ecology	53.8%	70.6%	56.1%	42.8%
Optometry	51.0%	46.3%	58.6%	47.1%
Public Health	46.6%	58.1%	47.1%	31.0%
Arts & Sciences - Arts and Humanities	43.9%	59.8%	43.6%	38.6%
Law	40.4%	49.3%	56.0%	33.5%
Veterinary	37.0%	48.4%	37.2%	29.1%
Medicine	35.2%	43.1%	32.4%	20.4%
Pharmacy	32.9%	44.6%	44.6%	16.6%
Dentistry	32.3%	32.3%	41.6%	24.9%
Fisher College of Business	31.3%	33.9%	41.8%	19.2%
Arts & Sciences - Social and Behavioral Sciences	30.8%	43.6%	34.7%	20.1%
John Glenn School of Public Policy	27.1%	40.4%	23.4%	11.1%
Food, Agriculture, and Environmental Sciences	25.6%	41.3%	26.0%	13.6%
Arts & Sciences - Natural and Mathematical Sciences	18.9%	35.3%	20.0%	13.1%
Engineering	18.4%	28.7%	23.3%	10.4%

Notes: Authors calculation with personnel record data from The Ohio State University 2006-2016

Among the lowest representation of female faculty are the Colleges of Engineering; Food, Agriculture, and Environmental Sciences; Public Policy; and Business.

"Leaky pipeline" effects are observed in many colleges, as there is a persistent drop in the share of female faculty with the seniority of rank. The College of Arts and Sciences - Social and Behavioral Sciences, which houses the Economics Department, decreases from 43.6% female assistant professors to 20.1% female full professors. FAES, which houses the Department of Agricultural, Environmental, and Development Economics, has an even more precipitous decline from 41.3 to 13.6%.

4. Explaining the Gender Wage Gap

Following Blau and Kahn (2017), we estimate the gender wage gap using log wage regressions that account for successively larger sets of control variables. Our full specification, estimated using ordinary least squares, takes the following form:

$$\ln(w_{it}) = \beta_0 + \beta_1 F_i + \beta_2 X_{it} + \phi_t + \phi_d + \epsilon_{it} \quad (1)$$

The dependent variable is log annual salary, for an individual *i* in year *t*, adjusted for full-time equivalency. The primary coefficient of interest is $\hat{\beta}_1$, which represents the estimated wage gap for female (*F*) faculty relative to male. The most parsimonious specification controls only for fiscal year fixed effects (ϕ_t), which account for account for aggregate wage fluctuations that affect the institution as a whole (*e.g.*, state budgets). We then add control variables X_{it}, including indicators for race/ethnicity (Black, Hispanic, Asian/Pacific Islander, Native American, and "other" including multiple and undisclosed ethnicity, with White as the omitted category); a quadratic in years of experience at the institution, adjusted for FTE status; and an indicator for instructor and/or clinical appointments; indicators for academic department; and indicators for faculty rank (associate and full, with assistant as the omitted category).

We present our results with successively larger sets of control variables to provide transparency in our estimation and to avoid over-controlling for factors that may themselves be

the result of differential treatment and/or opportunity on the basis of gender. For example, controlling for faculty rank may understate the gender wage gap by masking discrimination that occurs in the promotion process. Similarly, controlling for department fixed effects presumes that differences in average earnings across units are uncorrelated with the gender composition of those departments. As an alternative, we also utilize Oaxaca-Blinder decomposition (Blinder, 1973; Oaxaca, 1973) to decompose the estimated gender wage gap into components attributable to each set of control variables. This allows us to quantify differences in wages between men and women that can be explained, or attributed to, differences in characteristics, versus those that are due to differences in how men and women are compensated for the same characteristics. The latter is typically considered "unexplained" and indicative of labor market discrimination.

5. Results

Beginning with the most parsimonious model, column I of Table 4 shows an average female-male wage gap of 21.4% at The Ohio State University. This is comparable to the current gender pay gap for the nation (20%), the state of Ohio (22%), and the Columbus metropolitan area (19%). Based on the mean salary of $122,143 in 2016, this gap translates into an annual loss of $26,139 for female faculty, relative to their male peers. Adding controls for ethnicity (column II) has essentially no effect on the gender gap but reveals significant racial pay disparities as well. Hispanics earn 11.8% less than Whites. We lack sufficient data to accurately estimate the pay gap for Native Americans, Blacks, and those with multiple/undisclosed ethnicities; the point estimates are quite large (9.93%, 5.25%, and 6.21%, respectively) but not statistically different from zero. The gap for Asians/Pacific Islanders (API) is considerably smaller at 2.26% and also not significantly different from zero.

