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Of Age, Sex, and Money: Insights from Corporate Officer Compensation on the Wage Inequality Between Genders

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This paper shows that the gender and age of the wage setter are crucial determinants of the disparity in wages between sexes. We document our findings using a data set on compensation of corporate officers that is uniquely suited for this analysis because officer wages are set by chief executive officers (CEOs). We show that CEOs pay officers of the opposite gender less than officers of their own gender, even when controlling for job characteristics. Older and male CEOs exhibit the greatest propensity to differentiate on the basis of sex. Female officers receive smaller raises if the firm is headed by a man. Our results suggest that CEO gender and age are economically more important determinants of officer compensation than are firm stock performance, stock volatility, or return on assets.

Keywords: gender; officer compensation; inequality; pay gap
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1. Introduction

Women are, on average, paid less than men for equivalent work. This is the conclusion of a voluminous literature studying wage differences between sexes (see §2). In 2012, women earned less than men in each of the 50 states and in each of the 50 largest metropolitan areas in the United States, with the median difference in annual compensation amounting to $11,084.[1] Such differences in wages are persistent, substantial, and controversial, but the driving forces behind them are not fully understood. For example, wage disparity cannot be entirely attributed to differences in productivity or to self-selection. To date, a conclusive explanation of the origins of wage differences remains elusive.

In this paper, we study compensation of corporate officers of publicly traded U.S. companies to understand the determinants of wage differences. The corporate setting is particularly well suited to address this question because chief executive officers (CEOs) play a vital role in the determination of pay of all other officers. Specifically, CEOs recommend a level of officer compensation, which the board of directors can then approve. For example, Intel summarizes such compensation practices in its 2013 proxy statement:

> The CEO makes a recommendation to the Compensation Committee on the base salary, annual incentive cash targets, and equity awards for each executive officer other than himself and the Chairman of the Board, based on his assessment of each executive officer's performance during the year and the CEO's review of compensation data gathered from compensation surveys. The CEO documents each executive officer's performance during the year, detailing accomplishments, areas of strength, and areas for development.[2]

We take advantage of a data set that, for the period 1996–2011, contains detailed information on compensation and characteristics of CEOs and other officers. The data set thus befits an exploration of which characteristics of wage setters (CEOs) affect the compensation of wage receivers (non-CEO officers, "officers" hereafter).

Our analysis focuses on two characteristics of chief executives, their age and gender. We conjecture that wage setters may treat workers of the opposite gender differently: men underpaying women, and vice versa. We also posit that older executives, perhaps because they may have grown up during a time when wage differences between genders were more tolerated,

[1] These statistics are based on the U.S. Census analysis conducted by the National Partnership for Women and Families (2013).

[2] http://www.intc.com/intelProxy2013/statement/compensation-discussion-and-analysis/intels-compensation-framework/ (accessed August 1, 2013).

pay men more than they do women. Although both hypotheses are well motivated by the social identity theory (Tajfel and Turner 1979) and are sometimes discussed anecdotally, our data allow us to formally test them.

In our empirical analysis, we first show that wage differences between genders are as present in corporate offices as they have been shown to be in other contexts. In particular, female corporate officers receive significantly lower wages than do male officers. For our sample the average difference amounts to $64,200 per year in favor of males, a sum equal to more than 16% of median officer total compensation.

We next study the differences between how male and female CEOs set wages for their corporate officers. After controlling for firm characteristics, we find evidence that male CEOs compensate their officers more richly than female CEOs do. The difference in compensation by male and female chief executives amounts to $15,210 per year on average, or 4% of the median officer total compensation. We also show that older CEOs award their officers higher pay. For example, holding all other factors constant, we estimate that a CEO would compensate officers $14,550 per year more than a CEO who is 15 years junior.

Alarmingly, the higher wages awarded by male and older CEOs are not equally distributed between officers of different genders. Our analysis suggests that male CEOs pay female officers on average $46,500, or over 12% of median compensation, less than they do their male subordinates who work at the same firm. Moreover, female officers receive significantly lower increases in compensation than do male officers when the firm is headed by a male CEO. In contrast, we find limited evidence that male officers of female-led firms are paid less, or that they receive smaller increases in compensation relative to female officers.

