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ASSESSING THE CONTRIBUTION OF EDUCATION TO GENDER WAGE DISPARITIES IN HIGH-EARNING PROFESSIONS

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Article Info

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Abstract

The gender wage gap has shown a significant reduction over the years due to increased educational attainment and women's entry into traditionally male-dominated professions. However, this overall decline masks the persistence of wage disparities among high earners. The unequal distribution of top earnings has contributed to the maintenance of the gender wage gap, with men benefiting the most from recent high-wage earnings gains. Moreover, gender gaps in college premiums and disparities in educational credentials have been linked to high-wage gender inequality. Understanding the stagnation of the wage gap among top earners requires examining the role of educational processes. This study investigates the contribution of gender differences in educational credentials to the high-wage earnings gap and explores the potential of changes in women's educational attainment to mitigate earnings disparities. The economic returns of higher education are influenced by the field of study, which is associated with individuals' professional opportunities. Despite women's advantage in bachelor's degree attainment, significant gender differences persist in fields of study. These disparities in fields of study contribute to wage inequality, particularly among high earners. Furthermore, graduate degrees play a crucial role in understanding top end inequality. Although women have made strides in attaining advanced degrees, evidence suggests that gender inequality in the returns to these degrees persists, potentially limiting their impact on closing high-wage earnings gaps. This article assesses the extent to which gender disparities in field of study and advanced degrees explain the persistent gender wage gap among high-earning college-educated workers. Using microdata from the Census and American Community Survey, the analysis examines the contribution of these educational factors to gender inequality across the wage distribution. Decomposition models are employed to evaluate the influence of population differences in field of study and advanced degree attainment on gender wage gaps among high earners. The findings shed light on the mechanisms contributing to wage inequality dynamics in higher education and provide insights into whether changes in educational

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characteristics can help women overcome existing wage disparities. Ultimately, this research contributes to our understanding of the gender wage gap among college-educated individuals and informs policy and interventions aimed at promoting pay equity.

1. Introduction

As women have earned more college degrees, joined the workforce in greater numbers, and entered historically male-dominated professions, the gender wage gap has declined considerably. In 1980, the unadjusted female-male wage ratio was 0.60, but by 2020, it had reduced to 0.85 (England et al. 2020). This average reduction in the gender wage gap, however, masks important variation across the wage distribution. Indeed, while overall changes in the gender wage gap reflect greater parity among lower- and middle-earning workers, this gap remains high among top earners (England et al., 2020; Yavorsky et al., 2019). Scholars have argued that persistence of the highwage earnings gap is at least partly a result of broader changes in inequality dynamics, wherein increases in top earnings have far outpaced increases in earnings lower in the wage distribution (Autor 2014; Blau and Kahn 2017; Piketty et al. 2018). This research suggests that men are the primary beneficiaries of recent high-wage earnings gains, thus helping maintain the overall gender wage gap (Mandel and Rotman 2021).

High-wage gender inequality also has been linked to gender gaps in college premiums, in the sense that economic returns to a college degree among the top 10 percent of earners have grown faster for men than for women (Mandel and Rotman 2021). Together with the fact that high earners are disproportionately college graduates (Goldin and Katz 2008), better understanding the stagnating wage gap among the highest earners involves explicitly examining the role of educational processes. Scholarship and public discourse around the gender wage gap have focused on ways that women can take action to improve their labor market outcomes, with particular emphasis on the role of human capital attainment in altering women's occupational and earnings potential (Quadlin 2020). In this study, we investigate the contribution of gender differences in educational credentials to the high-wage earnings gap, and provide a critical look at the potential for changes in women's educational attainment to equalize earnings gaps between men and women.

The economic returns to higher education are highly dependent on field of study, which in turn are correlated with students' professional opportunities (Gerber and Cheung, 2008; Oh and Kim, 2020; Roksa 2005). Despite the overall female advantage in bachelor's degree attainment (DiPrete and Buchmann 2013), large and persistent gender differences in fields of study remain (Bayer and Wilcox 2019; Charles and Bradley 2009). Research has shown that wage inequality across fields of study can be as great as the average gap between a high school diploma and a bachelor's degree (Kim et al. 2015; Webber 2016), and that gender segregation across majors has contributed to the overall gender wage gap (Blau and Kahn 2017). It follows that field of study segregation, which tends to be largest in the highest-paid fields, would also explain at least part of the gender wage gap among high earners.

Relatedly, scholars have argued that graduate degrees are key to understanding top-end inequality (Oh and Kim, 2020; Torche 2011). Women now rival or outpace men in the attainment of master's, professional, and doctoral degrees, the latter two of which have become increasingly predictive of high earnings (Torche 2018). Advanced degrees therefore may equip women to reach greater economic parity with similarly educated men. But at the same time, evidence indicates gender inequality in the returns to advanced degrees, suggesting that women's attainment of advanced degrees may do little to close high-wage earnings gaps (Torche 2018). Taken together, research suggests that gender differences in the attainment of and returns to human capital likely contribute to the gender pay gap at the top of the wage distribution.

In this article, we assess the extent to which gender differences in field of study and advanced degrees explain the persistent gender wage gap among high-earning college-educated workers. This question is important for understanding the mechanisms that contribute to wage inequality dynamics among those with college degrees; while recent research has documented the rise of topend gender inequality among college workers (Mandel and Rotman 2021), less is known about mechanisms specific to higher education and how they may be contributing to these trends. This question also is key to assessing whether women are able to "overcome" existing wage inequality by altering the characteristics of their educational attainment. We use microdata from the Census and American Community Survey (ACS). We use 20 waves of data across all analyses, and our advanced degree and field of study analyses start with the first year these data were collected in the ACS—1990 and 2009, respectively. Our analyses consider *where* in the wage distribution these mechanisms are more and less consequential in accounting for gender wage gaps, focusing on high earners. We use decomposition models that allow us to assess the contribution of population differences in field of study and advanced degree attainment to gender inequality across the wage distribution. In total, we assess the extent to which women's attainment of "different" education (via fields of study) or "more" education (via advanced degrees) can effectively close gender wage gaps across the distribution of college-educated workers.

2. Motivation and background

2.1. The Persistence of High-Wage Gender Inequality

Generally speaking, women have experienced large wage gains relative to men since the 1970s; the female-male ratio has improved from about 0.60 in the 1970s to about 0.85, where it has remained since the early 2000s (England et al., 2020). Much of these gains reflect greater gender parity in labor force participation and postsecondary attainment (Blau and Kahn 2017). In the past few decades, women have increased their college attainment relative to men, and now earn around 57 percent of all bachelor's degrees (DiPrete and Buchmann 2013; U.S. Department of Education, 2019). Similarly, the employment rate of women college graduates increased from 59 percent in 1970 to 80 percent in 2007 (England 2010). Despite these changes in women's human capital and labor market participation, gains in the male-female wage ratio have slowed dramatically in the past 20 years.

Overall trends in the gender wage gap, however, may mask considerable variation in wage differences around the mean and thus may prevent scholars from understanding the dynamics of gender wage inequality. Specifically, some have suggested that the flattening in the growth of the female-male wage ratio is due to the stagnation of the gender wage gap at the top of the wage distribution (Blau and Kahn 2017; England et al., 2020; Mandel and Rotman 2021; 2022). Since the 1970s, when the unadjusted ratio of women's to men's earnings was relatively constant across the wage distribution, wage inequality has diverged among the highest earners, where the ratio has remained below 0.80 (Blau and Kahn 2017; England et al., 2020). Some have suggested that differential trends in the gender wage gap at the top of the distribution follow structural changes in wage patterns—that is, the highest earners have seen the highest wage growth (Mandel and Rotman 2022; Yavorsky et al., 2019). That the gender wage gap among top earners remains relatively high and stable compared to that among lower earners suggests that high-wage women are losing out on earnings growth enjoyed by high-wage men. In this article, we assess higher education as a potential mechanism for this particular inequality-generating process among the highest-earning men and women.

2.2. **Assessing the gender wage gap among college-educated workers**

Although social scientists have been attuned to inequality mechanisms associated with higher education, few explicitly identify high-earning, highly-educated workers as central to contemporary wage inequality. Yet, assessing mechanisms leading to the gender pay gap among high earners involves shifting focus away from the wage dynamics of all workers and toward the collegeeducated population specifically. As gender wage inequality among high earners has increased, a college degree has simultaneously become a key distinguishing factor in earnings potential for both men and women (Autor 2014; Chetty et al., 2017; Goldin and Katz 2008). By 2013, workers with a college degree made approximately 98% more per hour than those without one, versus 85% in the 2000s and 64% in the early 1980s (Carnevale et al., 2014). Further, recent research suggests that college premiums have increased more for the highest-paid men than for the highest-paid women (Mandel and Rotman 2021).

