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Revealing the Concealed Effect of Top Earnings on the Gender Gap in the Economic Value of Higher Education in the United States, 1980–2017

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ABSTRACT The expansion of women's educational attainment may seem to be a promising path toward achieving economic equality between men and women, given the consistent rise in the economic value of higher education. Using yearly data from 1980 to 2017, we provide an updated and comprehensive examination of the gender gap in education premiums, showing that it is not as promising as it could and should be. Women receive lower rewards to their higher education across the entire wage distribution, and this gender gap increases at the very top education premiums—the top quarter and, even more so, the top decile. Moreover, insufficient theoretical and methodological attention to this top premium effect has left gender inequality concealed in the extensive empirical studies on the topic. Specifically, when we artificially censor the top at the 80th wage percentile, the gender gaps in education premium reverse. Lastly, the growth in earnings inequality in the United States, which is greatly affected by the expansion of top earnings, is associated with the growing gender gap in education premiums over time. We discuss the meaning and implications of this structural disadvantage at a time when women's educational advantage keeps growing and higher education remains the most important factor for economic attainment.

KEYWORDS Education premium • Gender inequality • Returns to education • Glass ceiling • Devaluation

Introduction

One of the most prominent changes in the U.S. labor market over recent decades is the rising economic value of education, especially college education. This rise has been accompanied by an impressive rise in educational attainment, which has been particularly striking among women (DiPrete and Buchmann 2013). Given the consistent rise in the value of higher education, the continued expansion of women's education seems to be the most promising path toward achieving economic equality between men and women. Intrigued by the joint effect of the two processes, we provide an updated and comprehensive examination of the gender gap in the economic value of

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higher education. Our analysis covers long-term trends in this gap, from 1980, around the time when the two processes started to gain momentum, to 2017.

Our research is inspired by studies showing that gender disparities are greater at the top of the occupational and organizational hierarchies (e.g., Blau and Kahn 2017), findings that can be linked to the glass ceiling effect. It is also inspired by the prevailing findings that the economic value of higher education—also referred to as "returns to education" or "education premiums"—is *higher* for women than for men (e.g., DiPrete and Buchmann 2006; Dougherty 2005). This recurring finding contradicts the widely acknowledged argument that education and skills identified with femininity are valued less in terms of status and pay than those identified with masculinity (Acker 2006; Correll 2001; England 1992; Ridgeway 2011). Studies have shown that although women have entered into the upper ranks of the occupational or organizational structures (i.e., cracked the glass ceiling), these structures have become more gender unequal because the tendency to devalue women's work and skills is intensified at the higher ranks of organizational and occupational structures (Ridgeway 2011).

Based on the two theoretical notions of devaluation and the glass ceiling, we hypothesize that women's education premiums are lower than men's and that gender disparities in education premiums are strongly affected by the greater gaps at the top of the wage distribution. We also expect the gender gap in education premiums to widen over time with the expansion of overall wage inequality because of men's overrepresentation at the top of the earnings distribution.

Our theoretical claims are strongly tied to the choice of method used to measure returns to education, so our theoretical and empirical contribution carries important methodological implications. Specifically, we show how the conventional measure of education premiums (based on log wage) conceals the gender gap in education premiums because it substantially downplays the effect of premiums at the top, which are dominated by men. When we artificially censor the ceiling by setting a maximum wage (at the 80th wage percentile), the gender gaps reverse. Similarly, when we disaggregate the wage hierarchy, using quantile regression, we find the largest gender gaps in education premium at the highest wage levels. Our findings support the glass ceiling theory: much of the gap between men and women in education premiums is due to men's advantage at the top of the wage distribution. Consequently, downplaying the effect of wages at the top, where gender inequality is most pronounced, results in an underestimation, or even reversal, of the gender gaps in education premiums. This important observation, to the best of our knowledge, has never been reported before.

Furthermore, the underestimation of the gender gap in education premiums has become more evident over time with the growth in income inequality, which has been propelled by the rise in the very top wages (Saez 2017). Increasing income inequality has led to a substantial widening of the gender gap in education premiums over time. Thus, examining gender gaps in education premiums during a period of dramatic increase in earnings inequality also enables us to highlight the association between wage inequality (i.e., class inequality) and gender inequality.

Our findings demonstrate one of the major economic disadvantages women face: the lower economic rewards for their higher education relative to men. Given that higher education is the single most important factor in determining access to prestigious and rewarding positions in postindustrial labor markets, these findings imply that women's numerical advantage in higher education is far from sufficient to elimi-

nate gender inequality. As long as women's human capital remains underutilized and underrewarded, gender inequality will persist.

Theoretical Background

In the postindustrial labor markets of affluent economies, higher education has become a major determinant of access to prestigious and rewarding positions. Consequently, the pay gap between workers who acquired higher education and those who did not has increased substantially. In fact, the growth in earnings differences between more- and less-educated workers is the single most important factor that explains the overall increase of income inequality in the U.S. labor market since the 1970s (Goldin and Katz 2007). As a result, the economic value of higher education has attracted extensive scholarly attention (for a review, see Hout 2012).

The rising value of higher education has been accompanied by an impressive growth in educational attainment (DiPrete and Buchmann 2013). This expansion has been fueled, first and foremost, by the growth in the acquisition of higher education by women. By the mid-1980s, the share of women with a college degree exceeded that of men, a numerical advantage that grew during the 1990s and into the new millennium (Cotter et al. 2004; DiPrete and Buchmann 2013; Morris and Western 1999).

In combination, the two processes—women's advantage in higher education and the increasing returns to education—are expected to improve the economic attainment of women relative to men, thereby advancing gender equality. Indeed, gender occupational segregation and gender wage gaps have been in decline since the 1970s, yet the convergence in all dimensions of gender inequality has stagnated over the last two decades (Blau and Kahn 2017; England 2010) despite the continued expansion of women's educational attainment and the increasing value of education.