We reach similar conclusions of predominantly unilateral gender disparity when we focus on the age of the CEO: older male CEOs pay female officers significantly less than male officers of the same firm. Our results are only the more perplexing when one considers that gender and age variables have a far more significant economic impact on officer compensation than do a firm's stock performance, stock volatility, or return on assets. We obtain our results with officer-level fixed effects, including officer title dummies, and conservatively clustering standard errors. We show that other hypotheses are unlikely to explain our results because the pay disparity is conditional on the gender interaction, persists in the presence of officer-level fixed effects, and responds predictably to changes in CEO gender.

The interpretation of our results depends on the assumption that the CEO sets the wages of the corporate officers. Simply because a CEO recommends a level of compensation to the board need not imply that the board is compelled to take that recommendation. However, literature provides mounting evidence that CEOs possess significant power and can use their influence to benefit selected employees.[3] That we find strong evidence of CEO age and gender affecting the difference in wages earned by male and female officers is all the more striking if other confounding factors also affect officer wages.

2. Related Literature

This paper contributes to three strands of literature. First, it adds to the research on the gender pay gap. Second, it complements the work on gender pairing. Third, it contributes to the literature studying corporate compensation.

2.1. Gender Pay Gap

The U.S. Civil Rights Act of 1964 prohibits discrimination in the employment of women and other classes of workers. Figure 1 shows that the pay gap has been gradually declining: male median real compensation has stagnated while women's income has been on the rise. However, the progress toward wage equality appears to have slowed in the mid-1990s and to have all but stopped in the last 10 years. The most recent data show that women earn, on average, 20% less than men.[4]

Gender pay differences are apparent even when conditioning on the education level of the employee. For example, the highest-earning 10% of male workers with advanced degrees (professional or master's degree and above) earned at least $3,510 per week in the second quarter of 2013, compared with $2,339 or more for their female counterparts. The same relation holds when conditioning on age or ethnic background of workers.[5]

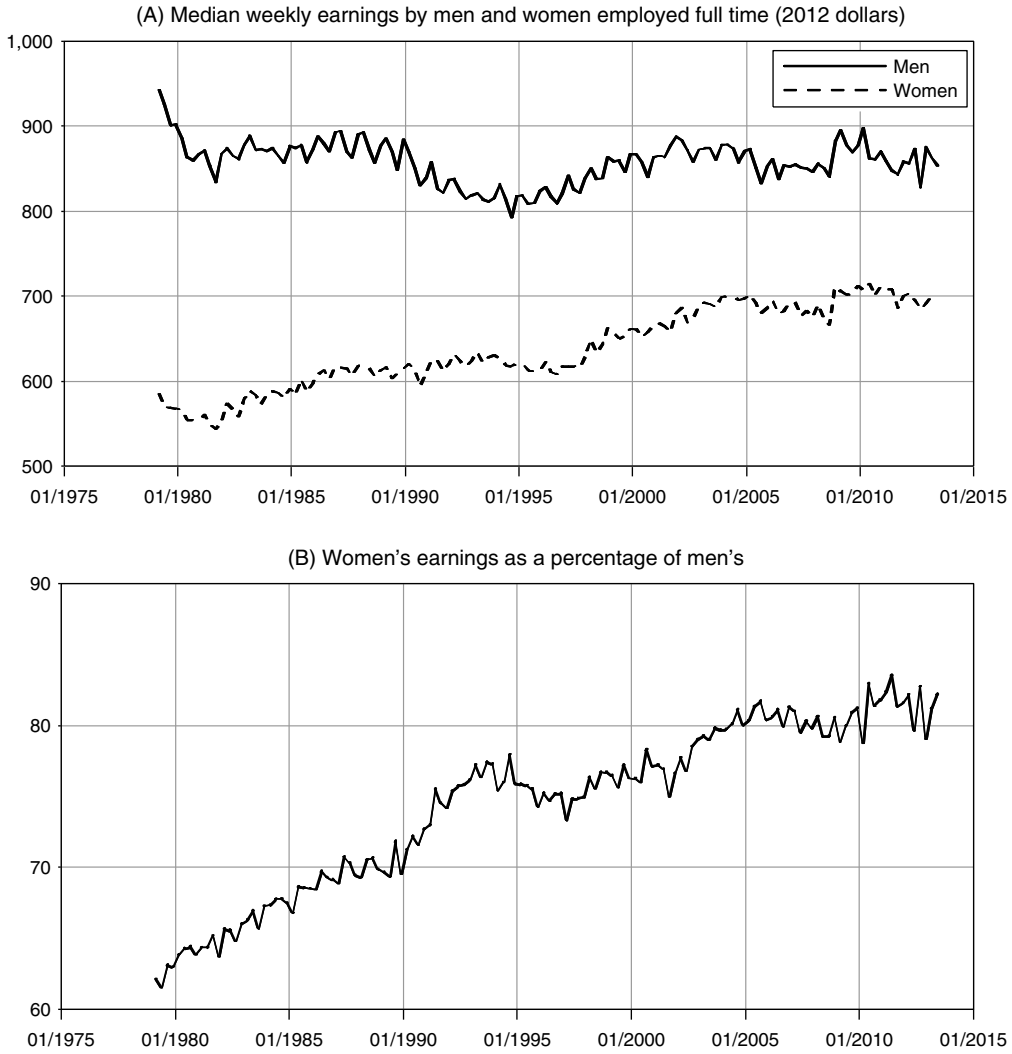
One possibility for a gender wage gap is that males simply perform better and are thus better compensated. For example, in a study of lawyers, Azmat and Ferrer (2012) find that men work longer hours and generate more client revenue and that controlling for these factors helps to explain the pay gap. Yet, in an examination of academic and intellectual capacity, Pope