Adding an indicator for clinical faculty and instructors actually increases the estimated gender wage gap slightly. In contrast, adding controls for years of service at the University

Table 4: Gender Wage Gap

	(1) Log(Wage)	(2) Log(Wage)	(3) Log(Wage)	(4) Log(Wage)	(5) Log(Wage)	(6) Log(Wage)
Female	-0.214***	-0.215***	-0.224***	-0.207***	-0.110***	-0.0523***
	(0.0218)	(0.0224)	(0.0195)	(0.0176)	(0.0112)	(0.00816)
Black		-0.0525	-0.0551	-0.0416	-0.0482*	0.00530
		(0.0377)	(0.0362)	(0.0363)	(0.0285)	(0.0234)
Hispanic		-0.118**	-0.119**	-0.0937*	-0.0327	0.00187
		(0.0572)	(0.0548)	(0.0480)	(0.0242)	(0.0198)
Native American		-0.0993	-0.0949	-0.0896	-0.0637	-0.0280
		(0.132)	(0.117)	(0.108)	(0.0413)	(0.0335)
Asian/Pacific Islander		-0.0226	-0.0229	0.00894	-0.0801***	-0.0481***
		(0.0291)	(0.0293)	(0.0241)	(0.0205)	(0.0176)
Other		-0.0621	-0.0830	-0.0420	-0.0248	0.00282
		(0.0718)	(0.0595)	(0.0508)	(0.0278)	(0.0268)
Observations	34,535	34,535	34,535	34,535	34,521	34,521
R-squared	0.075	0.077	0.101	0.115	0.554	0.650
Race/Ethnicity	No	Yes	Yes	Yes	Yes	Yes
Clinical/Instructor	No	No	Yes	Yes	Yes	Yes
Experience	No	No	No	Yes	Yes	Yes
College FE	No	No	No	Yes	No	No
Department FE	No	No	No	No	Yes	Yes
Faculty Rank	No	No	No	No	No	Yes

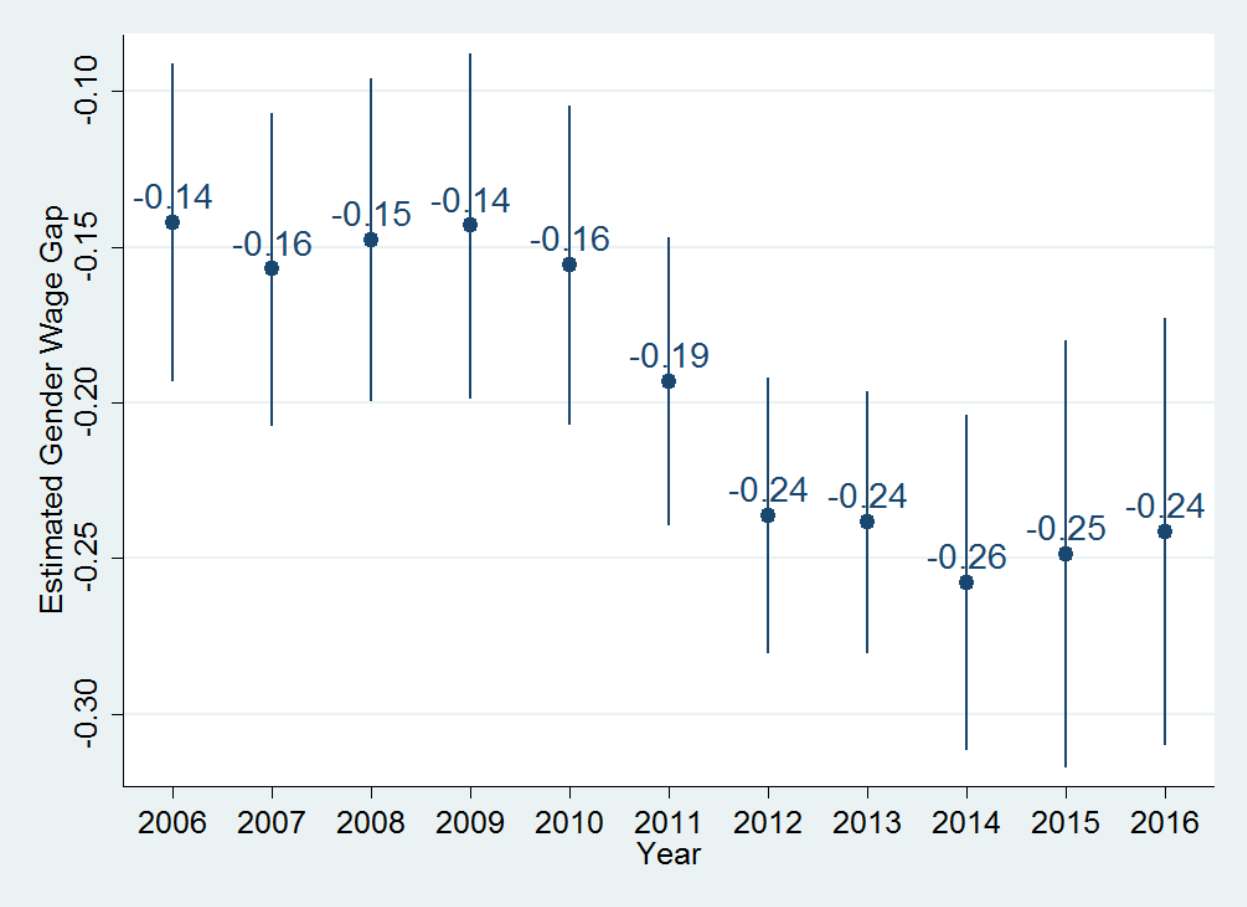
We control for fiscal year in all specifications. Race/ethnicity categories include Black, Hispanic, Asian/Pacific Islander, and multi/not reported. Experience included as a quadratic. Standard errors in parentheses and clustered at the department level. *** p<0.01, ** p<0.05, * p<0.1