Despite a frequent emphasis on overall wage inequality, some scholars also have extended theoretical and empirical social stratification research to assess processes driving within-group inequality (see, e.g., DiNardo et al., 1996; McCall 2000; VanHeuvelen 2018; Western et al. 2008). This line of inquiry includes investigations of the growing wage inequality among college graduates, which reflects both differential returns to majors and increasing returns to advanced degrees (Kim et al., 2015; Posselt and Grodsky 2017; Torche 2011; 2018). As a larger share of workers has attained at least a bachelor's degree over this period, the high level of inequality among this group has become central to total wage inequality trends, with much of these disparities being concentrated at the top of the wage distribution (Piketty et al., 2018). Investigating how wage variation among college-educated workers interacts with gender thus facilitates a focused assessment of the mechanisms contributing to gender inequality among high earners.

2.3. Higher education and the gender wage gap

As long as there remains a substantial gender wage gap among highly paid, highly-educated workers, women are unlikely to realize full economic parity with men. Investigating the mechanisms that have contributed to this gap is therefore critical to understanding potential pathways to greater wage equality. Of particular relevance to the gender pay gap among collegeeducated workers are the characteristics of their educational credentials—specifically, their bachelor's-level field of study and their highest degree attained.

A long line of research shows that field of study serves as a key predictor of wage attainment among college graduates, predicting wage gaps that rival those between college and non-college workers (Gerber and Cheung, 2008; Kim et al., 2015; Roksa 2005; Webber 2016). At the same time, majors continue to be highly segregated by gender, given gendered expectations and constraints that steer men and women toward different fields (Charles and Bradley 2009; Quadlin 2020; RiegleCrumb et al., 2012). Women disproportionately select into lower-paying majors such as education, the humanities, and some social sciences, while men disproportionately select into higher-paying majors such as STEM, economics, and finance (Charles and Bradley 2009). Scholarship on gender wage inequality has shown that gender segregation in fields of study explains a substantial portion of the overall gender wage gap (Black et al., 2006; Blau and Kahn 2017; Gerber and Cheung, 2008; Jacobs 1996).

Despite continued gender segregation, women have made inroads into increasing female representation in male-dominated fields (England 2010). Evidence suggests that this integration has contributed to observed reductions in the overall gender wage gap (Blau and Kahn 2017). This finding, and others like it, has led scholars to imply that gender wage gaps among college workers could effectively be closed if women were to choose majors more like men. For example, England et al. (2020) argue, "[gender] segregation [in fields of study] is important because, for the approximately one-third of adult Americans who have a baccalaureate degree or more, occupation and earnings are strongly affected, although by no means entirely determined, by their field of study" (6991). Relatedly, economists often conceptualize fields of study as reflecting variations in skill and training that contribute to occupational sorting (Altonji et al., 2016; Lemieux 2006). If this is the case, then gender differences in fields of study should be particularly consequential as women shift into fields that provide sufficient training and knowledge to connect to high-paying work.

Selection into advanced degrees is an additional mechanism that may help us understand the gender wage gap among college- educated workers. Although the female advantage in college completion is most notable at the bachelor's degree level, women also have made advances in graduate and professional education. In 2014, the percentage of U.S. women with a master's degree exceeded that of U.S. men, and women were approaching men's rates of attainment at the professional and doctoral levels (Posselt and Grodsky 2017). By facilitating greater access to more lucrative occupations and positions, women's advanced degree attainment may lead to greater pay equalization among certain segments of the labor market. And yet, as with bachelor's degrees, there is some evidence that the returns to advanced degrees are comparatively larger for men. Torche's (2018) analysis of Ph.D. holders shows that mean earnings for women converge to a lower level than that of their men counterparts. These patterns suggest that gender gaps may be a function of selection into graduate-level education or, at minimum that gender wage inequality may work differently across advanced degree categories.

2.4. **Field of study, advanced degrees, and the high-wage gender pay gap**

By focusing on central tendencies, most prior research has assumed that higher education characteristics contribute uniformly to gender wage gaps across lower-, middle-, and higher-paid workers (or otherwise has not investigated this issue explicitly). Yet, there is little theoretical reason why this would be the case. On one hand, we have good reason to suspect that these mechanisms would have the most explanatory power at the top of the wage distribution. For example, women's integration into male-dominated fields of study may provide greater economic returns to highlyskilled women with the potential for very high earnings. Such an argument has certainly been implied in prior research; scholars' emphasis on women's under-representation in STEM fields is motivated by the understanding that women are not selecting into majors that lead to top-income positions (Altonji et al., 2012). This line of reasoning implies that gender differences in major choice are most prevalent (or at least most consequential to total inequality trends) among top incomes.

But at the same time, we also have good reason to believe that higher education mechanisms would break down at the top of the labor market. In an audit study, Quadlin (2018) found greater gender discrimination among math majors than among English majors, the former typically understood to be a more lucrative field of study than the latter. Evidence of gender inequality in the returns to advanced degrees also suggests that very highly educated men have a higher pay ceiling than their female counterparts (Torche 2018). In addition, research in the social psychological tradition has pointed to multiple mechanisms that may lead to high-wage gender pay inequality, including assumptions that women are less competent, less capable, and less committed to their jobs than men (Ridgeway 2011). For college-educated women working in professional occupations, judgments about competence and capability are key criteria for hiring (Correll et al., 2007; Quadlin 2018; Rivera and Tilcsik, 2016). Even if women are perceived as competent, research shows that these same women may be penalized for seemingly lacking likeability—a double standard that does not affect men to the same extent, as men are often perceived as competent and likeability simultaneously (Cuddy et al. 2008; Quadlin 2018). These mechanisms have been shown to affect sorting into leadership positions (Eagly and Carli 2007), which tend to encompass the highest-paid positions for wage earners. Further, highly paid jobs frequently require employees to work long hours (Cha and Weeden 2014), which may disadvantage women if they are viewed as less committed to, or able to compete for, such work. Taken together, as women have entered maledominated fields, women have increasingly been incorporated in workplaces and occupations that expose them to gendered standards of evaluation. At high-wage locations in the labor market, variation in abilities and skills across fields of study and degree level may pale in comparison to these mechanisms of gendered assumptions of female competency and work commitment.

The extent to which field of study and advanced degree attainment explain observed inequalities among high earners thus remains an open question. This study therefore makes two key contributions to scholarship on the gender pay gap. First, by studying the extent to which gender differences in fields of study explain gender inequality across the wage distribution, this study considers whether reducing segregation in field of study can close gender gaps among the highestpaid workers. A modest contribution of field of study at the top of the wage distribution would suggest that other mechanisms, such as those related to gender discrimination and gendered stereotypes, may take greater precedence. Second, we consider the extent to which gender inequality processes at the top, middle, and bottom of the earnings distribution vary across advanced degree categories, thus providing evidence on whether increasing women's advanced degree attainment may further reduce the observed earnings gap among top earners. **3. Data and methods 3.1. Data**

Across all analyses, we use 20 waves of longform Census and ACS microdata (Ruggles et al., 2017). Census data are from years 1960, 1970, 1980, 1990, and 2000, while ACS data are from individual years 2005–2019. Census waves comprise either a 5% sample (1960, 1980, 1990, 2000) or 1% sample (in 1970) of the U.S. population, while annual waves of the ACS correspond to approximately 1% samples of the U.S. population. Our analyses of fields of study use data from 2009 onward, and our analyses of advanced degrees use data from 1990 onward, starting with the first year these data were collected. We use earlier waves of data to replicate (and further refine) patterns of high-wage gender inequality that have been identified in prior research, as we discuss later in this section. Census and ACS data are well-suited to our research because the large and nationally-representative samples allow for precise measurement of contributions of fine-grained fields of study, while also providing sufficient observations to reasonably assess gender wage gaps across the wage distribution.

We follow standard practices and include respondents ages 25–64 who worked 400 or more hours annually. We exclude those who report no income, are out of the labor force, live in group quarters, or are self-employed. We restrict our attention to wage-earners to align our findings with previous research on the gender wage gap (Blau and Kahn 2007; 2017), and also to ensure that any variation among top earners is not spuriously driven by different types of attachment to the labor market (e.g., employed versus self-employment). Given our interest in wage inequality among highly-educated, high-wage workers, we further restrict our sample to those with a bachelor's degree or more.

3.1.1. Wages

The main outcome is logged wage, which allows for comparability of results across different quantiles in the distribution of wages and is the standard measurement for quantile-specific wage effects (e.g. Firpo et al., 2009; 2018). Using logged wages (as opposed to unlogged wages) guards against the possibility that wage gaps are mechanically larger among higher-paid workers because absolute wage levels are larger. We construct this measure as the respondent's total pre-tax wage and salary income (or all wages, salaries, commissions, cash bonuses, tips, and other income received from an employer), divided by annual hours worked. Wages are adjusted to 2009 dollars using the personal consumption expenditure index (Bureau of Economic Analysis 2018), bottomcoded as half the federal minimum wage (Goldin and Margo 1992), and top-coded as 1.5 times the top-code values. We present regression coefficients as percent differences in wages, or the exponentiated coefficient minus one, multiplied by 100.