[3] For example, Graham et al. (2011) find that the CEO's opinion of a divisional manager is a crucial determinant of internal capital allocation. Duchin and Sosyura (2013) show that divisional managers with social connections to the CEO receive more capital and that these connections have greater effect on capital allocation than manager seniority or board membership. Glaser et al. (2013) document similar effects.

[4] The slowing convergence between the compensation of men and women is studied in detail by Blau and Kahn (2006).

[5] The numbers are taken from the Bureau of Labor Statistics, Usual Weekly Earnings Summary, July 18, 2013. See http://www.bls.gov/news.release/wkyeng.t05.htm (accessed September 10, 2013) for more details.

Figure 1 Gender Wage Gap



Notes. This figure plots in panel (A) the median weekly earnings by men and women employed full-time within the United States. The earnings, shown in 2012 dollars, are from the Bureau of Labor Statistics. Panel (B) shows the ratio of women's to men's weekly earnings.

and Sydnor (2010) show that male and female students have similar test scores, and Johnson and Kuennen (2006) find that female students outperform. Although Gneezy et al. (2003) observe that women underperform in a competitive environment, the authors find that they perform equally well in a cooperative setting. Relatedly, Apesteguia et al. (2012) show that female-only teams underperform in a business game, but teams composed of both sexes perform particularly well. Of salience to our study is the work of Blau and Kahn (2005); they find that the difference in adult literacy skills of men and women is inadequate to explain the gender pay gap within the United States.

In a financial context, Atkinson et al. (2003) find that female mutual fund managers perform comparably to their male peers.[6] Market participants appear to recognize that men and women perform equally well in corporate settings. For example, Farrell and Hersch (2005) show that female board additions do not negatively affect a firm's market value. In fact, Adams and Ferreira (2009) document that female directors have superior attendance records. Moreover, Martin et al. (2009) find that abnormal returns around announcements of the appointment of a female CEO are indistinguishable from zero. Evidence of superior female performance is presented by Weber and Zulehner (2010), who show that the survival rate of start-up firms increases with early female hires, and by Beck et al. (2013), who document that female loan officers are less likely to originate problematic loans.

Another commonly proposed explanation for the gender pay gap is that men and women self-select into different fields of work, with men choosing jobs that are more difficult or risky and hence more highly compensated. In a review of social economic experiments,

[6] These effects are studied in more detail by Niessen and Ruenzi (2007) and Bär et al. (2013).

Croson and Gneezy (2009) indeed find that women are more averse to risk and competition and have more malleable social preferences than men do.[7] Because of their aversion to competition, women prefer to be paid by a flat piece rate rather than by a tournament payoff, as Niederle and Vesterlund (2007) show. Cárdenas et al. (2012) demonstrate that, although gender differences in competitiveness can vary across countries, male children are uniformly more likely to seek risk than female children. Other personal preferences may induce women to avoid highly paid but demanding jobs. For example, it may be more difficult for women to achieve both high-powered careers and maintain a family. Indeed, Hewlett (2002) shows that 49% of "ultra-achieving" career women—those aged 41–55 with incomes in excess of $100,000 per year—are childless, whereas only 19% of men in the same category are.