(Table 4, column III) slightly reduces the gender gap, from 22.4 to 20.7%. This indicates that women have, on average, less experience at the institution, and this can, in part, explain the gender wage gap. Note, however, that we are able to control only for years of experience at the University and not for prior work experience. Racial disparities are also substantially smaller once we control for years of service, again indicating that faculty of color, on average, have fewer years of service than their white counterparts. This may reflect recent advances in diversity that have led to the hiring of larger numbers of women and people of color. This trend is evident

in the gender and racial composition of the faculty, which declined from 70% male and 81.2% White in 2006 to 59.8% male and 70.2% White in 2016.

To explore changes in the gender pay gap over time, we also run our specification for each year separately. These estimates are plotted in Figure 1 and reveal a significant trend break

Figure 1: Estimates of the Gender Wage Gap by Year



Notes: Gender wage gap is estimated from a regression of log wage on an indicator variable for if the individual is female, separately by year. Control variables include experience, experience squared, race/ethnicity, and an indicator for clinical/instructor appointment. Standard errors are clustered at the department level.

around 2011, with the gender gap becoming substantially worse in recent years,[5] counter to national trends (AAUW, 2018). The break coincides with two significant changes at the

[5] A regression with all years combined and allowing only the coefficient on gender to difference across years yields nearly identical results.

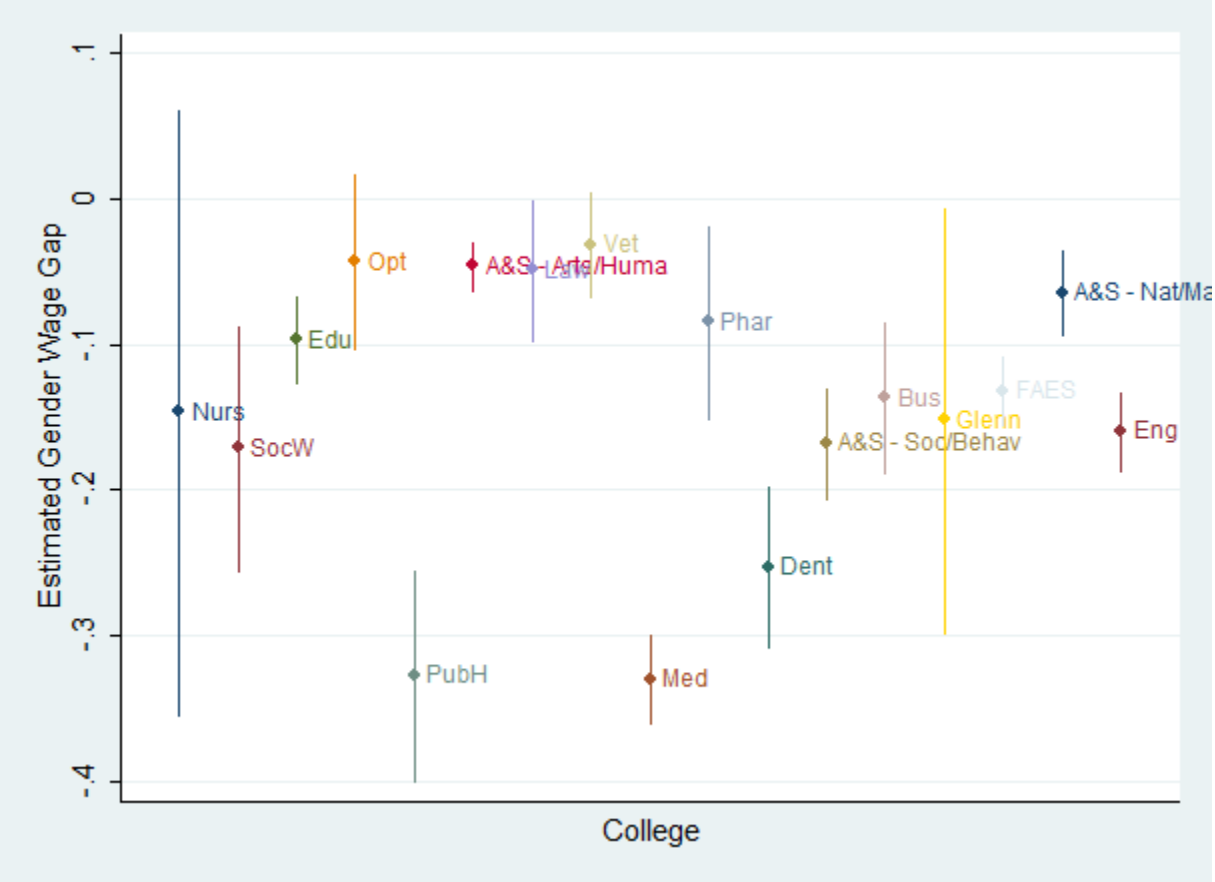
university: the conversion from quarters to semesters, and the start of a large hiring initiative aimed at enhancing interdisciplinary research in priority areas. However, the trend break remains evident even after controlling for academic department, suggesting that it is not driven by differential investments and/or hiring across units. The pattern also persists after additionally controlling for faculty rank, suggesting that it is not driven by retirements and/or changes in the composition of the faculty. These findings suggest that institutions interested in addressing gender disparities in pay should look carefully at changes over time to help identify changes in *de jure* policy and/or *de facto* administration that affect pay equity.

