# THE GENDER PAY GAP IN ACADEMIA: EVIDENCE FROM THE OHIO STATE UNIVERSITY

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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, race, 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 regarding how estimates are affected by sample exclusions and variable definitions will yield insight into possible sources of gender bias.

*Key words*: Discrimination, higher education, gender, pay gap.

*JEL codes*: J16, J31, J71.

As of 2016, the U.S. 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 (American Association of University Women 2018). Universities are no exception when it comes to the gender pay gap. Male full professors at U.S. 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 (Levenstein 2015; Allen-Hermanson 2017). There is also evidence of entrenched barriers unique to academia. For example, 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).

Gender disparities have been both prevalent and persistent in agricultural and applied economics as well. The Committee on Opportunities for and Status of Women in Agricultural Economics (CWAE) was established by the Executive Board of the American Agricultural Economics Association (AAEA) in 1980 and, as part of their charge, the committee conducted a survey of the profession. Using these data, regression estimates reveal a statistically significant gender pay gap of just under $3,800, even after controlling for research productivity (books, publications), experience, rank, and career interruptions (Lee 1981). A similar survey was conducted by CWAE–AAEA in 1998, which reveals a raw gender pay gap of $10,000 (Thilmany 2000). Focusing on the top twenty Ph.D. granting agricultural economics departments in the US, Hilmer and Hilmer (2005) find a persistent gender pay gap of 4% to 5%, even after

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controlling for publication quantity and quality and co-authorship.

Agricultural and applied economics departments also have some unique features that may differently affect the gender pay gap. As part of large, public land grant universities, salary data are largely a matter of public record and have been, in many cases, published by local news outlets or by the universities themselves. Although the data have certain limitations (e.g., bonus versus regular pay), this information could allow faculty to better address disparities during salary negotiations and performance reviews. On the other hand, responsibilities in agricultural outreach may pose unique challenges to women, to the extent that stakeholders and local extension agents remain predominantly male and outreach activities require significant travel to remote areas. 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. Ohio is often regarded as a bellwether for political (*The Economist* 2008) and consumer trends (Kiersz 2014) and, similarly, its flagship university may provide some useful insight on gender pay disparities in agricultural and applied economics, and higher education more broadly.

Our analysis highlights 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. Differences in the treatment of multiple appointments, part-time appointments, and non-academic appointments are shown to have significant impacts on the estimated gender wage gap. Overall, we find a substantial and robust gender wage gap of 11% in our preferred specification controlling for experience, clinical appointment, fiscal year, and department fixed effects. We also estimate a within-rank gender wage gap of 5.3%. Of course there remain a number of unobserved characteristics that influence productivity and compensation and may be correlated with gender. Therefore, we cannot say with certainty that the observed disparities are the result of discrimination. To some extent, labor market outcomes must reflect worker preferences, which may differ by gender. However, with mounting evidence that women face unique institutional barriers and are perceived less positively by peers and students, even controlling for quality of work, we must consider more carefully whether persistent disparities may be reflecting not only the preferences of workers but the constraints created by institutions, employers, and colleagues.

The remainder of the paper proceeds as follows. The next section provides a brief overview of the existing literature on the gender wage gap in academia, while the following section discusses the data sources used in the analysis and descriptive statistics. The subsequent section introduces the empirical framework, while the next section presents and interprets the results. The final section concludes.

## 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), as well as the 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 and institutions, the majority of assistant professors have attained a doctoral degree, 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

[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).

promotion, there remains a substantial wage gap, and, as documented in the field of economics, a persistent gap in the promotion rates of male and female academics (Kahn 1993; Dynan and Rouse 1997; McDowell et al. 1999, 2001; Ginther and Kahn 2004). 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 is likely to be larger when 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. Manuscripts authored by women undergo a more stringent peer review process, with female-authored papers spending roughly 6 months longer under review, despite scoring higher on a range of "readability scores" (Hengel 2017). Hengel (2017) also finds that, in the tenure process, 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 towards childcare rather than research during their tenure-track years, 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 is limited to only female faculty but, in the case of "gender-neutral" policies, both men and women who have a child may 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, as men are more likely to utilize the additional time to publish in high-quality journals than to provide child care (Antecol et al. 2018). Thus, rather than granting 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 effect, where female students and junior faculty 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 and Regev 2014; Bostwick and Weinberg 2018). Increasing the representation of female presidents and administrators may also increase the share of newly-hired female faculty (Ehrenberg et al. 2012). Ensuring representation of female peers on committees that conduct promotion evaluations has been proposed as one mechanism to alleviate the gender promotion gap. However, 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 (Bagues et al. 2017). Moreover, when an additional female evaluator is added to the committee, male evaluators tend to decide on less favorable outcomes for female candidates (Bagues et al. 2017).