The self-selection arguments are compelling and can explain the differences in unconditional average pay of men and women. However, ample evidence shows that the gender wage gap persists even conditional on men and women performing similar jobs. For example, Huffman (2004) finds that both between different jobs and within jobs women are paid less than men. In a study of compensation of academics, Barbezat (1991) reports that the gender wage differential declined during the 1970s but stalled thereafter, and it remained large, at nearly 20% of compensation. Most recent data from the Bureau of Labor Statistics (BLS) further confirm that the gender pay gap persists even among workers performing similar jobs. For example, within each occupation category reported by the BLS, men earned higher median wages than women did in both 2012 and 2013.[8]

Our results add to the literature on the gender pay gap in two ways. First, we document that the gender wage differential is substantial among corporate officers. Second, we provide new evidence on the sources of this pay gap.

2.2. Gender Pairing

Our second contribution is to the literature studying how economic decision making is affected by the genders of the interacting parties. Of particular relevance to our study are several papers that examine whether evaluators assess the same and opposite genders differently. In a study of National Science Foundation grant evaluations, Broder (1993) finds that female reviewers rate proposals by women more harshly than male evaluators do. Bagues and Esteve-Volart (2010) observe similar effects when examining Spanish judiciary appointments. They find that candidates are less likely to be granted an appointment when the evaluation committee is predominantly of the same gender as the candidate. These results may seem at odds with our findings, but Broder's speculation on the causes behind her discovery may resolve the apparent inconsistency. She conjectures that female evaluators may judge other women harshly to reduce competition because they perceive that resources allocated to their gender are scarce. In our context both the setting and incentives are markedly different. In contrast to judiciary and grant appointments, CEOs and subordinate officers operate in a cooperative environment and are not in direct competition with one another.

Gender pairing has also been shown to affect outcomes in other contexts. In a two-person bargaining experiment, Sutter et al. (2009) find that same-gender pairs suffer greater competition and retaliation, resulting in lower efficiency outcomes. Studying a sample of 128 Dutch retail stores, Delfgaauw et al. (2013) show that the interaction of genders of workers and their managers substantially influence the response to competitive incentives on sales growth. They find that the tournament incentive has the greatest effect when the manager and the majority of the workers are of the same gender. We add to this literature by showing that gender pairing of a wage-setting CEO and a wage-receiving officer significantly affects officer compensation.

2.3. Compensation of Corporate Officers

Our third contribution lies in studying the determinants of compensation of corporate officers. The focus of the literature studying corporate compensation has almost exclusively been on the pay of CEOs.[9] Such focus is only to be expected because CEOs exert more control over a firm's actions and performance than any other single individual. Yet the truth is that most firms are large, complex organizations that cannot be fully controlled by a single person, no matter how talented. CEOs thus require skilled teams to assist in the management of rank-and-file employees and in realizing the firms' strategic objectives. Understanding the determinants and implications of the compensation of corporate officers is thus important to get a better picture of the incentives of the top management and of the drivers of firms' performance.[10]

[7] In a financial setting, these results are echoed by Barber and Odean (2001) and Levi et al. (2010, 2014).

[8] See http://www.bls.gov/news.release/wkyeng.t04.htm (accessed September 10, 2013) for details.

[9] The literature is expansive. See, for example, Jensen and Murphy (1990), Gilson and Vetsuypens (1993), Mehran (1995), Yermack (1995), Core et al. (1999), Murphy (1999), Ofek and Yermack (2000), Datta et al. (2001), Jin (2002), Hartzell and Starks (2003), Harford and Li (2007), and Chhaochharia and Grinstein (2009).

[10] The lack of research on corporate officers stands in stark contrast to numerous studies of another important group, directors on a firm's board. See, for example, Yermack (1996, 2004), Jensen (1997), Ryan and Wiggins (2004), and Brick et al. (2006).

This paper begins to consider the role and compensation of non-CEO officers in the corporate setting. We emphasize "begins" because the research into the subject is essentially absent in the literature. One exception is Ogden et al. (2002), who analyze compensation of Fortune 500 chief purchasing officers. Their interest, however, is solely in one class of a very heterogeneous group of corporate officers of very large firms.

We examine the determinants of pay of corporate officers but our focus is on one dimension of their compensation: the gender gap. This dimension gives interesting (and perhaps even alarming) results that we explore in the rest of the paper.