3.1.2. Undergraduate majors

Following Altonji et al. (2016), we code majors into 51 categories developed by the U.S. Department of Education. The ACS does not provide information on fields of study for advanced degrees, and thus we cannot examine the implications of field of study at any level other than the bachelor's degree. We leave this as an important question for future data collection and research.

3.1.3. Controls

Our regressions adjust for measures that could confound the association between gender and wages. These include: race/ethnicity, whether the respondent is a native-born citizen, a quartic function of age, metropolitan status, and state and year fixed effects (when years are pooled). To further isolate the contribution of higher education credentials, we also include indicators for industry, respondent overwork (50+ hours/week), public sector employment, and family status. We measure family status with indicators that represent the interaction of marital status (married, divorced/separated, widowed, never married/single) and three parenthood measures (whether the respondent has their own children in the household, whether the respondent has their own children age 5 or under in the household, and the number of children in the household). Although not exhaustive, these controls provide a standard set of potentially confounding factors accounted for in studies using observational data (see, e.g., Glauber 2018).

3.2. Analytic strategy

Following previous research in this area (Blau and Kahn 2017; England et al., 2020; Mandel and Rotman 2021), we use quantile regression to estimate the gender wage gap across the earnings distribution. Specifically, we use a modern modification to the recentered influence function (RIF) regression model to predict quantile wage values, developed by Firpo and colleagues (2009, 2018), formally written as:

$$RIF(y; r, F_y) = r(F_y) + IF(y; r, F_y) \quad (1)$$

Y is the outcome under consideration, r refers generally to some statistical functional, r (Fy), which in our case is a particular wage quantile, and Fy refers to the cumulative distribution function of *Y*. Pragmatically, unconditional quantile regression via the RIF begins by transforming an outcome variable into two numeric values based on four pieces of information: the quantile of interest; the value of *Y* at that quantile; the density of *Y* at that quantile; and whether an individual's value of *Y* is above or below the quantile of interest (for detailed discussion, see Borgen et al., 2020; Rios-Avila and Maroto 2022).

For a particular quantile, the conditional expectation of RIF(Y; rS,Fy) can be modeled as a function of a set of variables, E [RIF(Y; v, Fy)|X]. The conditional expectation is written as:

$$E\left[RIF(Y; r, F_y) \middle| X\right] = X\beta \quad (2)$$

where β represents the marginal effect of X on the quantile of interest. These coefficients indicate the relative effect on the distribution of wages associated with observed characteristics among workers who are, for example, high-, middle-, or low-paid.

Care is needed when estimating RIF-based regression models to predict unconditional quantile levels. Borgen et al., 2020 have shown that these models risk producing biased results and assess population-level effects following treatment, but not individual-level treatment effects, while the latter is often of theoretical interest to the researcher. We follow suggestions from Borgen et al., 2020 and

Rios-Avila and Maroto (2022) to address these shortcomings by modifying the RIF regression model to estimate "quantile treatment effects" (QTEs) using inverse probability weighting. This approach involves computing inverse probability weights (in our case, gender is the treatment) to balance groups on observed characteristics. Next, a weighted RIF regression model estimates the average quantile treatment effect for gender. As noted by Borgen et al., 2020, QTEs have the benefit of recovering individual-level treatment effects, which guards against bias at extreme values. RiosAvila and Maroto (2022) note that QTEs will produce gender treatment effects, and can be used to answer the question: how large is the difference in wage distributions between treated and untreated (women and men), everything else assumed constant? (26). We replicated results using unconditional quantile regression models and found our results to produce more conservative associations (UQR results available upon request).

To situate our models in the context of trends in the gender wage gap, we begin by comparing the wage gap across the distribution of earnings for high school graduates and college graduates from 1960 to the present era. These analyses essentially replicate patterns that have been discussed broadly in prior research (e.g., Blau and Kahn 2017; Mandel and Rotman 2021), but we hone in details that are particularly relevant to our research. We then move to our main analyses, which assess the extent to which gender differences in educational credentials explain observed differences in the gender wage gap across the wage distribution. The first part of this analysis examines the contribution of bachelor's-level fields of study. We use a Oaxaca-Blinder (OB) decomposition (Jann 2008) to formally decompose the effect of field of study on the gender wage gap. The OB decomposition was developed to assess the sources of mean differences between two groups, and scholars have often applied it to detecting the relative contribution of mechanisms to group differences in wages. The OB decomposition uses separate linear regression models across groups to parse mean wage gaps into two components: (1) *composition effects*, or differences in the outcome attributable to the uneven distribution of observed characteristics across groups, and (2) *wage effects*, or differences in the coefficients across groups associated with observed characteristics, as well as differences in the intercepts. In our case, the composition effect is the proportion of the gender wage gap attributable to gender differences in field of study, and the wage effect is the remining unexplained proportion due to differential earnings returns for men and women.

Formally, the OB decomposition is written as:

$$\bar{Y}_a - \bar{Y}_b = \bar{\Sigma}(\bar{X}_a - X_b)\bar{\beta}_a + [\Sigma X_b(\beta_a - \beta_b) + (\alpha_a - \alpha_b)] \quad (3)$$

The first portion of this decomposition refers to the composition effect, and the bracketed second portion refers to the wage effect.

Firpo et al. (2018) demonstrate that the OB decomposition of mean wage differences across groups is simply a particular instance of a more general decomposition of any distributional statistic (see also Rios-Avila and Maroto 2022). Thus, RIF regressions estimated separately across two groups, such as men and women at some particular quantile, vm and vf, can be decomposed similarly to mean wages. The logic is extended to view $\bar{Y}_a — \bar{Y}_b$, shown above, as a general difference in wages across two groups measured in terms of some distributional statistic, of which the mean is a particular case. Similar to the RIF regressions discussed above, we adjust the RIF estimation with inverse probability weights to improve the accuracy of results (Firpo et al., 2018). We thus apply OB decompositions across the entire wage distribution of college workers.

Specifically, we estimate OB decompositions at each individual percentile between the 2nd and 97th to determine to what extent—and, critically, *where* in the distribution—field of study might reduce gender wage gaps among college-educated workers.

We take a similar approach to assessing the contribution of gender differences in advanced degrees to the high-wage gender pay gap. We begin by estimating the gender pay gap across the distribution for each advanced degree separately, to determine whether gender pay inequality operates differently across degree types. Next, we examine whether specific professional occupations may have had a particularly equalizing effect. Finally, we again use OB decomposition to investigate what role gender differences in advanced degrees play in the gender wage gap across the wage distribution (with a particular focus on high earners).

4. Results

4.1. Gender wage inequality across the earnings distribution

To situate our analyses in the context of trends in the gender wage gap, we begin by briefly assessing education-specific wage gaps across the distribution of earnings from 1960 to the present era. We present differential changes in the gender wage gap across the earnings distribution, shown as percent differences from unconditional quantile regression models. The left panel of Fig. 1 shows results for those with a high school diploma or less, and the right panel shows results for those with a bachelor's degree or more; all models adjust for the full set of demographic and work-related controls described in the methods section. As we see in the right panel, gender differences at very high-wage percentiles of college graduates have clearly separated from other groups over time. Although the magnitudes of the gender pay gap differ somewhat at the 90th percentile and below, they rarely deviate from mean differences by more than 5 percentage points. In stark contrast, the adjusted gender treatment effect at the 95th percentile has grown by about 75% over