Next we add controls for the college (Table 4, column IV) in which the individual is appointed, which has only a modest effect on the estimated gender and racial pay disparities. This indicates that differences in faculty gender/race composition across colleges are not driving observed pay disparities. However, we do find significant differences in the gender pay gap across colleges (Figure 2) when we run the regression separately for each unit. These patterns remain largely unchanged even after controlling for department within each college. This is notable, as this institution has tasked college Deans with addressing gender equity, and Deans have discretion in budgeting for salary adjustments. In general, colleges with larger shares of female faculty tend to have smaller pay disparities, providing some support for the hypothesis that diversity itself can help promote equity.

Accounting for the individual's home department (Table 4, column V) has a large effect on both gender and race gaps. The gender gap declines from 22.4% to 11%, indicating that, although women are more likely to be in departments with lower than average pay, the gender pay gap within departments is not as large as that across departments. This raises a separate but related equity question – namely, whether disciplines with larger proportions of women are

under-valued by the market as a whole. This issue is beyond the scope of this paper, and perhaps beyond the purview of University leadership as well. Nonetheless, we note that institutions committed to pay equity must also look carefully at parity across fields/occupations.

Figure 2: Estimates of the Gender Wage Gap by College



Notes: Gender wage gap is estimated from a regression of log wage on an indicator variable for if the individual is female, separately by college. Estimates are sorted from highest share of female faculty (left) to lowers (right). Control variables include experience, experience squared, race/ethnicity, and an indicator for clinical/instructor appointment. Standard errors are clustered at the department level.

With regard to racial disparities, we also find smaller pay gaps for Hispanics and Native Americans after controlling for department, neither of which retains statistical significance. Additionally, we find a slightly smaller gap for Blacks, though it is now significant, and the gap for API faculty is now 8.01%, roughly 3.5 times larger, and statistically significant. This

indicates that, although API faculty are more likely to be in departments with higher than average pay, they make significantly less than their white counterparts. Put another way, the pay gap for API faculty tends to be even larger in departments with higher salaries.

Differences across race/gender groups can also provide insight on implicit institutional and social barriers. Asians and Pacific Islanders are over-represented at the university, comprising 13.6% of our faculty sample but only 6.0% of the U.S. population. The persistent pay gap for API faculty, therefore, suggests that efforts to increase representation may be insufficient to reduce disparities. Moreover, Asians are typically not considered to be historically disadvantaged in education and employment and, as such, are often excluded from diversity initiatives. Our findings, however, indicate that pay disparities exist not only among historically disadvantaged groups, suggesting that race itself plays a central role.

Finally, we add controls for faculty rank in column VI (Table 4). This has the largest effect on pay disparities. The gender gap falls from 11 to 5.23%, and the race gap is now reversed, though not statistically significant, for Blacks, Hispanics, and those with multiple/undisclosed ethnicities. The gaps for Native Americans and API faculty shrink by about one-third and only the latter remain significant at 4.81%. Our estimates imply that women have salaries that are $6,388 lower per year than their male counterparts, and API faculty have salaries that are $5,875 lower per year than their white counterparts of the same rank. This specification represents our most conservative estimate of gender and racial pay gaps, as it is based on the highest degree of comparability we can attain with the current data. In effect, this specification provides a comparison of male/female (white/non-white) faculty with the same years of service, the same rank, and in the same department. However, these estimates should also be viewed as a

lower bound, with the true extent of gender/racial pay disparities likely falling somewhere between columns V and VI.