Two interconnected explanations for this stagnation are (1) the devaluation of women's work, which refers to women's underrated human capital; and (2) the glass ceiling effect, which refers to the higher economic disadvantages for women at the top (Albrecht et al. 2003; Cotter et al. 2001). Both, we argue, affect the gender gap in the education premium, and paradoxically, both may be intensified with the advancement of women in the labor market.

Devaluation, the Glass Ceiling, and Gender Gaps in the Education Premium Across the Wage Distribution

The term *devaluation* in a gendered context refers to the lower evaluation of traits and skills identified with femininity relative to traits and skills identified with masculinity. The tendency to devalue women (vs. men) and femininity (vs. masculinity) is based on deeply rooted societal beliefs about fundamental differences between men and women, which involve gender stereotypes and biased gender perceptions. Gender scholars tend to view the lower evaluation of women and femininity as a reflection of the unequal gender relations more broadly and in the labor market in particular (Acker 1990, 2006; Correll 2001; Ridgeway and Correll 2004).

England (1992) harnessed the term *devaluation* to explain both women's inferior

position in the labor market and the inferior position of occupations associated with femininity. She argued that employers' underestimation of women's traits, skills, and activities accounts not only for the lower wages of women relative to men but also for the lower status and economic rewards of women's jobs and occupations. Thus, traditionally women's work and other work done primarily by women is underremunerated because of its connection to traits and skills identified with femininity (England 1992). Empirical evidence for the lower wages in female-dominated occupations (England et al. 2002; Kilbourne et al. 1994; Levanon et al. 2009) is interpreted as a wage penalty resulting from the gender composition of these occupations (Acker 1991; Cohen and Huffman 2003; Ridgeway 2011; Tomaskovic-Devey 1993).

In the context of returns to education, the devaluation mechanism explains the lower evaluation of women's fields of study and consequently the lower rewards in female-dominated occupations. Given the gender segregation in fields of study and occupations, devaluation is a major mechanism that inhibits wage equality between men and women. Even when women approach new frontiers in the labor market, these areas (e.g., occupations, positions) are at risk of deterioration in terms of status and pay following the devaluation of women's work (Goldin 2014; Reskin and Roos 1990). Thus, as long as women's education and skills are devalued, the process of desegregation in fields of study and the upward occupational mobility of women that follows it will not lead to the elimination of gender earnings inequality (Busch 2017; Murphy and Oesch 2016). Based on these theories, our initial hypothesis is as follows:

Hypothesis 1 (H1): Women receive lower education premiums than men.

The tendency to devalue women's work and skills is intensified at the higher ranks of the organizational and occupational structures (Ridgeway 2011). This is because top positions are associated with requirements such as assertiveness, analytical abilities, and ambition that are stereotypically linked to men and masculinity. Thus, when a required position is at the top of the organizational hierarchy, prevailing gender beliefs—according to which men are more competent than women for such positions—are intensified (Gorman 2005; Gorman and Kmec 2009; Ridgeway 2011). In addition, high-status positions tend to be traditionally male-dominated, and thus to involve male culture and work conditions that exclude women (Acker 1990). These forces, which prevent women's advancement to higher ranks, construct the so-called glass ceiling.

When women do crack the glass ceiling and successfully enter high-paying positions, they experience greater wage discrimination. Because wage-setting systems in organizations are also affected by gendered assumptions and stereotypes about skill, responsibility, and competency, they produce different wage agreements for men and women (Acker 1991). In top positions, where wage-setting is less standardized and gender beliefs have greater impact, all forms of the glass ceiling—in access, work conditions, and rewards—are expected to intensify, resulting in greater gender inequality.

Indeed, studies that have examined gender disparities at different points of the wage distribution have shown that gender pay gaps vary considerably across the distribution and that the gaps are often larger in the upper segments (e.g., Albrecht et al. 2003; Arulampalam et al. 2007; Blau and Kahn 1997; de la Rica et al. 2008; Fortin and Lemieux 1998; Fortin et al. 2017). For example, the earnings ratio between male and female workers in the United States is much greater at the top. In 2012, the top 1% of women earned, on average, less than half of the average earnings of the top 1%

of men—a much larger gap than that between the average male and female worker (less than 25%; Blau and Kahn 2017). These findings motivate our interest in examining how gender inequality in returns to education varies across the wage distribution, leading to our second hypothesis:

Hypothesis 2 (H2): The gender gap in education premiums is wider at higher levels of the wage hierarchy.

Our aim to examine how men's dominance at the upper pole of the earnings distribution affects the gender gaps in education premiums is inevitably linked to changes in these gaps over time. In the next section, we discuss how the entry of women to previously male-dominated fields of study and occupations and the rise in earning inequality are expected to affect the gender gaps in returns to education.

Expected Trends in Gender Gaps in the Education Premium: The Glass Ceiling Paradox

Our interest in over-time trends is stimulated by women's entry into lucrative occupations. Studies have shown that the expansion of higher education among women was marked by a considerable expansion in fields traditionally dominated by men: medicine, business, law, and management (Cotter et al. 2004; DiPrete and Buchmann 2013; Weeden 2004). Because these fields of study lead to well-paying positions, women in the United States have largely increased their share in the upper rungs of the wage hierarchy. By 2007, women's relative proportion in the top wage quintile reached parity with men's and even exceeded men's in the 9th wage decile, although women remained underrepresented in the top decile (Mandel 2013).

Women's upward occupational mobility during the last decades may have opposite implications for their average wages because "women's wages fall behind men's more at the top of the wage distribution than at the middle or bottom" (Albrecht et al. 2003:146). Paradoxically, as more women overcome gender discrimination in hiring and promotion to crack the glass ceiling and enter high-paying positions, they may face greater earnings discrimination. Grodsky and Pager (2001) pointed to such a process in the case of racial inequality, showing that declining occupational segregation is associated with increasing racial wage inequality: as Black men enter high-paying positions, they experience more extreme racial disadvantages (Grodsky and Pager 2001:564). In addition to this process, occupations that undergo feminization are at risk of becoming less rewarding (Levanon et al. 2009), as noted earlier. These two mechanisms keep educated and "successful" women at a clear distance behind their male peers and may therefore mitigate the advantages accruing to women as a result of occupational mobility.