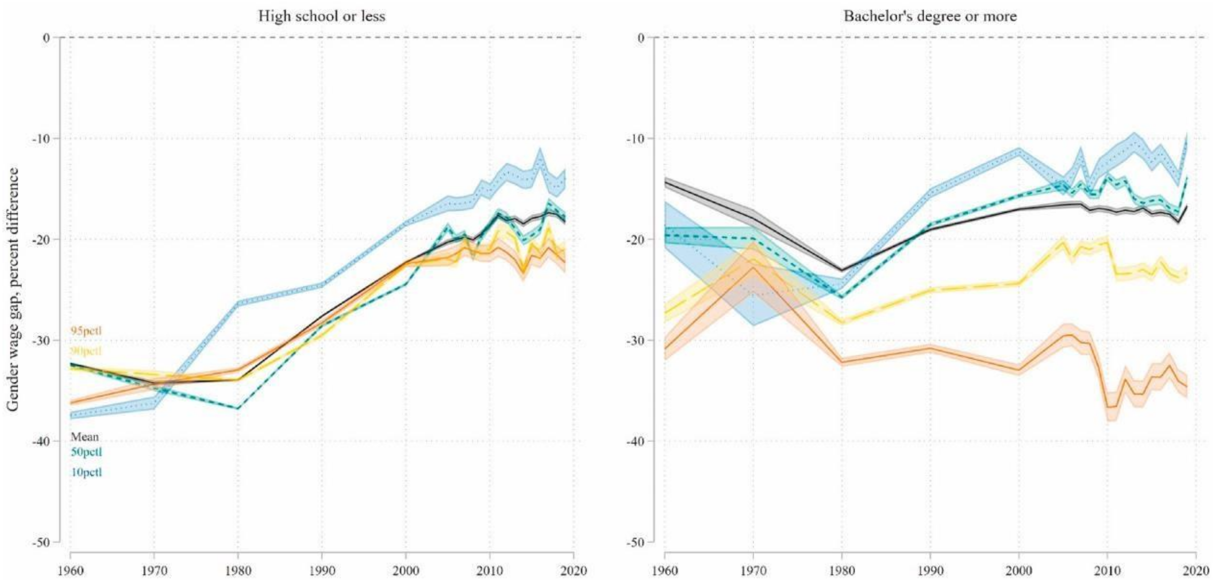

Fig. 1. Gender Wage Inequality Over Time, by Quintile

Notes: Data come from 1960 to 2000 census longform, and 2009–2019 American Community Survey. Samples: workers age 25–64 with 400 or more annual hours worked, not self-employed, not living in group quarters. "Bachelor's or more" refers to individuals with at least a bachelor's degree in 1990 and onward, and four years of college or more in years 1960–1980. Lines represent exponentiated gender coefficients from RIF quantile treatment effect models (see Rios-Avila and Maroto 2022 for details). Shaded areas represent 95% confidence intervals. Models adjust for a quartic age function, marital-by-parenthood status, whether a household has a young child, the number of children in the household, race/ethnicity, whether a respondent is a natural born citizen, education categories within broad groups, 19 industry categories, whether the respondent is a government worker, whether the respondent lives in a metro area, state contrasts, and whether respondent works long hours. RIF values are computed separately by men and women and inverse probability weights computed from economic, demographic, and human capital controls are both used to stabilize results (see Firpo et al., 2018 for technical details).

time, from about 20% in 1970 to about 35% in recent years ($p < 0.001$, two-tailed test). The distinction between gender treatment effects at high-wage percentiles and all others among collegeeducated workers is particularly evident from 1990 onward.

The left panel shows that the gender wage gap among less-educated workers follows a very different pattern. Here, gender effects at high percentiles followed overall trends, shrinking considerably over time, from about 35% in 1960 to about 20% in 2019. Broadly shared declines in magnitudes of gender treatment effects among less-educated workers thus contributed to the reversal in the location of gender wage gaps over time.

The results in Fig. 1 align with recent findings that gender wage inequality is largely a function of highly-educated workers at high wage percentiles (Mandel and Rotman 2021) and motivate our focus on mechanisms occurring within higher education to explain the contemporary locus of gender inequality. These mechanisms—fields of study and advanced degrees—are discussed in the sections that follow.

4.2. Field of study and gender inequality in the modern era

We begin by assessing perhaps the most commonly-studied mechanism that stratifies wages of college-educated men and women: uneven selection into fields of study. The typical returns to some fields of study, such as chemical engineering, are substantially higher than those in other fields, such as education. To demonstrate how these differences extrapolate to returns across the earnings distribution, Fig. 2 presents quantile-specific returns to field of study in the ACS sample of bachelor's degree holders (2009–2019, beginning with the first year that fields of study were collected in the ACS). Here we see that the fields with the highest returns at the 95th percentile are also generally male-dominated, i.e., economics, STEM fields, and finance (with biological sciences being a notable exception as a female-dominated field).

Before decomposing the contribution of field of study to high-wage earnings gaps, it is helpful to understand how a major's average pay is associated with gender wage inequality. Fig. 3 shows results from quantile regression models with an added interaction term for gender × the mean earnings for each major. We show three sets of results across these panels. The left panel shows men's and women's predicted log wages at the 10th, 50th, and 95th percentiles of earnings, across the range of typical major pay. The middle panel shows

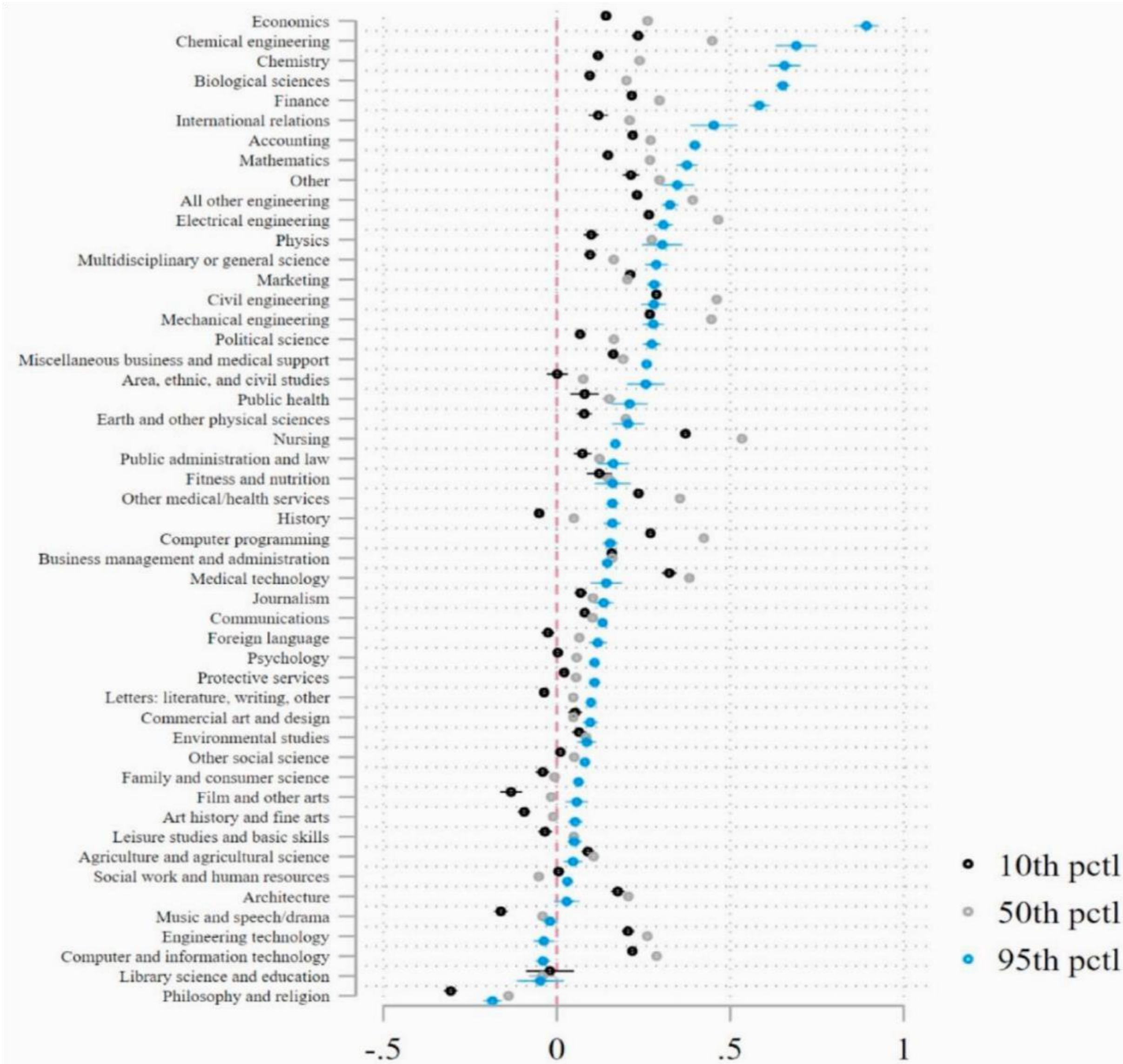

Fig. 2. Quantile Specific Returns to Field of Study

Notes: Coefficients are in reference to Education major. All controls used in main results are included to produce above coefficients. Fields of study are sorted by magnitude of 95th percentile coefficient. Sample: 2009–2019 ACS.

the gender pay gap for majors with high versus low average earnings (i.e., the between gender, within-major gaps) across the wage distribution. For example, the "95^{th} pctl: Low mean pay" contrast assesses the size of the gender wage gap among top-paid workers who majored in fields that are generally low-paying, such as philosophy/religion and library science. Meanwhile, the "95^{th} pctl: High mean pay" contrast assesses the size of the gender wage gap among top-paid workers who majored in fields that are generally high-paying, such as economics and finance (a key location of inequality, as we discuss further below). The right panel shows the earnings gap across majors separately for men and women (i.e., the within-gender, between-major gaps) across the wage distribution. For example, the "95^{th} pctl: Male" contrast assesses the earnings gap across fields of study among all top-paid men.