Decomposition Analysis

To provide a clearer apportionment of the gender pay gap to various factors, we conduct a Oaxaca-Blinder decomposition, as described above. In Table 5, we can see in the bottom row that differences in characteristics between male and female faculty account for 73% of the 19.74% gender pay gap. That is, if female faculty were observationally equivalent to their male counterparts, the gender gap would be roughly one-quarter of its current size. Consistent with the regression analysis, faculty rank and department play the largest roles, explaining 50 and 37% of the gap, respectively. Other factors have relatively modest effects and are, in fact, negative. This is particularly interesting for years of experience at the institution. Our estimates show that, if women possessed the same experience as men, the gender pay gap would be even larger. But,

Table 5: Oaxaca-Blinder Decomposition

	Explained	Unexplained
Year	-0.0143***	0.0191
	(0.0013)	(0.134)
Clinical	-0.0069***	0.0622***
	(0.0008)	(0.0050)
Experience	-0.0037***	-0.0718***
	(0.0007)	(0.0111)
Race/Ethnicity	-0.0016***	0.0022
	(0.0003)	(0.0026)
Department	0.0721***	0.0119
	(0.0047)	(0.0177)
Faculty Rank	0.0986***	0.0297***
	(0.0029)	(0.0071)
Total	0.1441***	0.0533***
	(0.0056)	(0.0042)

Notes: Results are for a Oaxaca-Blinder Decomposition that decomposes the explained and unexplained variation in the gender wage gap into various components. Race/ethnicity categories include Black, Hispanic, Asian/Pacific Islander, and multi/not reported. Experience included as a quadratic. Standard errors in parentheses and clustered at the department level. *** p<0.01, ** p<0.05, * p<0.1 N=34,519

because men have more experience than women, this implies that the returns to experience are negative, a common finding in academic settings.

The "unexplained" portion of the decomposition is due to differences in how men and women are compensated for the same characteristics and accounts for 27% of the gender wage gap. Here, we find suggestive evidence of gender discrimination, particularly with respect to clinical appointments and faculty rank. If female faculty with clinical appointments and associate/full rank received the same salary adjustment as their male peers, the gender pay gap would shrink by almost 60%. Experience, however, is again found to be negative, implying that the inverse returns to experience are actually less pronounced for women than for men.

Clinical Faculty

Salary determination for clinical faculty and instructors is substantially different than for faculty holding only tenure track academic appointments. Clinical faculty and instructors tend to have more transferable skills and greater mobility both across employers and industries and, in some cases, these appointments represent secondary employment for the individual. The criteria for performance evaluation and promotion also differ, due to differences in job requirements and work tasks. Therefore, we repeat our analysis limiting attention to only tenure track faculty with no clinical or instructor appointment.

In Table 6, we see that the gender pay gap is much smaller in the restricted sample, ranging from 2.17% to 15.9%. This reflects both smaller gender disparities outside the Medical Center, which houses 80% of clinical appointments, as well as less dispersion in salaries for non-clinical appointments.[6] Racial gaps, however, are generally larger in this sample, even though racial pay disparities also tend to be smaller outside the Medical Center. This may suggest that

[6] The standard deviation of salary in 2016 is approximately $132,000 for clinical faculty, compared to $65,000 for non-clinical faculty.

salary determination is more objective for clinical faculty than for academic faculty (*e.g.*, patient evaluations versus publications in diverse journals). Controlling for department and rank again has the largest effects on the estimated wage gap. However, among non-clinical faculty, rank accounts for a much larger proportion of the gender gap, consistent with the relatively smaller weight – with regard to salary and prestige – placed on rank promotion in clinical positions.

Table 6: Gender Wage Gap Estimates (Excluding Clinical)