Furthermore, at a time of increasing wage inequality, which has been stimulated in particular by the expansion of top earnings (Saez 2017), the advantage of men at the very top is expected to translate into an *increasing* advantage in education premiums for men as compared with women. The theories reviewed here lead to our last hypothesis:

Hypothesis 3 (H3): Gender gaps in education premiums expand over time with the expansion of top earnings, which are dominated by men.

Gender Inequality and Education Premiums

The education premium—or more specifically, the college wage premium—refers to the additional average wage of college graduates relative to that of workers with no college degree. In the United States, estimates of this premium rose from around 50% in the early 1980s to around 90% in the early 2000s (Autor et al. 2008: figure 2). For economists, the education premium indicates the market value of college education under the assumption that skills and knowledge acquired in institutions of higher education make workers more productive. Thus, the increase in the college wage premium indicates that these skills have become more valuable in the labor market in recent decades.

Those who seek to understand the gender gap in education premium most commonly ask which of the two genders has greater incentives to invest in higher education. To answer this question, researchers have typically measured the education premium in percentage points (or in log wage differences) and have uniformly shown that until the new millennium, women received higher, not lower, education premiums than men (see, e.g., Brand and Xie 2010; Card and DiNardo 2002; Charles and Luoh 2003; Chiappori et al. 2009; DiPrete and Buchmann 2006; Dougherty 2005; Hubbard 2011; Long 2010; Perna 2003; Reisel 2013; Trostel et al. 2002). In other words, until the early 2000s, women had greater incentives to invest in college education given their lower potential earnings otherwise. For example, among young (ages 30–34) White full-time workers in the early 2000s, the additional wage gains associated with higher education among men were around 70%, compared with about 120% among women (DiPrete and Buchmann 2006: table 1).

We address a different theoretical question: what are the gaps between men and women in the economic gains from higher education? An answer to this question requires that education premium be measured in absolute terms (in this case, U.S. dollars) in order to yield a scale that is comparable between groups with different earnings distributions. This is because the measure of education premium in relative (percentage) terms makes it impossible to draw comparisons between men and women given that it is strongly affected by the different earnings of men and women without a college education. Given that non-college-educated women tend to earn much lower wages than non-college-educated men—that is, they have a lower starting point (the denominator)—their wage premium may seem very large relative to men's when translated to percentages (for a methodological discussion on this topic, see Hodson 1985; Petersen 2017). The distinction between relative and absolute measurements is commonly noted in other research areas, such as income inequality, poverty, and social mobility (e.g., Atkinson and Brandolini 2010; Callan and Nolan 1991; Chakravarty 1984), but it has not been applied to the study of returns to education.

Furthermore, we expect the gender gaps in education premiums not only to be in favor of men (H1) but also to be greater at the higher end of the wage distribution (H2). However, relative measures do not fully account for this mechanism because they are based on log-transformed earnings, which compress the top incomes that generate the highest education premiums (U.S. dollars in this case). Given that wage distributions are skewed to the right (i.e., toward the very top wages), researchers often employ a logarithmic transformation, which "squeezes" the right tail of the distribution by compressing the highest wage observations. When used to examine

gender inequality, this method could be problematic because gender inequality tends to be most pronounced at the highest levels, as discussed in the previous section. Given that the highest wage observations tend to be dominated by men, "squeezing" these observations systematically biases the results, causing an underestimation of the gender gap.

Lastly, the growth in earnings inequality in the U.S. labor market in recent years, which was stimulated by disproportional wage expansion at the very top (Saez 2017), leads us to expect that the gender gap in education premiums will continue to widen over time (H3). This continued widening of the gap, we argue, can be revealed only when the top premiums are not compressed—that is, when the gender gap in education premiums is measured in dollar earnings, and not in log earnings. The substantive implications of comparing coefficients between groups in log-transformed models are not fully recognized among social scientists (Petersen 2017). In fact, except for one study in sociology (Portes and Zhou 1996) and one in criminology (Hannon and Knapp 2003), we are not aware of any studies that discuss the substantive (rather than methodological) implications of the different measures.[1]

Data Source and Variables

We use data from 38 Annual Social and Economic Supplements of the Current Population Survey (CPS-ASEC) conducted between 1980 and 2017 by the Integrated Public Use Microdata Series-CPS (IPUMS-CPS) (Flood et al. 2017). Our sample includes all employees aged 25–64 with positive earnings. The annual sample sizes, after selection, range from 48,333 to 82,950. We use the IPUMS-CPS person-level weight (WTSUPP) in all analyses.

The dependent variable, weekly wage, is measured by the total annual pretax wage and salary income from the calendar year that preceded the survey, divided by the number of weeks that a person worked and adjusted for inflation (2017 basis).[2] Although a top-coding method was implemented in all files,[3] to be conservative, we also censor the top 0.5% of the weekly wage distribution in each year and assign to these observations the value of the 99.5 percentile. Gender (female = 1), college education (defined as bachelor's degree or higher; or, in the surveys before 1992, at least four years of college), and the interaction between them are the main covariates. The model controls for all available variables that are known to be related to wage: working hours, a dummy variable for overwork (working 50 or more hours per week, following Cha and Weeden [2014]), age (in years) and age squared, race (White; Black; Hispanic; or other, which includes respondents from mixed, Asian, or Pacific origins), marriage, number of children, and employment in the public sector. The interaction between gender and college education reflects the gap in education premiums between women and men. Because we use 38 regressions, one for each year,

[1] For more details on the properties and applications of the log transformation, see Aitchison and Brown (1957) and Heckman and Polachek (1974).