As one would expect, wages are higher for both men and women in fields that typically translate to higher incomes—so, for example, both men and women tend to earn more when they major in chemical engineering as opposed to philosophy/religion. Yet, we also observe greater gender inequality among high-wage returns than among middle- or low-wage returns, as shown in the left panel. Moreover, when we look at the results in the middle and right panel together, we can see that gender gaps in high-wage earnings are due mostly to much higher returns to high-paying majors for men than for women (for example, the top-paid men in chemical engineering make much more than the top-paid women in chemical engineering). The results in this figure generally support the notion that women are losing out on particularly high wages despite majoring in high-paying fields of study and, thus, field of study may be

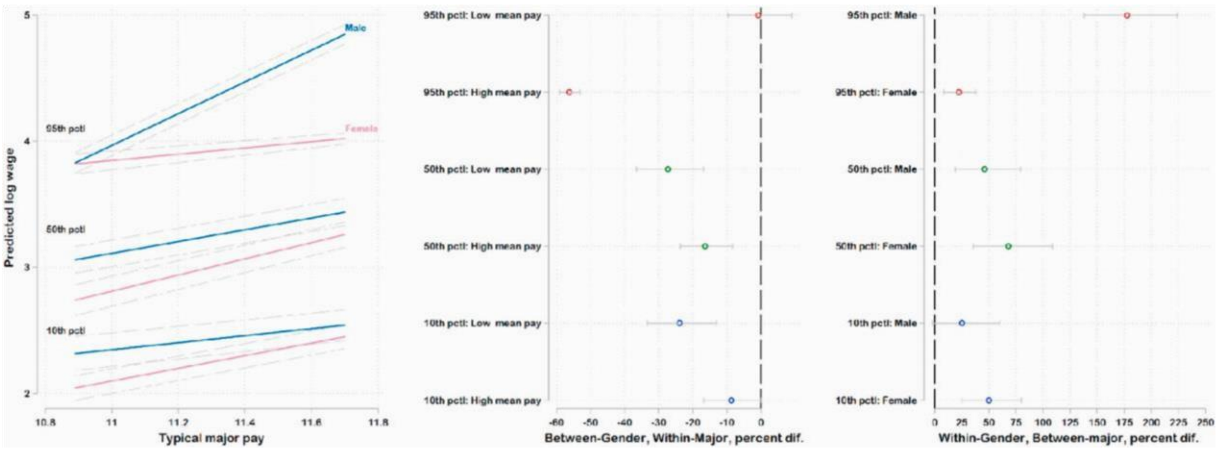

Fig. 3. Contrasting the Gender Pay Gap According to Field of Study's Typical Pay

Notes: left panel: Predicted log wage levels estimated from three separate RIF regression models (predicting 10th, 50th, and 95th percentiles). All regression models include controls discussed in the Data Section. Predicted values computed from an interaction between mean field of study pay and gender. Dashed lines indicate 95% confidence intervals. Middle panel: Gender coefficient among lowest (low mean pay) and highest (high mean pay) paying fields of study. Each coefficient set estimated from one of three separate RIF regression models (10th, 50th, and 95th percentiles). Bars around dots indicate 95% confidence intervals. Right panel: Change in predicted wage within gender, and across lowest and highest paying field of study. Each coefficient set estimated from one of three separate RIF regression models (10th, 50th, and 95th percentiles). Bars around dots indicate 95% confidence intervals. Sample: 2009–2019 ACS.

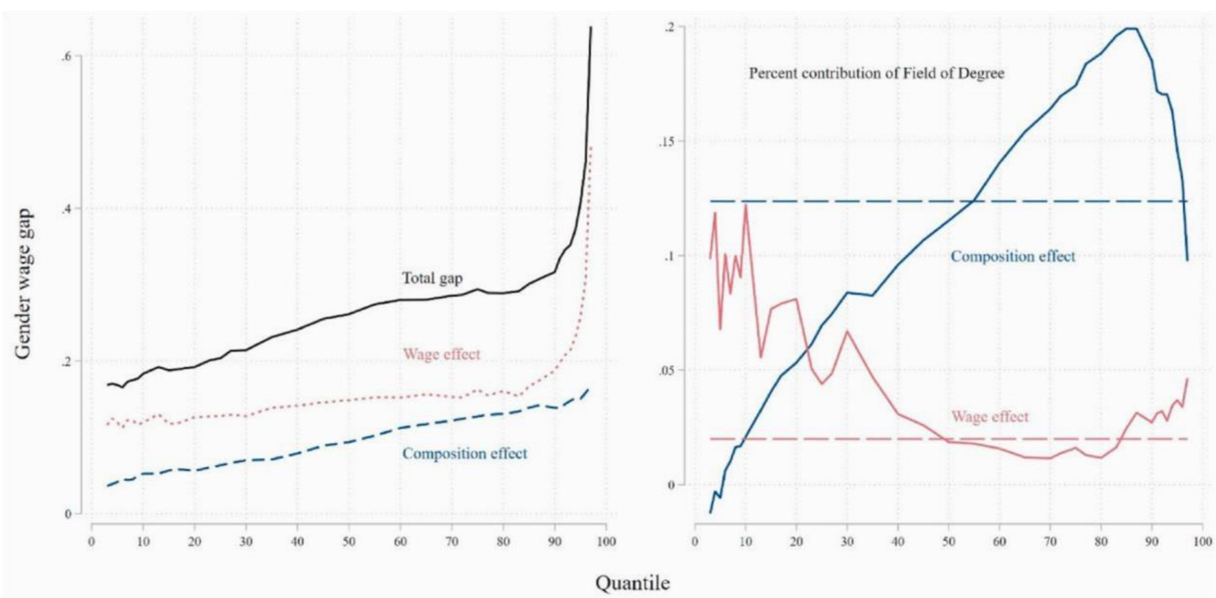

Fig. 4. Oaxaca-Blinder Decomposition of Gender Wage Gap, by Wage Quantile, Bachelor's-Level Fields of Study

Notes: Data come from 2009 to 2019 American Community Survey. Sample is restricted to individuals with only a bachelor's degree but not higher. Samples otherwise the same as those in Fig. 3. Results are computed from Oaxaca-Blinder decompositions of specific wage quantiles (Firpo et al., 2018). Left panel shows proportion of the gender wage gap (black line) between 2nd and 97th percentiles attributable to composition effects (blue line) and wage effects (red line). Results computed by estimating unconditional quantile regression models at each quantile using controls listed under Fig. 3, and 51-category field of study variable. Right panel shows proportion contribution of field of study composition and wage effects to total gender wage gap. Percent values are computed by dividing quantile-specific field of study composition or wage effect by quantilespecific gender gap. Horizontal dashed lines are values computed from Oaxaca-Blinder decompositions on mean wages. RIF values are computed separately by men and women, then inverse probability weights computed from demographic, human capital, and economic characteristics are used to compute a counterfactual distribution of women to men's observed characteristics. This reweighted sample is used to compute "pure" compositional and wage effects, visualized above (see Firpo et al., 2018 for technical details). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

unable to explain the gender wage gap at high wage percentiles.

To address this question more directly, we estimate Oaxaca-Blinder decompositions at each wage quantile between the 2nd and 97th, presented in Fig. 4. As we discussed earlier, the ACS does not provide information on fields of study for advanced degrees. Because students often receive bachelor's and advanced degrees in different fields (e.g., a bachelor's degree in biology and an MD), we restrict our focus for the time being on workers whose highest degree is a bachelor's degree. As with all of our quantile regressions, the results assess the contribution of field of study net of our full set of demographic and occupational characteristics.

The left panel shows the amount of the total gender wage gap at each quantile that is due to: *compositional effects*, or uneven gender distribution of all observed characteristics in our model, and *wage effects*, or the unequal returns to field of study and other model covariates. While the wage effects are larger than the compositional effects at each level of the earnings distribution, they become the overwhelmingly dominant portion of the total wage gap beyond the 90^{th} percentile. Unexplained inequality in the differential returns to observed characteristics therefore contributes more to the gender wage gap across the distribution, but especially among high earners. It may be that some of this effect is due to unobserved college and pre-college measures, such as institutional prestige or personality traits, or unobserved measures otherwise affecting labor market outcomes, such as family responsibilities (e.g., division of household labor and childcare), and partner characteristics (e.g., partner's overwork; Bianchi et al., 2012; Cha and Weeden 2014; Doan and Quadlin 2019; Quadlin et al. 2021). However, even if we assume that some of the overall wage effect is attributed to potentially observable factors such as institutional selectivity, a sizable proportion of the unexplained gap among the highest earners would likely remain. Simply put, field of study and other observable characteristics fare poorly at explaining these critical gender wage gaps among the highest earners.