	(1) Log(Wage)	(2) Log(Wage)	(3) Log(Wage)	(4) Log(Wage)	(5) Log(Wage)	(6) Log(Wage)
Female	-0.159***	-0.157***	-0.157***	-0.137***	-0.0786***	-0.0217***
	(0.0187)	(0.0183)	(0.0183)	(0.0216)	(0.01000)	(0.00743)
Black		-0.0720*	-0.0720*	-0.0608	-0.0876***	-0.0115
		(0.0406)	(0.0406)	(0.0409)	(0.0282)	(0.0185)
Hispanic		-0.112**	-0.112**	-0.0920**	-0.0408*	0.00120
		(0.0487)	(0.0487)	(0.0432)	(0.0224)	(0.0160)
Native American		-0.206**	-0.206**	-0.177**	-0.114**	-0.0613**
		(0.0934)	(0.0934)	(0.0769)	(0.0466)	(0.0302)
Asian/Pacific Islander		0.00829	0.00829	0.0402	-0.0569**	-0.0205
		(0.0293)	(0.0293)	(0.0286)	(0.0246)	(0.0189)
Other		-0.0800**	-0.0800**	-0.0321	-0.0172	0.0134
		(0.0378)	(0.0378)	(0.0356)	(0.0293)	(0.0238)
Observations	25,718	25,718	25,718	25,718	25,707	25,707
R-squared	0.047	0.051	0.051	0.079	0.544	0.730
Race/Ethnicity	No	Yes	Yes	Yes	Yes	Yes
Experience	No	No	Yes	Yes	Yes	Yes
College FE	No	No	No	Yes	No	No
Department FE	No	No	No	No	Yes	Yes
Faculty Rank	No	No	No	No	No	Yes

We control for fiscal year in all specifications. Race/ethnicity categories include Black, Hispanic, Asian/Pacific Islander, and multi/not reported. Experience included as a quadratic. Standard errors in parentheses and clustered at the department level. *** p<0.01, ** p<0.05, * p<0.1

Multiple Appointments

Our preferred estimates retain a single observation per person, per year, with each individual assigned to a single department based on the appointment split. An alternative approach is to inflate each observation to 100% FTE status to create one observation per appointment, per year, resulting in multiple observations in a year for each individual with multiple appointments. The

latter approach, in effect, attributes salary determination to each department that holds a portion of an individual's appointment but may place too much weight on individuals with multiple appointments. Additionally, individual performance evaluation for those with multiple appointment is, in many cases, conducted by a single department or tenure initiating unit. In these cases, it may not be appropriate to attribute this salary to other units simultaneously.

Table 7: Gender Wage Gap Estimates (Allowing for Multiple Appointments)

	(1) Log(Wage)	(2) Log(Wage)	(3) Log(Wage)	(4) Log(Wage)	(5) Log(Wage)	(6) Log(Wage)
Female	-0.210***	-0.210***	-0.220***	-0.195***	-0.0891***	-0.0262***
	(0.0256)	(0.0258)	(0.0262)	(0.0237)	(0.0101)	(0.00985)
Black		-0.0538	-0.0532	-0.0321	-0.0486*	0.00422
		(0.0423)	(0.0417)	(0.0427)	(0.0254)	(0.0197)
Hispanic		-0.0994*	-0.100*	-0.0536	-0.0479*	-0.0138
		(0.0555)	(0.0532)	(0.0468)	(0.0250)	(0.0214)
Native American		-0.137	-0.133	-0.0903	-0.0846*	-0.0595***
		(0.135)	(0.122)	(0.119)	(0.0443)	(0.0227)
Asian/Pacific Islander		-0.0380	-0.0400	0.0126	-0.0668***	-0.0317*
		(0.0411)	(0.0397)	(0.0334)	(0.0209)	(0.0171)
Other		-0.0486	-0.0708	-0.00875	-0.0319	0.00242
		(0.0627)	(0.0520)	(0.0422)	(0.0213)	(0.0170)
Observations	41,480	41,480	41,480	41,480	41,466	41,466
R-squared	0.068	0.069	0.090	0.128	0.671	0.739
Race/Ethnicity	No	Yes	Yes	Yes	Yes	Yes
Clinical/Instructor	No	No	Yes	Yes	Yes	Yes
Experience	No	No	No	Yes	Yes	Yes
Department FE	No	No	No	No	Yes	Yes
Faculty Rank	No	No	No	No	No	Yes

We control for fiscal year in all specifications. Race/ethnicity categories include Black, Hispanic, Asian/Pacific Islander, and multi/not reported. Experience included as a quadratic. Standard errors in parentheses and clustered at the department level. *** p<0.01, ** p<0.05, * p<0.1

In Table 7, we see that changing the treatment of multiple appointments initially has little effect on estimated gender gaps, compared to our main results in Table 4 utilizing only one observation per person, per year. However, controlling for department now reduces the estimated gender gap substantially more, from 19.5 to 8.91, compared to the reduction from 20.7 to 11%

shown in Table 4. The difference when controlling for rank is even starker – the gap falls from 8.91 to 2.62, compared to the drop from 11 to 5.23%.