[2] For robustness, we repeated the analysis with the hourly wage as the dependent variable, and the results did not substantially change. The results are available in the online appendix (section B).

[3] More information is available online: https://cps.ipums.org/cps/income_cell_means.shtml.

we present only the statistics of interest: men's premium (the main effect of college education) and women's premium (the main effect of college education plus the interaction term between college education and gender). All coefficients across all years are displayed in the online appendix (Table A1).

Method of Analysis

In order to examine gender differences in returns to education, we start with two ordinary least squares (OLS) regression models that use the same specifications and differ only in how the dependent variable, wage, is measured. In the first, the commonly used model, wage is measured in logarithmic terms, and so the education premiums are estimated in relative terms (hereafter, referred to as the *log model*). In the second model, wage is measured in U.S. dollars, with the premiums estimated in absolute terms (hereafter, referred to as the *absolute model* or *real wage model*). Note that in the second model, concerns regarding possible bias due to right skewness of the wage distribution can be dismissed. In large samples, such as the CPS samples used in this study, the regression model's normality assumption is not violated, even when the distribution of the dependent variable is skewed (Lumley et al. 2002; Wilcox 2010).

To examine whether gender inequality in returns to education is higher at the top of the income distribution (H2), we use quantile regression and estimate gender differences in returns to education in different segments of the wage distribution (for a similar application, see also Arias et al. 2002; Buchinsky 1995; Flabbi et al. 2007; Reisel 2013). The quantile regression is similar to OLS, but instead of conditional mean differences, it estimates conditional differences at specific percentile cut points. We conduct a series of quantile regressions to estimate returns to education at five points of the distribution: the 10th, 25th, 50th, 75th, and 90th percentiles. Compared with the OLS regression, the quantile regression estimates are more robust and less sensitive to outliers and a nonnormal distribution of errors (Buchinsky 1998; Koenker and Bassett 1978).

Findings

Descriptive Statistics

We start with a descriptive presentation of the gross differences between workers with and without college education, by gender. Our goal in this presentation is to show trends in the education premium over the entire period for men and for women and to explore how the gender gaps in the education premiums are affected by the domination of men at the top of the earnings distribution. Panel a of Figure 1 shows the mean weekly wage (in inflation-adjusted U.S. dollars) of workers with and without college education by year and gender. The gaps between the averages (marked by the colored bars) represent the college wage premium. Consistent with H1 and H3, panel a shows that women's premiums are indeed lower than men's. Further, although women's premiums have increased over time, men's premiums have risen even faster, resulting in growing gender disparities in education premiums over time.

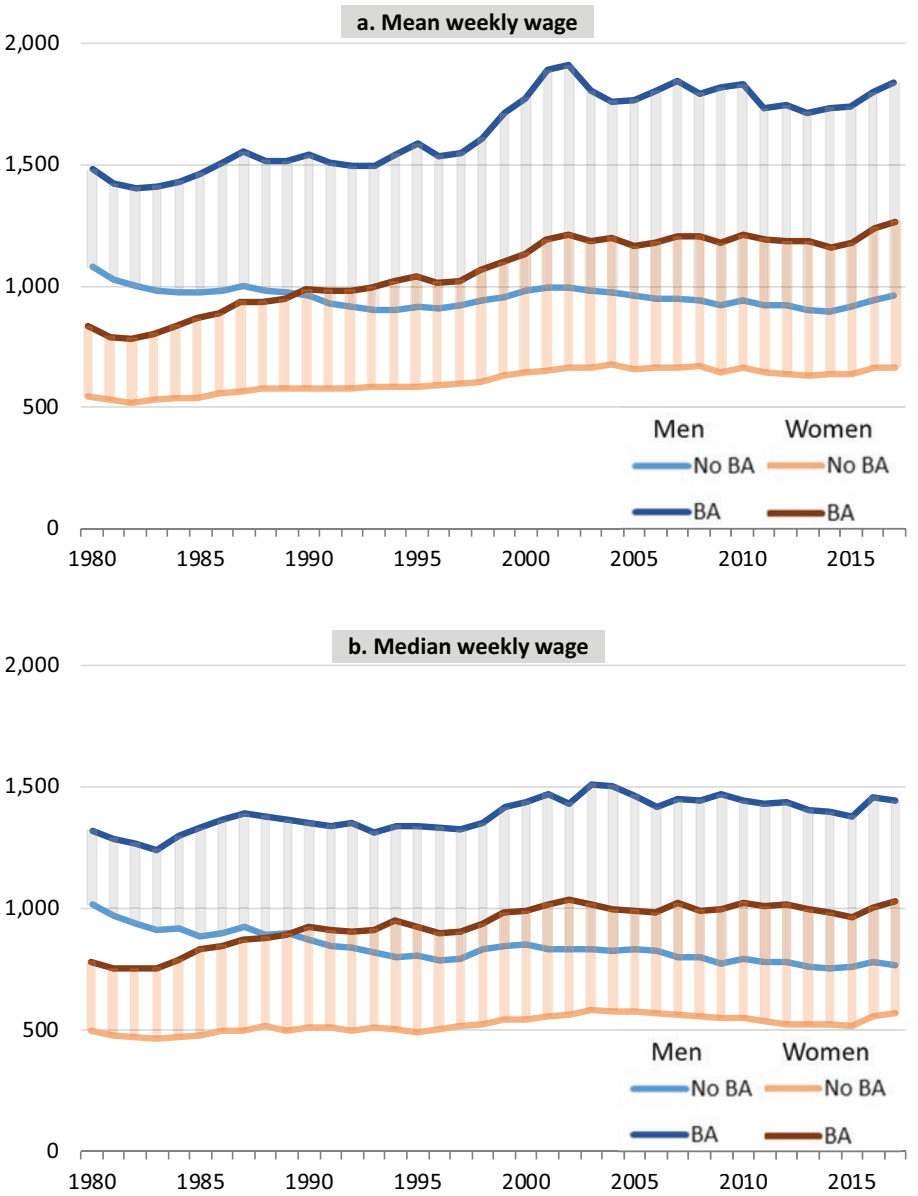

Fig. 1 Wage differences between workers with and without a college degree, by gender: mean (panel a) and median (panel b) weekly wage (in 2017 U.S. dollars)

Panel b of Figure 1 presents the median (rather than the mean) wages of more- and less-educated workers, by gender. The medians are not sensitive to the values of the highest wages, which results in smaller gaps between workers with and without college education when looking at median wages compared with mean wages.