To increase the representation and subsequent success of traditionally underrepresented groups, 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; Gaule and Piacentini 2018). 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 body of literature examining 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 across fields 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.

## Data

Our analysis uses personnel records from The Ohio State University from 2006–2016, including annual information on each employee's salary, gender, age, faculty 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 four years. In preparing the data for analysis, several limitations must be noted, and some assumptions must be made to simplify the intricacies of the raw personnel records into a tractable dataset. We explain each step in detail and highlight the impact of these decisions regarding variable definition 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, 26.8% 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, 9.4% have joint appointments. The most common joint appointment in our data is a 50–50 split (83%), but a wide range of combinations is observed. Without additional information about the funding lines for each position, there is no a priori guidance as to how one should assign these individuals to departments. For example, each individual–department appointment could be treated as one 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 position and, even in the context of split appointments, some positions do not add up to full-time (FTE = 100%). To facilitate comparison, one may consider inflating less than full-time salaries to be comparable to that of a full-time employee. On the other hand, the years of experience will be overstated for part-time employees, and

[2] In our sample, 4,237 person-year observations (12.27%) have 50–50 splits between academic and clinical units. In the case of 50–50 academic appointments (only 182 observations, or 0.53% of the entire sample), one department is chosen randomly. We test the sensitivity of our findings to these assumptions in the following section.

should be deflated. In all specifications, we inflate the annual salary by dividing the total annual salary reported by the total appointment for that year. For years of experience, we multiply each year of service by the total FTE for the year.

Our data also lack other important characteristics of the faculty appointment. First, we cannot distinguish between nine- and twelve-month appointments, and reported pay reflects only the usual base salary. Consequently, the pay for those on nine-month appointments with bonuses, special assignments, or funded research projects may be understated. To the extent that this reflects activities that are not compensated by the base salary, this is not problematic. However, there are some disciplines where bonus pay is the norm, and it is unclear, given the data we have, how this differs by gender. Second, our measure of years of experience is based only on starting date at the university. We do not observe prior experience, nor do we have information on year of terminal degree. We also do not observe professional, family, and medical leaves, which may differentially affect accumulated years of experience, and which may be weighted differently in performance evaluation. Finally, we do not have data on spousal hires; the "two body problem" likely affects the scope for salary negotiation and may disproportionately affect women as well. It is not clear a priori whether spousal hires are at an advantage or disadvantage; couples may have fewer outside options, but many institutions also have explicit spousal accommodation policies.

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 earned about $36,700 less than male academics per year. Women also had two years less experience at the institution than men. We find no significant difference in the incidence of part-time or joint appointments. But, among faculty with clinical appointments, women were significantly less likely to hold joint appointments (not shown). Finally, while 54% of men achieved tenure in 2016, only 41% of women held tenured appointments.

**Table 1. Summary Statistics (2016)**

| | Male | Female | Difference (Male - Female) |
|---|---|---|---|
| Annual Salary | 162,725 | 129,952 | 34,773*** |
| Institution Experience | 12.68 | 10.37 | 2.31*** |
| FTE | 0.87 | 0.88 | −0.01 |
| Joint Appointment (%) | 27.29 | 25.26 | 2.03 |
| Tenured | 0.54 | 0.41 | 0.13*** |
| Observations | 2327 | 1564 | 3891 |

*Note*: Results are the difference in means for male and female faculty. Data on annual salary, age, years in rank, experience, FTE, tenure status, and appointment split are sourced from personnel records of The Ohio State University. The t-statistics for test of equality of means appear in parentheses. ***indicates $p < 0.01$.