The right panel shows the percent of the total effect that can be explained by the composition and wage effects of field of study specifically. (Thus, while the wage effect and composition effect add to the total gap in the left panel, they do not add to 100 percent in the right panel because the right panel excludes composition and wage effects from other variables in the model.) The horizontal dashed lines show the results for mean wages, as a point of comparison for trends across the distribution. Clearly, the composition and wage effects at mean wages are not representative of the full distribution. For example, the horizontal dashed line for field of study's wage effect sits just above zero, and thus a decomposition of mean wages would suggest that unequal returns to field of study do not contribute to gender wage gaps. However, when we compute decompositions within quantiles, we can see that the mean zero wage effects are primarily representative of median results. Below the 20th percentile, wage effects are more consequential than composition effects. At the 90th percentile and above, wage effects contribute about 5% of the total gender gap. Likewise, the compositional effects increase from functionally 0 at low wages, to a peak of explaining 20% of the wage gap at the 80th percentile, before declining substantially to about 10% at the highest wages. Notably, the stark decline in composition effects at top wages, plus the growth in wage effects in this area, show that field of study composition fares poorly as an explanation of gender wage inequality among those highest wage earners, who are the most consequential for total inequality trends.

To put the magnitude of field of study in additional perspective (especially in comparison to other consequential factors), Fig. 5 presents the composition and wage effects comparing field of study ("major") to the other covariates in explaining gender wage gaps across the wage distribution. The left panel shows that, along with industry differences, field of study provides the most sizable contribution to compositional effects across the wage distribution. However, among the highestpaid workers, overwork status grows to a similar magnitude of field of study and industry. Looking at the right panel, field of study has a more modest wage effect among top earners compared to race/ethnicity, industry, family status, and metropolitan status. Taken together, the findings in this figure (and throughout this section more broadly) demonstrate that while field of study is a sensible focus for understanding gender differences in pay generally among college-educated workers, their explanatory power is weakest among the highest-paid workers who are driving total inequality trends.

4.3. Advanced degree attainment and gender inequality in the modern era

We now turn to our assessment of a second mechanism through which higher education may contribute to high-wage gender inequality: advanced degree attainment. Fig. 6 presents the earnings advantage for advanced degree-holders relative to bachelor's degree-holders, taken from quantile regressions. These patterns are consistent with previous research showing that advanced degree holders generally have higher wages than those with a bachelor's degree alone (Mullen et al. 2003; Oh and Kim, 2020; Torche 2018), but our results highlight the unique advantages among professional and (to a lesser extent) doctoral degree-holders with very high wages. Among the highest earners, professional degree-holders have exceptionally high earnings relative to those with a bachelor's degree, reaching 3 times their earnings (or even more) in some years). In contrast, the earnings advantage for master's degree-holders is relatively constant and modest, at about 10–20% across the earnings distribution.

Fig. 7 shifts our focus by presenting trends in the gender wage gap by quantiles and within degree types. Among the many patterns notable in Fig. 7, we highlight two that extend the results we have already discussed. First, in most years and for most degree categories, we observe a similar pattern and ordering of gender treatment effects. Across degree types, wage gaps tend to be smaller at lower wage percentiles, and largest among highest wage percentiles. These trends are most notable among those with just a bachelor's degree and those with a master's degree—the two categories that, together, comprise approximately 90% of those with a bachelor's

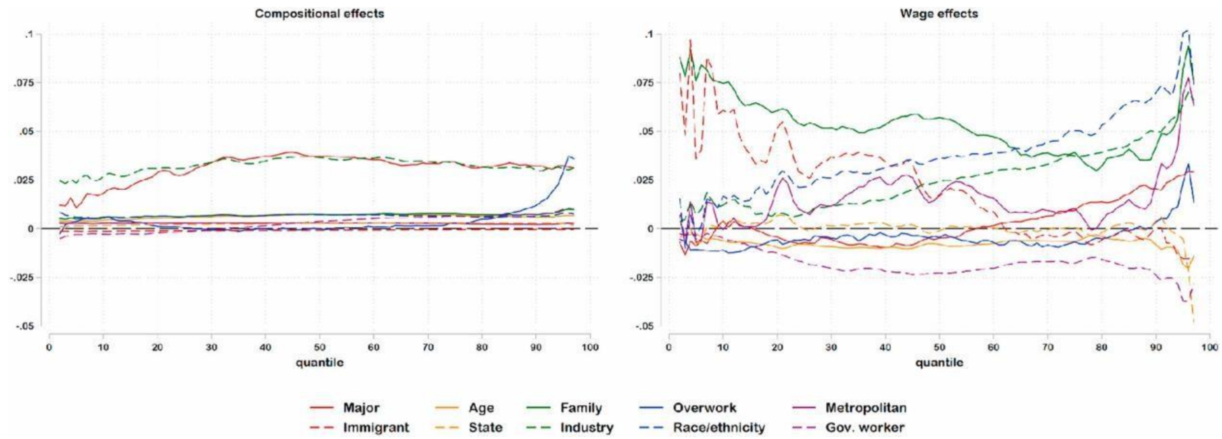

Fig. 5. Oaxaca-Blinder Decomposition of Gender Wage Gap, by Wage Quantile, All Covariates Notes: Field of study is labeled as "major" in the legend.

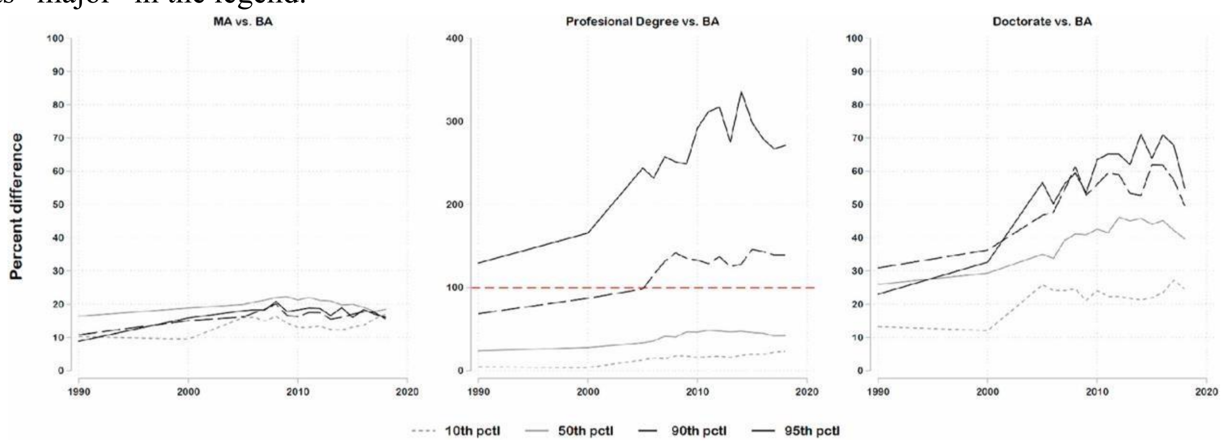

Fig. 6. Wage Differences by Advanced Degrees

Notes: Results are from unconditional quantile regression models estimated on those with a bachelor's degree or more. Lines indicate the wage premium associated with advanced degree categories. Samples pool both men and women. Note that the *y*-axis is the same for the left and right panels, but the *y*-axis has been altered for the middle panel because wage differences are so very large. The dashed red line in the middle panel is used to indicate where the *y*-axis would be. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

degree or more. Second, the relative magnitude of high-pay wage gaps is similar across most education groups and most years. Gender treatment effects tend to be around 25–30% at high wage percentiles. A key exception occurs among professional degree-holders from about 2009 onward. The gender treatment effect at the 95th percentile has converged to the magnitude of the median gender wage gap, shrinking from about 50% in 1990 to about 20% in 2019. At the same time, the 90th percentile wage gap has shrunk from about 40% in 2010 to about 30% in 2019. These patterns suggest that, although much potential for progress remains, gender pay- equalizing mechanisms may have occurred among high-wage earners with professional degrees over this period.