The differences between more- and less-educated women (i.e., women's education premium) are quite similar in both panels of Figure 1. However, men's education

premiums differ substantially across the two panels, especially after the mid-1990s, when they became extraordinarily high following the steep rise in the value of education. Because college-educated men are overrepresented among the top earners and because the median downplays the effect of men's top wages, the premiums are more modest and thus gender gaps in the value of education are smaller. Taken together, the initial findings based on the descriptive analysis support our hypotheses that men's education premium is higher than women's (H1), that their advantage is linked to their overrepresentation at the top end of the wage distribution (H2), and that the gender gap has expanded over time (H3).

Trends in Gender Gaps in College Wage Premiums: Testing Hypotheses 1 and 3

The research on returns to education has predominantly relied on relative measures of the college wage premium. Nevertheless, as discussed earlier, testing our hypotheses regarding gender differences in the economic gains from higher education requires absolute measures of college premiums. In the following analysis, we use both methods to uncover the implications of using either relative or absolute measures of college premiums for estimating gender differences and their change over time.

Panel a of Figure 2 displays long-term trends in education premiums for men and women, estimated by the conventional relative measure of the log-wage model. The panel shows the relative wage differences (in percentages) between workers with and without college education (based on the exponents of the beta coefficients, e^{β}), by gender and year. Confirming previous studies, the relative education premiums for both men and women grew considerably between 1980 and 2017, a well-documented process that is indicative of the substantial increase in class inequality (Hout 2012).

In line with previous studies (e.g., DiPrete and Buchmann 2006; Dougherty 2005; Hubbard 2011), the panel also shows that until the new millennium, women received higher education premiums than men.[4] For example, in 1980, the average wage of men with a college degree surpassed the average wage of men with no college degree by 34%, whereas the corresponding gap among women was 46%. This finding, as already noted, does not indicate that women's education has greater economic value than men's, but rather that the gap between women who graduated from college and those who did not was larger (in percentages) than the equivalent gap among men until the early 2000s. This result is an indication of women's higher incentives to acquire higher education.

Panel b of Figure 2 displays the results of regression analyses that use exactly the same data and model specifications but use real (inflation-adjusted) wage, rather than its log transformation, as the dependent variable. This panel presents the absolute wage gaps between more- and less-educated workers, by gender and year. The trend within each gender group is similar to that presented in panel a of Figure 2: the education premium is rising for both groups but is increasing at a faster pace for men. That

[4] The gender differences are nonsignificant ($p > .05$) from 2002 onward, except for 2004, 2009, 2014, and 2016.

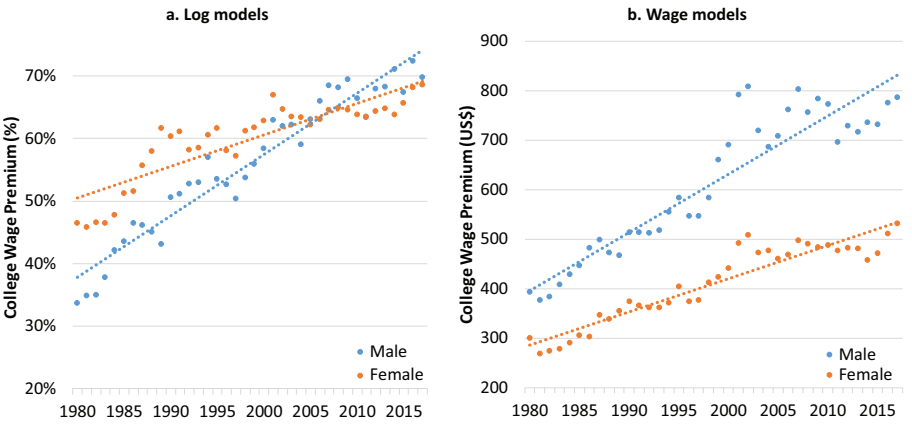

Fig. 2 Log models (panel a) and wage models (panel b) of education premiums, by gender

said, the gender gaps shown in panel b are markedly different from the equivalent gaps shown in panel a. First, the education premium in U.S. dollars is much higher for men than for women at all time points, confirming H1. Second, with the rise in wage inequality between more- and less-educated workers over the last four decades, men's advantage in education premiums has also widened considerably, consistent with H3. None of these findings can be seen in panel a.

To take the preceding example, the 46% gap between women with and without college education in 1980 equals $300 weekly, which is actually less than the equivalent 34% education premium for men that equals $393 weekly. By 2017, the education premium, in relative terms, had climbed to 70% for both men and women. This 70% premium has very different value for men and women because of women's lower starting point: it is worth about $785 for men but only $530 for women. Thus, whereas men's education premiums were higher than women's by nearly $100 weekly in 1980, the gap had more than doubled to around $250 by 2017, consistent with H3. Recall that all wages have been inflation-adjusted according to 2017 prices. The takeaway from these results is that, as predicted by H1 and H3, men receive higher returns than women, and men's advantage has increased over time.