We next analyze these differences within faculty ranks to gain 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 significantly less than men in 2016 ($28,000–$32,000) within the same rank. Female assistant professors are not statistically significantly different in years of experience. However, female assistant professors hold slightly higher FTE appointments than male assistant professors. Male associate professors have approximately one more year of institution-specific experience than women. Among full professors, women are, on average, one year younger but do not differ significantly in experience or FTE. 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 show that even female assistant professors have lower salaries than their male colleagues, 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 (Table 3). 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

[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.

**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 | 151,885 | 124,749 | 27,136*** | 139,958 | 111,175 | 28,782*** | 188,599 | 158,253 | 31,346*** |
| 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 |
| Joint Appt. | 43.1 | 37.1 | 6.1*** | 21.7 | 15.2 | 6.4*** | 19.9 | 15.7 | 4.2*** |
| 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 |

*Note*: 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. The t-statistics for test of equality of means appear in parentheses. Asterisks indicate the following: ***= $p < 0.01$; **= $p < 0.05$, and *= $p < 0.1$.

**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% |
| 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% |
| Moritz College of Law | 40.4% | 49.3% | 56.0% | 33.5% |
| Veterinary Medicine | 37.0% | 48.4% | 37.2% | 29.1% |
| Medical Center | 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 Affairs | 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% |

*Note*: Authors calculation with personnel record data from The Ohio State University 2006–2016.

ranks. The second-highest is the College of Social Work, with 73.2% female faculty members.

Among the lowest representation of female faculty are the Colleges of Engineering, Food, Agriculture, and Environmental Sciences (FAES), Public Policy, and Business. With the exception of nursing, we also see 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%. It is important to note that our data do not allow us to determine whether this is due to differential attrition from academic careers, or differences in gender compositions across cohorts. However, given that this trend is evident even in female dominated units, it seems probable that both factors are at play.

**Table 4. Average Faculty Salary by College (2016)**

| | Pooled | Male | Female | Difference |
|---|---|---|---|---|
| Nursing | 131,404 | 121,614 | 131,933 | 10,319 |
| | | | | (0.228) |
| Social Work | 96,044 | 128,664 | 87,889 | −40,775** |
| | | | | (−2.639) |
| Education and Human Ecology | 103,039 | 108,222 | 99,251 | −8,971 |
| | | | | (−1.367) |
| Optometry | 127,058 | 122,912 | 130,926 | 8,014 |
| | | | | (0.586) |
| Public Health | 126,195 | 147,719 | 102,799 | −44,920** |
| | | | | (−2.506) |
| Arts and Sciences – Arts and Humanities | 94,921 | 98,361 | 90,871 | −7,490** |
| | | | | (−2.080) |
| Moritz College of Law | 170,496 | 177,713 | 161,904 | −15,809 |
| | | | | (−0.848) |
| Veterinary Medicine | 142,737 | 147,929 | 136,103 | −11,826 |
| | | | | (−1.181) |
| Medical Center | 192,797 | 218,597 | 156,785 | −61,812*** |
| | | | | (−9.204) |
| Pharmacy | 132,378 | 147,781 | 111,375 | −36,406*** |
| | | | | (−2.726) |
| Dentistry | 132,227 | 142,154 | 117,923 | −24,231** |
| | | | | (−2.056) |
| Fisher College of Business | 221,153 | 228,988 | 203,603 | −25,385 |
| | | | | (−1.499) |
| Arts and Sciences - Social and Behavioral Sciences | 125,333 | 135,844 | 105,606 | −30,238*** |
| | | | | (−3.417) |
| John Glenn College of Public Affairs | 120,513 | 128,183 | 107,730 | −20,453 |
| | | | | (−0.819) |
| Food, Agricultural, and Environmental Sciences | 109,848 | 114,124 | 100,535 | −13,589*** |
| | | | | (−2.946) |
| Arts and Sciences - Natural and Mathematical Sciences | 116,811 | 119,127 | 108,729 | −10,398* |
| | | | | (−1.723) |
| Engineering | 123,835 | 129,151 | 105,115 | −24,036*** |
| | | | | (−3.998) |

*Note:* Results are the difference in means for male and female faculty, by college. Data are sourced from personnel records of The Ohio State University. The t-statistics for test of equality of means appear in parentheses. Asterisks indicate the following: ***= $p < 0.01$; **= $p < 0.05$, and *= $p < 0.1$.