3. Hypotheses

We build on the theory of social identity to motivate our hypotheses. This theory supposes that ingroups—associations of individuals with similar traits—may treat outgroup members differently than their own membership. The theory is attributable to Sherif (1966) and is eloquently described in Tajfel and Turner (1979).[11] The literature on this theory is expansive, with notable economic studies that relate closely to our work. In a laboratory experiment, Chen and Li (2009) show that inducing ingroup identity, such as prompting individuals to recall their gender before engaging in a cooperative game, can influence their charity, envy, and social-welfare-maximizing behavior. Akerlof and Kranton (2000) show that modeling social identity directly into the utility function helps to explain the effects of gender discrimination on compensation.

For this study, we examine the relation between characteristics of wage setters (CEOs) and compensation earned by wage receivers (non-CEO officers). We speculate that the ingroup in our application is determined by sex—men identify with men and women with women. As in Chen and Li (2009), we test whether individuals of the ingroup benefit other members of the same group. In our context this supposes that wage setters will benefit wage receivers. Our specific tests are guided by four hypotheses enumerated below.

First, we conjecture that CEOs compensate officers of the opposite gender differently because these workers would be perceived to be part of the outgroup.

Hypothesis 1 (H1). *CEOs pay officers of the opposite gender less than officers of their own gender.*

Second, we hypothesize that the age of the CEO plays an important role in the gender wage gap of corporate officers. Age may affect wage-setter decisions because both the ageing process and/or the social norms in which a CEO grew up may influence ingroup identification.

[11] See Tajfel (1986), Deaux (1996), Hogg (2002), and Chen and Li (2009) for extensive surveys.

Hypothesis 2 (H2). *The difference in compensation of male and female corporate officers increases with CEO age.*

Third, if compensation is a function of the officer–CEO gender interaction, then officer compensation should respond to a new CEO of differing gender.

Hypothesis 3 (H3). *Officer compensation increases* (*decreases*) *when an opposite-gender* (*same-gender*) *CEO is replaced by a same-gender* (*opposite-gender*) *CEO.*

Fourth, if ingroup identification is stable, then any effects that social identify has on compensation should persist over time. We therefore study how compensation fluctuations are affected by gender interaction.

Hypothesis 4 (H4). *Officer compensation increases more under the leadership of a same-gender CEO than an opposite-gender CEO.*

4. Data and Methodology

We obtain compensation structure, gender, and other officer-specific characteristics from the Compustat ExecuComp data set. The primary data cover a panel of 2,548 large, publicly traded U.S. companies for the period 1996–2011. Our sample accounts for over 84% of market capitalization of publicly listed common stocks on all U.S. exchanges. We supplement these data with the characteristics of the board of directors and other firm-level characteristics from the Center for Research in Security Prices and Compustat.

Table 1 summarizes the gender composition of officers in our study. The sample is clearly dominated by men. Women fill only 2.4% of all CEO positions, although they account for a considerably larger 7.8% of other officer titles. Although the female representation is low, our sample includes over 4,000 female officer-year observations.

The gender imbalance is the reflection of the reality of the upper echelons of corporate America. The ExecuComp data set records the officer information for the largest publicly listed firms in the United States, including the entirety of the S&P 1500 index. The overrepresentation of men in our sample is the manifestation of the genuine gender imbalance that exists within the population of the U.S. publicly traded firms. All other studies that use these data or, more generally, analyze genders within corporate offices, face the same limitations.[12] Importantly, our sample is well representative of the underlying population, covering thousands of firms and individuals across numerous industries over a span of 16 years. No data set of medium or large U.S. public firms would yield substantially different results.

[12] See, for example, Atkinson et al. (2003), Farrell and Hersch (2005), Lee and James (2007), Niessen and Ruenzi (2007), Adams and Ferreira (2009), Adams and Funk (2012), Bär et al. (2013), Amore et al. (2014), and Levi et al. (2014).