After controlling for department and/or rank, the gender gap is much more similar to that estimated for the sample excluding clinical faculty. This may reflect, in part, the high incidence of multiple appointments among clinical faculty. Thus, when clinical faculty are attributed to multiple departments, controlling for department and rank within each department has much larger effects on the estimated gender gaps. Similarly, because a much larger share of faculty with clinical appointments remain at the rank of assistant, controlling for rank has a larger effect when viewed at the appointment- rather than individual-level. In effect, allowing for multiple appointments places clinical faculty in both academic and clinical departments and allows the indicator for clinical to absorb a larger portion of the salary variation.

6. Conclusion

This paper estimates the gender wage gap for faculty at The Ohio State University over a ten year (2006-2016) period. We highlight some of the key data challenges researchers face when using personnel records – such as issues of classification, sample exclusion, and variable definition – and how these challenges can influence the assessment of gender wage inequality. We find a disparity of 21.4% when controlling only for secular trends in salaries, and significant discrepancies, for both women and people of color, persist even after accounting for differences in labor market characteristics. Our preferred specification, which controls for year, work experience, type of appointment, and department indicates a gender pay gap of 11%. Controlling additionally for rank yields a statistically significant gap of 5.23%. The latter is undoubtedly a conservative estimate, as it implicitly assumes parity in promotion and tenure. Even our preferred estimate likely understates the gender gap, as it presumes that pay disparities across

departments are not correlated with gender balance within departments and/or that disparities across units are driven by compensating differentials set in a market free of discrimination.

Oaxaca-Blinder decomposition analysis confirms that department affiliation and faculty rank account for the largest share of the gender wage gap. Nearly 90% of the disparity would be eliminated if women had the same distribution of rank and affiliation as their male counterparts. Perhaps even more concerning, we also find that a large portion of the gender wage gap at Ohio State *cannot* be explained by differences in observed characteristics; fully one-quarter (27%) of the gap is attributable to differences in how observationally-equivalent – except with respect to gender – faculty are compensated. This unexplained portion of the gender pay gap is often taken as evidence of discrimination, as equivalent workers are receiving different levels of compensation for reasons that cannot be observed.

However, the extent to which the "unexplained" gap can be truly attributed to discrimination depends on the extent to which we have accounted for differences in productivity across workers. Empirical analyses of observational data will always be limited in their ability to identify the precise mechanisms by which gender- and race-based discrepancies arise. One reason for this is that some individual characteristics will always remain unobservable or imprecisely measured, leaving open the question of whether observed disparities can be justified by market factors. A second, equally challenging, reason for this is that factors included as control variables are, almost without exception, themselves the product of systems that display some implicit or explicit discrimination, leaving open the question of where the causal chain truly begins. Finally, there is ample evidence that preferences, and perhaps even production technologies, differ by gender, which implies that, even in the absence of discrimination, disparities may arise due to gender differences in underlying utility and cost functions.

Work in progress seeks to improve these estimates by adding measures of course loads, teaching evaluations, and research productivity to provide a more complete explanation of the academic gender wage gap. In addition, we explore peer and leadership effects, as represented by the share of female colleagues and administrators within the department and/or institution, to better understand the role of mentorship and female representation in narrowing the gender wage gap. Finally, we aim to expand the analysis to include a broader range of institutions[7] both in and outside academia and to utilize both temporal and cross-sectional variation in institutional characteristics and employment and compensation policies to identify the impact of these factors on gender parity.

[7] We particularly welcome inquiries from those who would like to contribute data for analysis or who would like guidance on how to conduct similar analyses for their institutions.

References

American Association of University Women. 2018. “The Simple Truth About the Gender Pay Gap.” Washington, D.C.

Antecol, H., Bedard, K., & Stearns, J. (2018). Equal but Inequitable: Who Benefits from Gender-Neutral Tenure Clock Stopping Policies?. *American Economic Review*, *108*(9), 2420-41.

Bagues, M., Sylos-Labini, M., & Zinovyeva, N. (2017). Does the gender composition of scientific committees matter?. *American Economic Review*, *107*(4), 1207-38.

Bertrand, M., & Hallock, K. F. (2001). The gender gap in top corporate jobs. *ILR Review*, *55*(1), 3-21.

Bertrand, M., Goldin, C., & Katz, L. F. (2010). Dynamics of the gender gap for young professionals in the financial and corporate sectors. *American Economic Journal: Applied Economics*, *2*(3), 228-55.

Blackaby, D., Booth, A. L., & Frank, J. (2005). Outside offers and the gender pay gap: Empirical evidence from the UK academic labour market. *The Economic Journal*, *115*(501).

Blau, F. D., Currie, J. M., Croson, R. T., & Ginther, D. K. (2010). Can mentoring help female assistant professors? Interim results from a randomized trial. American Economic Review, 100(2), 348-52.

Blau, F. D., & Kahn, L. M. (2017). The gender wage gap: Extent, trends, and explanations. Journal of Economic Literature, 55(3), 789-865.