Table 4 additionally presents average salaries and the raw gender pay gap within each college, again ordered by the proportion of female faculty. The units with the lowest average salaries are social work, arts and humanities, and education, which all fall in the top five for highest proportion of female faculty. In contrast, the units with the next lowest salaries, FAES and natural sciences, have very low female representation, though these units may also have greater compensation via funded projects (e.g., "soft money" faculty) that would not be reflected in regular base salary. The units with the lowest female representation also tend to have the largest raw gender pay gaps (as a proportion of the overall average), though social work and public health have particularly large gaps despite having a large proportion of female faculty.

## 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:

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

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 ($\phi_t$), which account for aggregate wage fluctuations that affect the institution as a whole (e.g., state budgets). We then add control variables $X_{it}$, including the following: indicators for race/ethnicity (Black, Hispanic, Asian/Pacific Islander, Native American, and "other", including multiple and undisclosed ethnicity, with White as the omitted category); experience and experience squared at the institution, adjusted for FTE status; an indicator for instructor and/or clinical appointments; indicators for academic department ($\theta_d$); 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 gender disparities that may be present in the promotion process (Sarsons 2017). 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, as follows. Separate OLS regressions are estimated for men and women, denoted (for simplicity, $i$ and $t$ subscripts have been suppressed and fixed effects have been collapsed into a single parameter vector)

$$(2)\quad \ln(w_M) = X_M\beta_M + \mu_M \text{ and } \ln(w_F) = X_F\beta_F + \mu_F.$$

Then, the gender gap can be expressed as

$$(3)\quad \ln(\bar{w}_M) - \ln(\bar{w}_F) = b_M\bar{X}_M - b_F\bar{X}_F = b_M(\bar{X}_M - \bar{X}_F) + \bar{X}_F(b_M - b_F).$$

This allows us to quantify differences in wages between men and women that can be explained, or attributed to, differences in characteristics $(\bar{X}_M - \bar{X}_F)$ versus those that are due to differences in how men and women are compensated for the same characteristics $(b_M - b_F)$. The latter is typically considered "unexplained" and indicative of labor market discrimination.

## Results

Beginning with the most parsimonious model, column 1 of table 5 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 2) 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. A more complete discussion of racial pay gaps is beyond the scope of the current paper, but we present the findings here to highlight the need for additional research.

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 5, column 3) 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

**Table 5. 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*** | −0.0526*** |
| | (0.0219) | (0.0225) | (0.0195) | (0.0176) | (0.0113) | (0.00822) |
| Black | | −0.0525 | −0.0550 | −0.0415 | −0.0494* | 0.00381 |
| | | (0.0377) | (0.0362) | (0.0363) | (0.0285) | (0.0234) |
| Hispanic | | −0.118** | −0.119** | −0.0936* | −0.0313 | 0.00268 |
| | | (0.0572) | (0.0548) | (0.0480) | (0.0241) | (0.0198) |
| Native American | | −0.0992 | −0.0948 | −0.0895 | −0.0640 | −0.0282 |
| | | (0.132) | (0.117) | (0.108) | (0.0414) | (0.0335) |
| Asian/Pacific Islander | | −0.0225 | −0.0228 | 0.00898 | −0.0799*** | −0.0480*** |
| | | (0.0290) | (0.0293) | (0.0241) | (0.0205) | (0.0176) |
| Other | | −0.0621 | −0.0830 | −0.0419 | −0.0247 | 0.00292 |
| | | (0.0718) | (0.0595) | (0.0508) | (0.0279) | (0.0269) |
| Observations | 34,533 | 34,533 | 34,533 | 34,533 | 34,518 | 34,518 |
| R-squared | 0.076 | 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 |
| Department FE | No | No | No | No | Yes | Yes |
| Faculty Rank | No | No | No | No | No | Yes |

*Note:* 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 appear in parentheses and are clustered at the department level. Asterisks indicate the following: ***= $p < 0.01$; **= $p < 0.05$, and *= $p < 0.1$.