Table 1 Sample Description by Officer Gender

A: Number of unique individuals			
	Male	Female	Total
Chief executive officers	4,604	113	4,717
Other officers	17,065	1,446	18,511
B: Number of individual-year observations			
	Male	Female	Total
Chief executive officers	22,442	502	22,944
Other officers	52,983	4,138	57,121
Officers under male CEO	51,759	3,914	55,673
Officers under female CEO	1,224	224	1,448
C: Average officer characteristics by gender			
Variable	Male	Female	Difference
Salary (thousands)	339	326	12.8***
Bonus (thousands)	202	152	49.6***
Total compensation (thousands)	540	478	62.4***
Age (years)	52.1	49.5	2.6***
Tenure (years)	4.2	3.6	0.6***

Notes. This table reports the number of unique chief executive and other officers, broken down by gender, in panel A. Panel B shows the number of individual-year observations, including the number of male and female officers working for chief executives of either gender. Panel C summarizes average characteristics of male and female officers and shows their difference. Differences that are statistically significantly different from zero at better than 1% are indicated by three asterisks. The sample period is 1996–2011.

The literature encountering similar gender imbalance does not deal with this concern directly, but in robustness tests described in §4.3, we propose methods to address the imbalance. These tests provide even stronger evidence of the gender and age of the CEO affecting officer compensation than does our primary analysis, which we now discuss.

4.1. Regression Framework

To test our hypotheses, we run the following pooled regressions:

$$\begin{aligned}\text{Log total officer pay}_{it} &= \beta_0 + \beta_1 \text{Gender variables}_{it} \\ &\quad + \beta_2 \text{CEO and officer characteristics}_{it} \\ &\quad + \beta_3 \text{Board of director characteristics}_{it} \\ &\quad + \beta_4 \text{Other firm-level controls}_{it} + \epsilon_{it}, \quad (1)\end{aligned}$$

where i denotes officers and t indexes years. We use total officer compensation because both of its components—salary and bonus—are controlled by the CEO. For robustness, we also consider the two components of total compensation separately. We take the natural log of compensation to control for skewness in the data (see Albuquerque et al. 2013). The regressions also include fixed effects for years, for officer titles, and for the 48 industries obtained from Ken French's data library.[13] We conservatively cluster standard errors at the officer level.

4.1.1. Fixed vs. Random Effects. In specifying our regression, we consider both the fixed- and the random-effects designs. The random-effects model will produce a more efficient estimator than the fixed-effects model in those instances where its application is appropriate. However, random-effects models should be avoided when the random effect is not independent from the explanatory variables. In our study the random effect would be either an individual or joint firm–individual effect relating to compensation. Our right-hand-side variables include age, tenure, firm performance, and title effects. It is therefore intuitive that the random effect would correlate with our explanatory variables, and hence the random-effects model may be inappropriate. To verify that the fixed-effects model is justified, we conduct the Hausman test as detailed in Wooldridge (2002, p. 288) and find that a random-effects model is rejected at better than 1%. Hence, we use the fixed-effects approach throughout the paper. It is prudent to note that because our analysis is based on fixed-effects estimation, the results may not apply outside U.S. corporate offices.

4.2. Explanatory Variables

We now describe the key variables used in our analysis. Table A.1 of the appendix provides complete definitions of all variables.

4.2.1. Gender Variables. Four gender variables are of particular importance in our analysis. First, the *Opposite gender* dummy takes the value of 1 if the officer and the CEO are of opposite genders. A negative regression coefficient on this variable would suggest, consistent with H1, that CEOs pay officers of the opposite gender less than they do officers of their own gender. For example, it would be consistent with male CEOs paying less to female workers than to male ones, hence driving the gender wage gap.

Second, we define the *Misogyny* variable as the product of the *Male CEO* and *Opposite gender* dummies. A value of 1 indicates situations when a female officer works for a male CEO. This variable allows us to determine whether female officers receive a lower wage from a male CEO. A negative coefficient on this variable would suggest that this is the case. Third, we set the *Misandry* variable to 1 if the CEO is female and the officer is male; we set it to 0 otherwise. A negative coefficient on this variable would imply that male officers receive lower wages from a female CEO.

[13] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html (accessed April 18, 2013).

Whereas the *Opposite gender* dummy allows us to determine whether CEOs treat officers of opposite genders differently, it does not by itself indicate whether male CEOs, female CEOs, or both exhibit such discriminating behavior. In contrast, the coefficients on the *Misogyny* and *Misandry* variables show this clearly. We do not include these two variables in regressions alongside the opposite gender and male officer dummies because doing so would induce multicollinearity or, if all variables are included, would result in a model that is not full rank.

Our final gender variable, *Generational sexism*, is the product of the *Misogyny* dummy and *CEO age* in years. Its inclusion in models with CEO age allows for a separation of the effect of CEO age on officer compensation from the effect of older men setting wages differently for male and female officers. A negative coefficient would suggest, consistent with H2, that the gender pay gap increases with the male wage setter's age.