Blinder, A. S. (1973). Wage discrimination: reduced form and structural estimates. Journal of Human resources, 436-455.

Boring, A. (2017). Gender biases in student evaluations of teaching. *Journal of Public Economics*, *145*, 27-41.

Bostwick, V. K., & Weinberg, B. (2018). Nevertheless She Persisted? Gender Peer Effects in Doctoral STEM Programs.

Ductor, L. (2015). Does co-authorship lead to higher academic productivity?. Oxford Bulletin of Economics and Statistics, 77(3), 385-407.

Ductor, L., Goyal, S., & Prummer, A. (2018). *Gender & Collaboration*. Faculty of Economics, University of Cambridge.

Dynan, K. E., & Rouse, C. E. (1997). The underrepresentation of women in economics: A study of undergraduate economics students. *The Journal of Economic Education*, *28*(4), 350-368.

Ehrenberg, R. G., Jakubson, G. H., Martin, M. L., Main, J. B., & Eisenberg, T. (2012). Diversifying the faculty across gender lines: Do trustees and administrators matter?. *Economics of Education Review*, *31*(1), 9-18.

Gaule, P., & Piacentini, M. (2018). An advisor like me? Advisor gender and post-graduate careers in science. *Research Policy*, *47*(4), 805-813.

Gayle, G. L., Golan, L., & Miller, R. A. (2012). Gender differences in executive compensation and job mobility. *Journal of Labor Economics*, *30*(4), 829-872.

Ginther, D. K., & Hayes, K. J. (2003). Gender differences in salary and promotion for faculty in the humanities 1977–95. *Journal of Human Resources*, *38*(1), 34-73.

Ginther, D. K., & Kahn, S. (2004). Women in economics: Moving up or falling off the academic career ladder?. *Journal of Economic perspectives*, *18*(3), 193-214.

Goldin, C., Katz, L. F., & Kuziemko, I. (2006). The homecoming of American college women: The reversal of the college gender gap. Journal of Economic perspectives, 20(4), 133-156.

Goldin, C., & Katz, L. F. (2016). A most egalitarian profession: pharmacy and the evolution of a family-friendly occupation. *Journal of Labor Economics*, *34*(3), 705-746.

Hale, G., & Regev, T. (2014). Gender ratios at top PhD programs in economics. *Economics of Education Review*, *41*, 55-70.

Hatch, Joshua. 2017. "Gender Pay Gap Persists Across Faculty Ranks." *Chronicle of Higher Education*. March 22. https://www.chronicle.com/article/Gender-Pay-Gap-Persists-Across/239553.

Hengel, E. (2017). Publishing while Female. Are women held to higher standards? Evidence from peer review.

Holmes, Alex. 2017. "Gender Pay Gap: Universities Are Doing Better than the BBC (But There Is Work to Do)." *Times Higher Education*. July 29. https://www.timeshighereducation.com/blog/gender-pay-gap-universities-are-doing-better-bbc-there-work-do.

Kahn, S. (1993). Gender differences in academic career paths of economists. *The American Economic Review*, *83*(2), 52-56.

Kassenboehmer, S. C., & Sinning, M. G. (2014). Distributional changes in the gender wage gap. *ILR Review*, *67*(2), 335-361.

Leibbrandt, A., & List, J. A. (2014). Do women avoid salary negotiations? Evidence from a large-scale natural field experiment. *Management Science*, 61(9), 2016-2024.

Levenstein, Margaret. 2015. “CSWEP 2015 Statistical Report on the Status of Women in the Economics Profession.” *American Economic Association*. https://www.aeaweb.org/about-aea/committees/cswep/survey/2015-statistical-report.

MacNell, L., Driscoll, A., & Hunt, A. N. (2015). What’s in a name: Exposing gender bias in student ratings of teaching. *Innovative Higher Education*, *40*(4), 291-303.

Mason, M. A., & Goulden, M. (2002). Do babies matter?. *Academe*, *88*(6), 21.

McDowell, J. M., Singell, L. D., & Ziliak, J. P. (1999). Cracks in the glass ceiling: gender and promotion in the economics profession. *American Economic Review*, *89*(2), 392-396.

McDowell, J. M., Singell Jr, L. D., & Ziliak, J. P. (2001). Gender and promotion in the economics profession. *ILR Review*, *54*(2), 224-244.

Noonan, M. C., Corcoran, M. E., & Courant, P. N. (2005). Pay differences among the highly trained: Cohort differences in the sex gap in lawyers' earnings. *Social forces*, *84*(2), 853-872.

Oaxaca, R. (1973). Male-female wage differentials in urban labor markets. International economic review, 693-709.

Pezzoni, M., Mairesse, J., Stephan, P., & Lane, J. (2016). Gender and the publication output of graduate students: A case study. *PloS one*, *11*(1), e0145146.