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 with interactions between year and the indicator for female. These estimates are plotted in figure 1 and reveal a significant trend break around 2011, with the gender gap becoming substantially worse in recent years, counter to national trends (American Association of University Women 2018).[4] The break coincides with two significant changes at the 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.

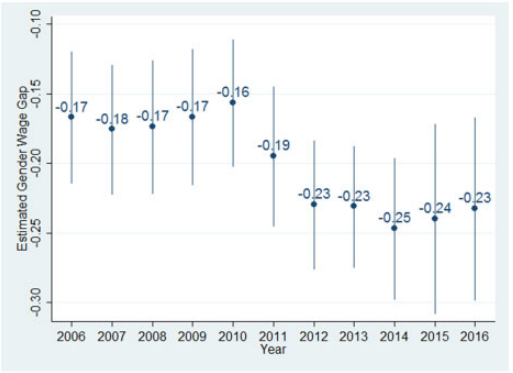


**Figure 1. Estimates of the gender wage gap by year**

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

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

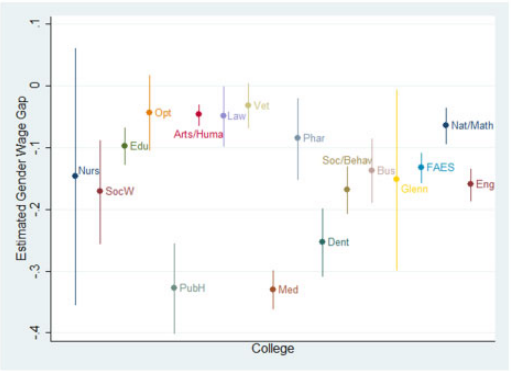


**Figure 2. Estimates of the gender wage gap by college**

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

Next we add controls for the college (table 5, column 4) 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 5, column 5) 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 undervalued 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.

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 7.99% (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 overrepresented 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 6 (table 5); this has the largest effect on pay disparities. The gender gap falls from 11% to 5.26%, 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 4.80%. 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 5 and 6.

*Decomposition Analysis*. To provide a clearer apportionment of the gender pay gap to various factors, we conduct an Oaxaca-Blinder decomposition. Although the regression analysis reveals which factors play a significant role in salary determination, it does not show how these factors contribute to the gender gap. For example, we see that controlling for faculty rank reduces the estimated gender pay gap, but this does not necessarily imply that reducing gender disparities in the tenure process would eliminate the gender gap in pay. That is, we may observe gender differences in pay both because there are fewer women in the rank of full professor and because men and women are compensated differently within the rank of full professor. The advantage of the Oaxaca-Blinder decomposition is that it quantifies both the relative contribution of each factor, as well as the role of both "explained" (differences in observed characteristics) and "unexplained" (differences in the treatment of men and women with the same characteristics) factors.

In the bottom row of table 6, we find that differences in characteristics between male and female faculty account for 73% of the 19.74% gender pay gap.[5] 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, 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.[6] Experience is again found to be negative, implying that the inverse returns to experience are actually less pronounced for women than for men. We also find suggestive evidence of gender discrimination, particularly with respect to clinical appointments and department. If female faculty with clinical appointments received the same salaries as their male peers, the gender pay gap would shrink by a little over 30%. And, perhaps most concerning, if women were compensated the same as their male counterparts within the same department, the gender pay gap would shrink by nearly 90%.

**Table 6. Oaxaca-Blinder Decomposition**

| | Explained | Unexplained |
|---|---|---|
| Year | −0.0141*** | 0.0200 |
| | (0.0013) | (0.0134) |
| Clinical | −0.0076*** | 0.0627*** |
| | (0.0009) | (0.0051) |
| Experience | −0.0035*** | −0.0712*** |
| | (0.0007) | (0.0110) |
| Race/Ethnicity | −0.0015*** | 0.0028 |
| | (0.0003) | (0.0026) |
| Department | 0.0718*** | 0.1742* |
| | (0.0047) | (0.0921) |
| Faculty Rank | 0.0995*** | −0.1359 |
| | (0.0029) | (0.0933) |
| Total | 0.1447*** | 0.0526*** |
| | (0.0056) | (0.0042) |

*Note:* Results are for an Oaxaca-Blinder Decomposition that decomposes the explained and unexplained variation in the gender wage gap into components explained by various covariates. Race/ethnicity categories include Black, Hispanic, Asian/Pacific Islander, and multi/not reported. Experience is included as a quadratic. Standard errors appear in parentheses and are clustered at the department level. Asterisks indicate the following: ***= $p < 0.01$; and *= $p < 0.1$. N = 34,533.