We conducted several sets of supplementary analyses to further examine these unique pay gaps among professional degree-holders. First, we examined specific occupations that we suspected might be driving shrinking gender wage gaps among high-wage professional degree-holders. As background, this group includes a heterogeneous mix of degree types and occupations; lawyers, physicians, primary school teachers, pharmacists, managers, registered nurses, dentists, and veterinarians comprise about 70% of occupations in this group, with lawyers and physicians being the most common. Fig. 8 shows results estimating the gender pay gap across the wage distribution and within these most common professional occupations. Based on these data, it appears that convergence in the gender pay gap of the highest-wage professionals over time has been driven primarily by lawyers and, to a lesser extent, physicians. Among lawyers, the high-wage gender gap shrunk from about 50% to nearly 0% between 1990 and 2019. Among other occupations, high-

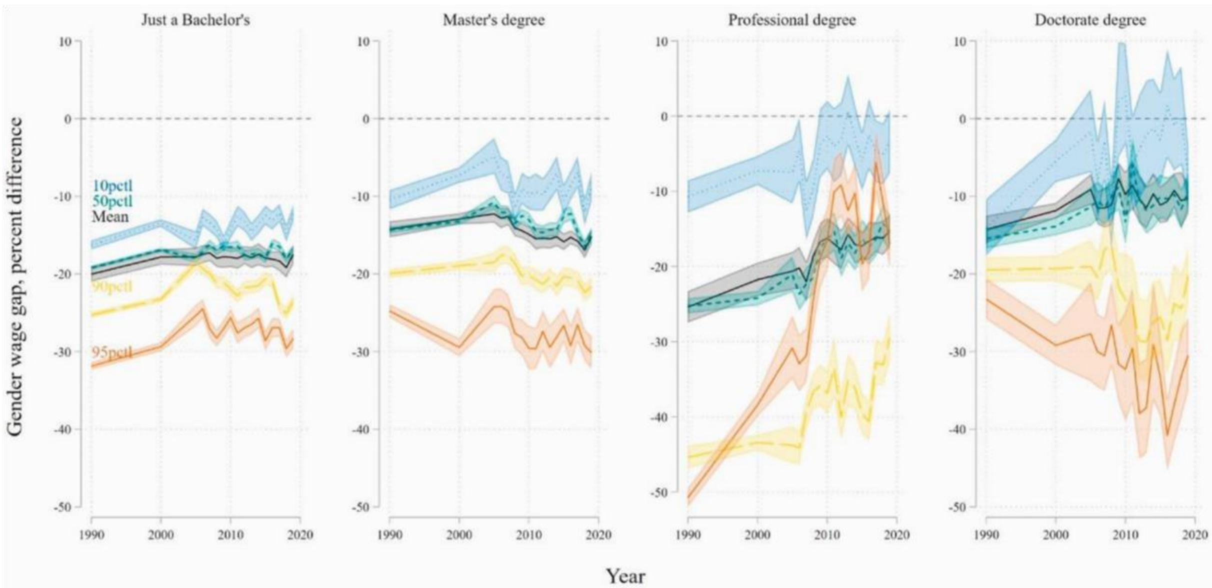

Fig. 7. Gender Wage Gap, by Quantile and Degree Type

Notes: Replication of Fig. 2, separately by degree category (for respondents with a bachelor's degree or more). See Fig. 1 notes for additional details. Advanced degree categories available in 1990 and onward. wage gender gaps shrunk more modestly or remained at similar levels over time.

Second, following their importance to the gender pay gap as suggested in Fig. 5, we examined gender gaps in hours worked across advanced degree types. These analyses (not shown) indicate that highly-paid workers with professional degrees have larger gender gaps in annual hours worked compared to those with lower wages. Thus, men and women at the top of the wage distribution may be paid similar wages, but men are able to maintain their earnings advantage by working more hours. This mechanism is well-established as key to maintaining gender inequality among professional workers (Cha and Weeden 2014). Third, workers with professional degrees have high probabilities of self-employment, as well as high returns to self-employment, compared to workers with other levels of educational attainment. In supplementary analyses (also not shown), we find that men with professional degrees were increasingly likely to be self-employed over time, and that the predicted top annual incomes in this group were uniquely high. Thus, top-end wage-setting among this highly-paid group is partially underestimated when self-employed workers are excluded from the sample, as they are in our main analyses.

We are thus left with unclear takeaways as to what might be driving gender equalization among highly-paid workers with professional degrees. At first glance, the findings in Fig. 8 suggest some real progress in gender wage equality occurring through some occupation and degree specializations. However, further examination of wage-setting mechanisms among this group demonstrates that any apparent equalization among lawyers and physicians is concentrated among narrow occupational niches, and may also mask mechanisms that high-earning men with professional degrees use to maintain earnings advantages.

The final set of analyses assesses the contribution of advanced degrees to gender wage gaps using Oaxaca-Blinder decompositions. Results from this analysis, as shown in Fig. 9, indicate the extent to which gender differences in advanced degree attainment, and inequality in the returns to advanced degree attainment, contribute to gender gaps across the distribution. As we see in the top row, compositional differences have small influences across the full distribution of wages. Women's greater attainment of master's degrees has a small but negative influence, especially among lower- and middle-wage workers, while we suspect that the small positive influence of compositional differences at the professional and doctoral level are legacies of women's historical underrepresentation at these upper echelons of higher education. Importantly, compositional differences are *not* most prominent at upper wage levels, which we would expect to see if women's selection into advanced degree categories were driving top-end gender inequality.

At the same time, we observe inverse effects across percentiles for wage effects. At the 10th and 50th percentiles, we observe mostly negative values, indicating that women receive relatively higher returns to advanced degrees than men among those with middle and low wages. In contrast, we observe increasingly large returns for men relative to women at the 95th percentile. By 2019, unequal returns to advanced degrees explain about 5% of the wage gap for master's and doctoral degrees, and about 15% for professional degrees. Thus, we find that selection into "more" education does not help explain the large wage gaps between high-earning, highly-

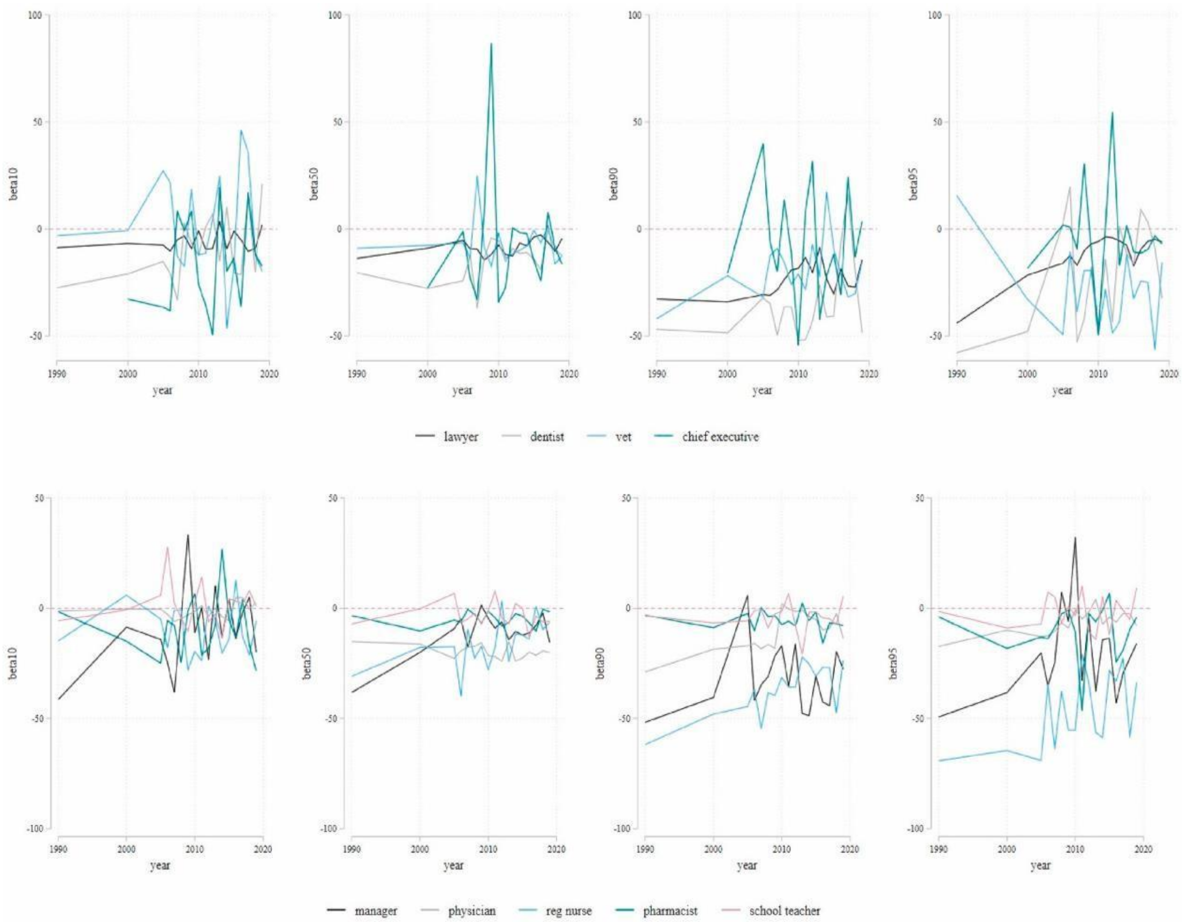

Fig. 8. Occupation-Specific Gender Wage Gaps, Professional Degree-Holders

Notes: Lines represent gender wage gaps among the most common occupations for those holding a Professional Degree. Sample: 1990 and 2000 longform Census, 2009–2019 American Community Survey. Respondents with a Professional Degree. Regression coefficients estimated separately by occupation. educated men and women. Compositional differences have little explanatory power here, leaving large unexplained gender gaps at the top of the wage distribution. We therefore surmise that mechanisms rooted in higher education, including selection into majors and advanced degrees, are poorly equipped to explain the most persistent gender wage gaps.