The Role of Top Premiums: Testing Hypothesis 2

Our second hypothesis highlights the importance of top education premiums for the gender gaps. As noted earlier, given the glass ceiling effect, the use of log wage to explore gender inequality may underestimate the gap because it compresses the right tail of the wage distribution, where men are overrepresented. Thus, the compression of top wages lowers the estimated education premiums of men much more than those of women. To demonstrate the effect of the top earnings in forming the gender gaps in returns to education, we reestimate the education premium in U.S. dollars after imposing a "wage ceiling" by censoring the distribution at the 80th wage percentile.

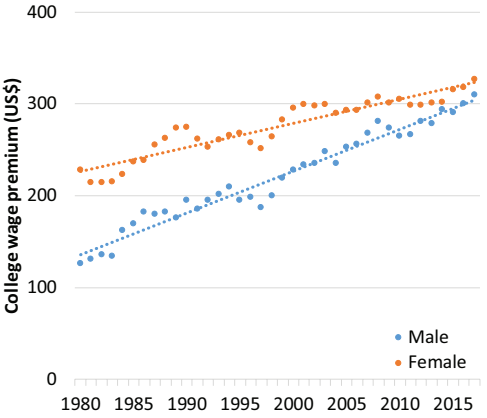

Fig. 3 Wage models of education premiums in censored samples, by gender

For each year, we assign the value of the 80th wage percentile to all observations that exceed it. This crude and artificial compression of the top wages mimics the compression wrought by the log transformation for the purpose of intuitively demonstrating the implications of compressing top wages for the trends.

Figure 3 displays the results of this simulation. The trends in education premiums in the censored sample, although calculated in real U.S. dollars, resemble the trends based on the log models shown in panel a of Figure 2; in both models, women's premiums are higher than men's, and their advantage in education premiums dissipates toward the end of the period. The trend shown in the censored sample, however, is very different from the trend shown in the noncensored sample (Figure 2, panel b), although both models estimate the education premium in real dollars.

The similarity between Figure 3 (U.S. dollars in censored samples) and panel a of Figure 2 (log) and their dissimilarity to panel b of Figure 2 (U.S. dollars) imply that gender differences in education premiums are strongly affected by the top of the wage distribution, where men are overrepresented, as framed by H3. This analysis highlights the strong effect of a relatively small group of men with a college degree who earn disproportionately high wages, suggesting that much of the gender gap in education premiums is due to the gap between highly paid men and highly paid women.

To more systematically explore the significance of top wages for the gender gaps in education premiums, we use a series of quantile regressions that estimate gender differences in education premiums at five points of the distribution: the 10th, 25th, 50th, 75th, and 90th percentiles. We present the variability of gender differences in returns to education in absolute terms in Figures 4 and 5, each of which offers a different way of visualizing how the absolute premiums and the gender gaps in premiums vary across the distribution and over time.[5] Both figures present the estimated college wage premium—that is, the net effect of college education on men's

[5] The results of a similar distributional analysis of returns to education in relative terms—that is, based on log-earnings models—adds little to the current discussion. Thus, we provide them in the online appendix (section A, Table A2; and section C).

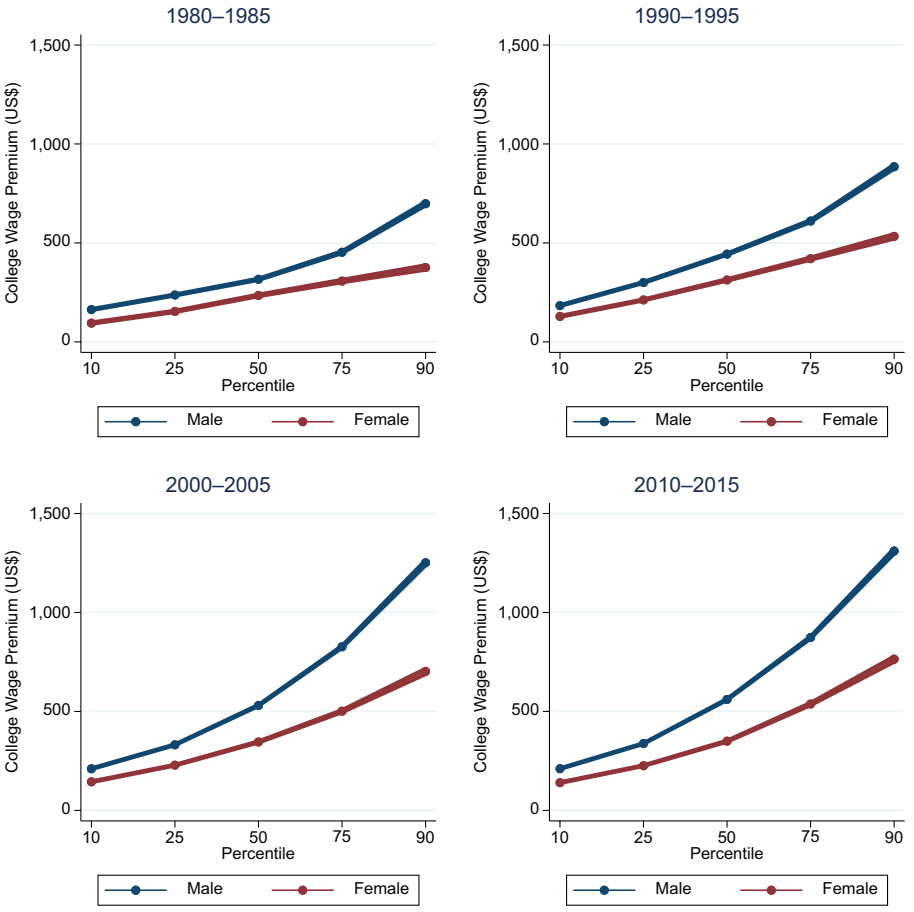

Fig. 4 Education premiums (in weekly US$), by gender, wage percentiles, and period (based on quantile regressions)

and women's wages—after background characteristics mentioned are controlled for; Figure 4 highlights the variation in premiums *across the distribution* (with years clustered into groups), whereas Figure 5 highlights the *over-time trends* at different points of the distribution.