4.2.2. CEO and Officer Characteristics. To account for the possibility that officer compensation is affected by nongender characteristics of the CEO, we include in the regressions the log of CEO total compensation, CEO age, and years of tenure at the firm.[14] We also include officer age and tenure as controls. These variables are known determinants of the wage rate of workers, an observation confirmed in a 2009 report prepared by the CONSAD Research Corporation for the U.S. Department of Labor (CONSAD Research Corporation 2009). The age of non-CEO officers is reported for approximately 60% of observations. We include this important determinant of compensation as a control in all regressions despite the reduction in the sample size. In unreported results we find that our variables of interest increase in significance when we exclude officer age from regressions.

Average compensation differs across officer titles, and it is possible that women earn lower wages because they are employed in positions that require less effort and hence offer lower pay. To minimize the possibility that our results are driven by a "title effect," we classify officers from the ExecuComp database into 52 groups by their titles. The database records titles in a variety of ways (such as "chmn," "chairperson," "chairman," or "ch.mn.," all meaning "chairman"), and many officers have multiple titles (e.g., chief financial officer, treasurer). As a result, there are thousands of titles in our sample. Since assigning unique categories for each title is immensely costly in terms of degrees of freedom, we add dummy variables manually to the most frequent title categories. We include the resulting title dummy variables in all of our regressions.

[14] Motivated by the findings of Bandiera et al. (2009) that compensation structure of managers affects their preferences for subordinates, we confirm that our results are robust to including CEO salary and bonus as two separate controls. These results are omitted for brevity.

4.2.3. Board of Directors and Other Firm-Level Characteristics. Consistent with past literature on executive compensation (Agarwal 1981, O'Reilly et al. 1988, Brick et al. 2006, Albuquerque 2009, Graham et al. 2013), we add a series of controls that include both firm and stock characteristics when estimating our models of officer pay. Firm sales and employees act as proxies for the size of the firm and the complexity of the workforce under management, respectively. Return on assets and level and volatility of stock returns capture firm profitability and risk. Tobin's *Q* (market-to-book ratio) acts as proxy for, among other things, firm efficiency and presence of growth options. Research-and-development (R&D) and advertising expenses; debt; capital expenditures; and plant, property, and equipment (PPE) are all normalized by asset size and are included to characterize the nature of the firm management and production process. We include dummies to account for industry variation.

The CEO has substantial influence on the compensation of subordinates, but any pay proposal the CEO presents must ultimately be approved by the board of directors. For this reason we include as controls the number of directors on both the general board and on the compensation committee. Since we are interested in gender interactions, we also include the proportion of female directors on both the board and the committee.

4.3. Robustness

A possible critique of our analysis is that our sample is composed of predominantly male observations, and therefore our results may be driven by this gender imbalance. In unreported robustness checks (available upon request), we repeat our regression analysis by (1) equally weighting female and male officer observations in the regression, thereby creating an inefficient estimator but one which better fits female observations; and (2) bootstrapping our sample with 1,000 repeated draws of male observations in equal frequency to female observations and then averaging parameter estimates and determining regressor significance across all draws. These tests show that our variables of interest (*Opposite gender, Misogyny, Misandry*, and *Generational sexism*) remain robust and in most instances increase in significance.

The board of director variables we use as controls are available starting in 1996, whereas all other variables are populated starting in 1992. We show that our results improve in significance if we exclude the board of director variables and thereby extend the sample. We also find that the significance of our variables of interest increases when we exclude officer age as a regressor, because this important control is missing for approximately 40% of the observations in the ExecuComp database. These results are omitted for brevity and are available upon request.

For robustness and to rule out possible explanations of our findings, we employ the Abowd-Kramarz-Margolis (AKM) fixed-effects method (Abowd et al. 1999) popularized in the finance literature by Graham et al. (2013). In this method, fixed effects are estimated for both officers and firms. In most instances this procedure would severely restrict the size of the sample because only officers that switched between firms could be admitted for analysis. However, the AKM method leverages the transitions of officers from one firm to another to determine firm fixed effects, which can be used in the estimation of nonmoving officers' personal fixed effects. The AKM method can thereby retain a large percentage of observations while still generating firm- and officer-level fixed effects.