*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.

[5] The total gender pay gap is computed as the sum of the "Total" explained and unexplained columns (0.1441 + 0.0533).

[6] This is the share of the "unexplained" gap as a fraction of the total wage gap (0.0533 / 0.1974).

**Table 7. Gender Wage Gap Estimates (Excluding Clinical)**

| | (1) Log (Wage) | (2) Log (Wage) | (3) Log (Wage) | (4) Log (Wage) | (5) Log (Wage) |
|---|---|---|---|---|---|
| Female | −0.159*** | −0.156*** | −0.137*** | −0.0784*** | −0.0219*** |
| | (0.0187) | (0.0183) | (0.0216) | (0.00998) | (0.00743) |
| Black | | −0.0720* | −0.0608 | −0.0899*** | −0.0141 |
| | | (0.0407) | (0.0410) | (0.0283) | (0.0186) |
| Hispanic | | −0.112** | −0.0920** | −0.0394* | 0.00199 |
| | | (0.0487) | (0.0432) | (0.0222) | (0.0160) |
| Native American | | −0.206** | −0.177** | −0.114** | −0.0616** |
| | | (0.0934) | (0.0769) | (0.0467) | (0.0301) |
| Asian/Pacific Islander | | 0.00828 | 0.0402 | −0.0567** | −0.0203 |
| | | (0.0293) | (0.0286) | (0.0247) | (0.0189) |
| Other | | −0.0800** | −0.0321 | −0.0174 | 0.0134 |
| | | (0.0378) | (0.0356) | (0.0294) | (0.0237) |
| Observations | 25,717 | 25,717 | 25,717 | 25,705 | 25,705 |
| R-squared | 0.047 | 0.051 | 0.079 | 0.544 | 0.729 |
| Race/Ethnicity | No | Yes | Yes | Yes | Yes |
| Experience | No | No | Yes | Yes | Yes |
| Department FE | No | No | No | Yes | Yes |
| Faculty Rank | No | No | No | No | Yes |

*Note:* We control for fiscal year in all specifications. Race/ethnicity categories include Black, Hispanic, Asian/Pacific Islander, and multi/not reported. Experience is included as a quadratic. Standard errors appear in parentheses and are clustered at the department level. Asterisks indicate the following: ***= $p < 0.01$; **= $p < 0.05$, and *= $p < 0.1$.

In table 7, we see that the gender pay gap is much smaller in the restricted sample, ranging from 2.19% 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.[7] 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 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.

*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 and 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 appointments 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.

In table 8, 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 5.26% that we observe when

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

**Table 8. 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 |

*Note*: We control for fiscal year in all specifications. Race/ethnicity categories include Black, Hispanic, Asian/Pacific Islander, and multi/not reported. Experience is included as a quadratic. Standard errors appear in parentheses and are clustered at the department level. Asterisks indicate the following: ***= $p < 0.01$; and *= $p < 0.1$.

including only one observation per person per year. 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.

## 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 that 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 persist, for both women and people of color, 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 faculty rank yields a statistically significant gap of 5.26%. 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 The Ohio State University *cannot* be explained by differences in observed characteristics; 27% of the current gap is attributable to differences in how observationally-equivalent—except with respect to gender—faculty are compensated. Put another way, a little over one-quarter of the difference in pay between male and female faculty are due to discrimination. In particular, appointment type (clinical/instructor vs. academic) and faculty rank appear to be the largest sources of discrimination.

Finally, we reiterate a note of caution in the interpretation of these estimates. Empirical analyses of observational data are 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, 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.

Work in progress adds measures of course loads, teaching evaluations, and research productivity to provide a more complete explanation of the academic gender wage gap. Finally, we aim to expand the analysis to include a broader range of institutions 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.[8]

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[8] 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.

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