In line with our hypotheses, Figures 4 and 5 show that (1) men receive higher returns to education than women, (2) men's advantage is evident across the distribution, and (3) men's advantage is substantially larger in the upper segments of the distribution. The figures show that in all periods, the gender gap in returns to education is larger at the top percentiles, especially the 75th and 90th percentiles. In addition, the gaps widened considerably over time. At the end of the 1990s, men's premiums began to rise at an especially fast pace, leaving women's premiums far behind. For example, the (inflation-adjusted) gender gap in the education premium at the 75th percentile was $188 weekly in 1997, but this figure almost doubled within 10 years, reaching $350 by 2007. This part of our analysis, then, adds an important piece to the puzzle: it

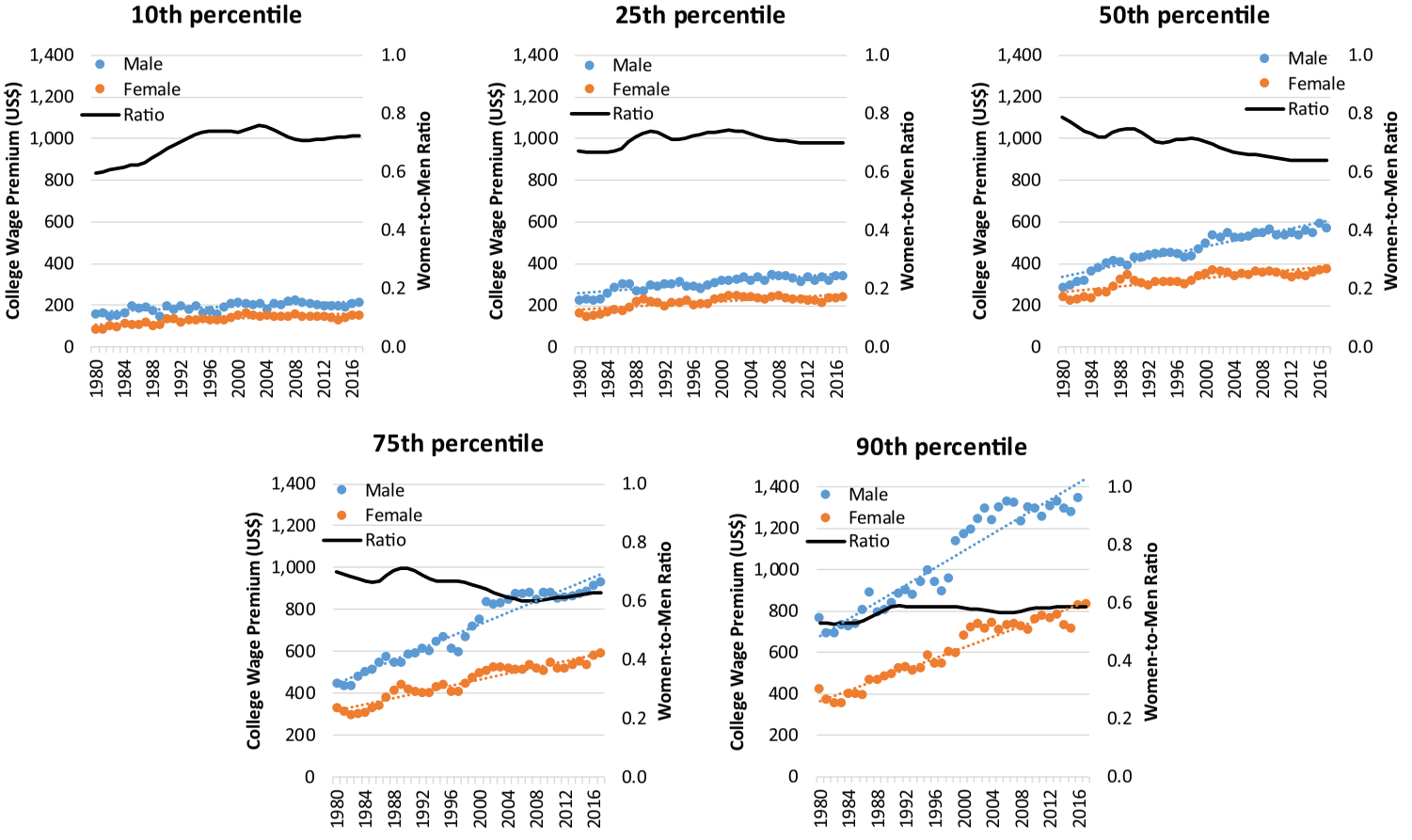

Fig. 5 Education premiums (in weekly US$, left scale) and women's to men's education premium ratios (right scale), by year and wage percentile (based on quantile regressions)

provides evidence for the significant role of wages at the top of the earnings distribution in shaping inequality in returns to education between men and women. In other words, despite the continuous rise of women's educational attainment, forces that limit women's access to high-paying positions account for their lower returns to education.

Arguably, the larger gender gaps in college premiums at the top percentiles may simply reflect the larger range of wages within these percentiles. To address this possibility, we add to Figure 5 loess-smoothed lines (corresponding to the right axes) that represent the ratios between women and men in the *absolute* education premiums (i.e., the ratio between the orange and blue dots). The ratios vary by year, but not by much. On average across the entire period, women's education premiums are about 70% of men's at the lower percentiles (up to the median) and decline as we move to the higher end of the distribution. At the 75th percentile, women's education premiums fall to an average of 65% of men's (across all years), and at the top decile they decline further, to only 57% of men's premiums. The declining women-to-men ratios as we ascend the distribution indicate that gender gaps in education premiums are indeed larger at the top end of the distribution, in accordance with H2.