5. Discussion

Over the past six decades, we have witnessed a relocation of gender wage inequality: whereas the largest wage gaps were once concentrated among lower-paid, lower-educated workers, today these wage gaps sit among the highest-paid, highly-educated workers. Motivated by this reordering of gender wage inequality and the centrality of college-educated workers to total inequality trends, in this article, we assessed to what extent these wage gaps are attributable to higher education mechanisms—specifically, undergraduate fields of study and the attainment of advanced degrees. Prior research has shown that higher education mechanisms may help to close gender wage gaps at the mean, and some of this research has implied that women's attainment of "different" or "more" education may even be most effective at the top of the wage distribution. We considered whether this is the case, using Census and ACS data as well as statistical techniques that allow us to decompose the influence of selection into fields of study and advanced degrees across the entire wage distribution.

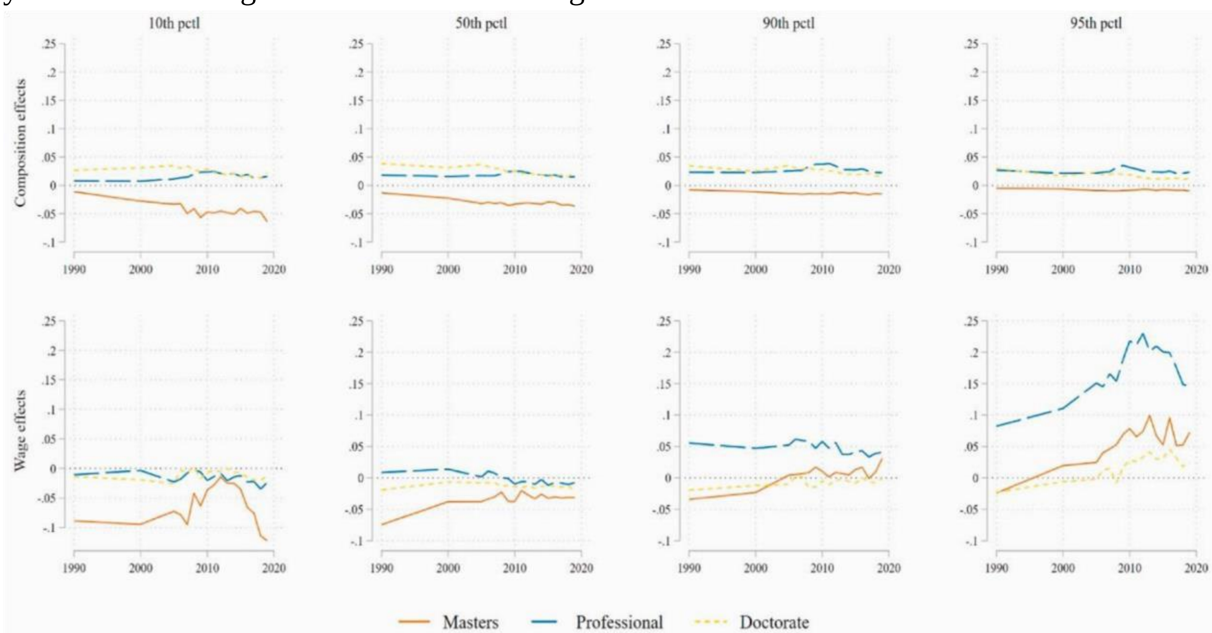

Fig. 9. Oaxaca-Blinder Decompositions, Advanced Degree Contribution to Total Gender Gap

Notes: Results show composition and wage effects of advanced degree categories, relative to just a Bachelor's degree. Y-axes indicate proportion contribution of advanced degree category to overall gender gap at a particular percentile. See Fig. 4 notes for additional details. RIF values are computed separately by men and women and inverse probability weights computed from economic, demographic, and human capital controls are both used to stabilize results (see Firpo et al., 2018 for technical details).

While we find these explanations to fare relatively well among most college-educated workers, their explanatory power breaks down when we focus on the top of the wage distribution—the location with the largest and most persistent gender wage gaps that are driving total inequality trends. For example, compositional differences in fields of study explain a substantial amount of the gender wage gap among middle- and lower-paid workers, but they are less effective at explaining wage differences among highly-paid workers, and are partially counteracted by unequal returns to fields of study among the highest-paid men. Further, we find large and growing wage effects at the highest percentiles among advanced degree holders, challenging the notion that women's selection into the upper echelons of higher education could significantly equalize top-end pay.

Our findings thus raise the question: If fields of study and advanced degrees do not account for gender wage inequality at the top of the college wage distribution, then what does? This "unexplained" portion of the wage gap represents both unobserved factors and sources of economic discrimination. We have already listed some of the factors that are likely to play a role in this unexplained portion, namely, institutional prestige, personality traits, gendered patterns of household labor and childcare, and partner characteristics such as partner's overwork (which we expect would be particularly consequential for high-earning women partnered with high-earning men, given prior research on the gendered prioritization of careers in elite couples; Ely et al. 2014). This information is not reported in Census data, but future research can incorporate other datasets to investigate their salience at the top of the wage distribution. In addition to these, we also emphasize occupation and firm sorting as mechanisms that recent research has highlighted among highly-paid workers, and especially highly-paid men (e.g., Wilmers and Aeppli 2021). As we described in footnotes at the end of the results section, our supplementary analyses of occupational sorting (using data from the 1990 Census classification scheme, i.e., 3-digit occupation codes) revealed largely the same pattern we find for fields of study and advanced degrees, with this mechanism breaking down at the top of the wage distribution. However, recent research points to much variation in job titles within occupations, suggesting that occupational codes may overlook important sources of inequality at the level of jobs (Martin-Caughey 2021). Relatedly, the timeconsistent measures in the IPUMS may not sufficiently measure the entrepreneurship used to create advantage through occupational differentiation (see Neely 2018 for examples in finance). We suspect that there may be unique interactions between occupational attainment, the development of new occupational categories, and educational attainment over time, and these topics are worthy of future research.

After considering these alternative mechanisms, we are then left with the explanation of discriminatory wage-setting practices, which we take seriously as an explanation for at least part of the top-end gender wage gap. By "discriminatory wage-setting practices," we mean a number of practices including but not limited to unequal pay within occupations, access to narrower job titles, and hiring and promotion discrimination. Our results clearly underline the substantial wage disadvantages faced by highly-educated, highly-paid women compared to their men counterparts, and the inadequacy of standard educational mechanisms to explain such disadvantages. Even if many additional unobserved organizational, social-psychological, institutional, and genetic factors are unevenly distributed between men and women, such mechanisms would have to be herculean in size to rule out gender discrimination at the top of the wage distribution. We are transparent that our results leave space to more fully assess how unexamined mechanisms contribute to gender wage inequality at the top of the college labor market. But we are also skeptical that selection on any of these factors can adequately account for the findings we have presented. We instead take seriously the idea that gender discrimination is robust among highly-paid, highly-educated workers, and that such discrimination is an engine of contemporary inequality trends.

Although the wage gap at the top of the distribution remains largely unexplained, the size of the wage gap and amount explained by our models may in fact represent an optimistic scenario. We adjust for an indicator of working long hours, defined as 50 h a week or more. Long hours tend to associate with higher pay, operate as a key mechanism of gender inequality (Cha and Weeden 2014), and may help proxy the consequential fine-grained form of gender occupational segregation found by Martin-Caughey (2021). Long working hours itself likely represents a core selection mechanism that produces gender inequality, making both the gender wage gap at the top and the unexplained portion larger with its exclusion from models.

Taking a broader view, our findings demonstrate that while college-educated workers are the drivers of contemporary inequality, college is a necessary but not sufficient point of entry to the highest-wage positions. Rather, a select group of college-educated men use mechanisms *other than higher education credentials* to distance themselves from all other wage-earners. Recent studies have highlighted just how consequential these men are for total inequality trends (Keister et al. 2022; Yavorsky et al., 2019), and we likewise suggest that understanding these men's pathways to the highest-wage positions is key to understanding and eventually reducing inequality.

Theoretically, our results also importantly reiterate that the gender wage gap is not a onedimensional social problem with a singular individual-level or policy solution. Just as the keys to alleviating gender inequality differ between college and non-college workers, they also differ among college workers at different points in the wage distribution. While individual-level sorting, such as fields of study and advanced degrees, has much explanatory power lower in the college wage distribution, and thus this might be an effective policy solution to close gender gaps among middle wages, high-wage gender inequality follows an entirely different logic. We thus encourage scholars to not think of the gender wage gap as one social problem, but instead as many social problems that require different research and different policy solutions.

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