It is important to address the difference between the growing gender gap in absolute education premiums over time and the stability of the ratio between women's and men's premiums (represented by the solid black lines in Figure 5). For example, during the last two decades, the absolute gender gap in education premiums at the 90th percentile widened, whereas the ratio remained rather constant (around 57%). However, because of the growth in overall earnings inequality, which was especially evident at the top of the distribution, the real value of this 57% ratio increased considerably. If we take into account that wages are measured in inflation-adjusted dollars, the rather stable ratio conceals the widening gap in the purchasing power of higher education between men and women over time. The gender gap in the (inflation-adjusted) education premium at the 90th percentile was $339 in 1985, increasing to $563 in 2015 despite only a modest change in the ratio (from 54% to 56%). Thus, the rather stable ratio of women's to men's premium cancels out the effect of the growth of earnings (class) inequality on the gender gap in premiums. In other words, although the ratio is stable, the growth of earnings inequality diminishes the purchasing power of women's higher education relative to men's, in line with H3 (on the effect of the overall wage/class inequality on gender inequality, see Blau and Kahn 1997, 2007; Mandel and Shalev 2009).

Discussion

In this paper, we examined gender gaps in the college wage premium across four decades to shed light on processes that perpetuate gender disparities and impede gender equality in the labor market. We addressed two interrelated mechanisms that prevent women from taking full advantage of their education: the devaluation of work and skills associated with women and femininity, and the glass ceiling effect. Both mechanisms stem from deeply rooted social and cultural beliefs about the lower competencies of women (relative to men) that, in turn, shape organizational practices of hiring, promoting, and rewarding workers (Acker 1990; Ridgeway and Correll 2004). The devaluation theory points to the underappreciation of work done by educated

women relative to men, resulting in lower returns to education. The glass ceiling theory points to the overrepresentation of men at the top, which translates into higher returns to education. The two mechanisms are interrelated: because top positions are associated with requirements that are stereotypically linked to men and masculinity, the tendency to devalue women's competencies is greater at the top of the organizational hierarchy (Huffman 2004; Ridgeway 2011).

The findings support our hypotheses that women receive lower absolute returns to their education than men do (H1) and that this gender gap increases over time with the rise of earnings inequality, especially at the top (H3). The findings further reveal how gender inequality in education premiums is affected by top premiums (H2) and how the choice of measurement method is crucial for revealing that. Consistent with the glass ceiling theory and our second hypothesis, the analysis shows that much of the gap between men's and women's education premiums is due to men's advantage in access to the best-paying jobs. When we artificially censored the ceiling by setting a maximum wage (at the 80th wage percentile), we found that the gender gaps reversed. Similarly, when we disaggregated the wage hierarchy, we found the largest gender gaps at the highest wage levels.

Our study provides strong and novel evidence of the importance of absolute measurements and of top positions for revealing gender inequality in returns to education, but the implications of our findings are applicable to social groups beyond gender. As for the former, the evaluation of all forms of inequality rests on normative dispositions regarding what is worth measuring. Indeed, the value of relative and absolute measurements of income inequality, poverty, and social mobility has long been debated (e.g., Atkinson and Brandolini 2010; Callan and Nolan 1991; Chakravarty 1984), and both approaches have been found valuable in their own right but for different purposes. In the context of returns to education, relative measures are important from the individual's point of view, whereas absolute measures are more suitable for cross-group comparisons. Relative measures allow researchers to examine which of the groups has greater incentives to invest in education, and show that women (until recently) had greater incentives to invest in higher education, *given their potential earnings otherwise* (DiPrete and Buchmann 2006; Dougherty 2005; Hubbard 2011). Absolute measures reveal the added purchasing power associated with higher education, and as our findings indicate, women receive lower economic rewards for their education, and the gaps between men and women are widening over time—a finding that remains concealed when education premiums are measured in relative terms.

The greater disadvantages of women (or other marginalized groups) at the top have two manifestations: (1) greater restrictions on entering positions in the higher segments of the occupational structure, and (2) larger disparities between women who succeed in entering these higher segments and their male counterparts. Regarding the first, women have substantially improved their position in the occupational structure (Blau et al. 2013; England and Li 2006; Mandel 2012, 2013). However, with the upward occupational mobility of women in recent decades, more women have entered occupational levels at which they are subjected to the greatest disadvantage (the second manifestation).

The two manifestations are interrelated and may offset each other: although women's position in occupational or organizational structures has improved, these structures have changed in a non-gender-neutral way, becoming more unequal for women

who do crack the glass ceiling. Grodsky and Pager (2001:564) pointed to such a mechanism in the case of racial inequality:

> Occupational mobility and earnings inequality are intimately linked such that movement into higher-earning occupations (declining occupational segregation) is associated with greater within occupation wage disparities (increasing racial wage inequality) . . . As black men gain entry to the most highly compensated occupational positions, they simultaneously become subject to more extreme racial disadvantage.

Laurison and Friedman (2016) also found that when workers from lower socioeconomic backgrounds are successful in entering prestigious occupations, they face a significant "class ceiling" in terms of earnings.

Equal access to the higher rungs of the occupational hierarchy is crucial, and antidiscrimination legislation has pursued this goal since the Civil Rights Act of 1964. However, as shown in this study, the issue is about not only the limited access of individuals (women, Blacks, or other minorities) to higher positions but also, and no less importantly, the devaluation of their skills and education. Although racial and gender inequality take very different forms at the individual level, the "structure of disadvantage" (Grodsky and Pager 2001) that underprivileged groups face could be quite similar. Because structural aspects of inequality are not targeted against any specific individual, the documentation of this process is difficult, the evidence is highly ambiguous, and consequently the legal basis for claims of discrimination is unclear. Petersen and Saporta (2004) argued that for these reasons, the devaluation mechanism offers an "opportunity structure" that allows for more discrimination relative to individual mechanisms. Precisely for this reason, the focus on structural mechanisms is especially critical today, in a period of rapid growth in education premiums and a continual rise in women's skills and education. ■

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