We begin by assigning each officer and company a group number. The group-assigning algorithm is described in detail in Abowd et al. (2002) and summarized in Graham et al. (2013). In brief, we arbitrarily select one firm from our main sample and then identify all officers associated with that firm. Then all firms associated with each of those officers are added to the group. We then reiterate, finding all firms associated with each of the newly added officers, and again find all officers associated with the newly added firms. This process continues until the group is not enlarged by iterating, whereupon all of the observations in this group are set aside from the original sample, and the remaining observations are processed for the next group. This continues until all officers and firms have been assigned into their own unique group. Once groups are assigned, we repeat our regression analysis but now include both firm- and officer-level fixed effects.[15] Our results, summarized in Table A.2 of the appendix, remain robust, suggesting that the differences in compensation of men and women are not due to individual characteristics such as risk aversion, negotiation ability, self-selection, or productivity.

Workplaces differ along many dimensions, such as culture, type of work, and power arrangements. An important qualification implied by these differences is that any results obtained by studying one workplace need not be directly applicable to another. Although our results are robust to a variety of controls and to our using conservative estimation procedures, one should be careful not to extrapolate them to settings outside the U.S. corporate offices.

5. Results

5.1. Summary Statistics

We provide statistics on the number of officers in our study and summarize the differences between characteristics of male and female officers in Table 1. Our sample includes 23,228 CEOs and other officers over 16 years. The number of observations of officers working for a CEO of opposite gender is large: 1,224 for male officers and 3,914 for female officers. The sample also includes over 50,000 observations where the genders of wage setters and wage receivers match. Consistent with the literature discussed earlier, we find that women have significantly lower salaries, bonuses, and total compensation. However, female officers are also on average younger and with shorter tenures at the firm than are their male peers.

In Table 2 we present the number of observations and the comparison of salary, bonus, compensation, age, and tenure by gender and by industry (panel A) or titled position (panel B).[16] Some industries (e.g., retail) and job titles (e.g., vice president (VP) of human resources) are well represented by women, whereas others are clearly dominated by men (e.g., shipbuilding, VP of engineering). The differences in gender representations along these two dimensions motivate us to include industry and title dummies in our analysis.

Table 3 reports the mean, median, quartile, and standard deviation for CEO, officer, and firm characteristics. The average CEO is 55 years old with over six years of tenure with the firm (panel A). The average officer is 51 years old with nearly four years of tenure (panel B). CEOs earn on average over two times more in total compensation than do other officers ($1.2 million versus $531,000). Firm-level summary statistics shown in panel C are in line with those reported in prior literature (e.g., Brick et al. 2006).

5.2. Gender Wage Gap: Evidence from Sorts on CEO Age and Sex

We begin the analysis of the wage differences between genders by performing a simple sort. Every year, we assign officers into groups conditional on CEO gender and sort them into tertiles by CEO age. For each officer and year, we then compute excess compensation as the difference between their compensation and industry-year median pay. Finally, we calculate the average excess compensation for each CEO age-tertile and CEO gender combination. Table 4 reports the results of these calculations.

The sorting procedure yields several interesting insights. First, consistent with H1, male CEOs pay male officers substantially more than they do their female subordinates. This result holds robustly irrespective of CEO age. For example, male officers working for

[15] Following the suggestion in Abowd et al. (2002), we conduct the AKM analysis on the first group alone. This group contains over 38% of all observations, whereas the next largest set contains just 0.8% of the observations.

[16] In panel A we show the proportionate frequency of male CEOs overseeing female officers, and vice versa. In panel B, this statistic is less meaningful and hence omitted for brevity. For example, every company has a chief financial officer, so the reported figures would reflect what is already shown in Table 1.

Table 2 Summary Statistics by Industry and Officer Title

	Observations					Salary		Bonus		Total comp.		Age		Tenure	
Industry	M	F	%F	%MF	%FM	M	F	M	F	M	F	M	F	M	F
A: Summary by industry															
Tobacco products	54	9	14.3	27.8	55.6	618	592*	282	0***	899	592*	53	56	2.8	2.9
Retail	3,724	599	13.9	6.9	87.3	442	449***	131	111	573	560	52	49***	4.8	4.2***
Fabricated products	50	8	13.8	12.0	75.0	256	227	79	28	335	255	49	45**	3.2	8.8***
Real estate	32	5	13.5	0.0	100.0	398	425	21	28	419	453	49	58***	3.3	4.0
Consumer goods	944	133	12.3	2.4	89.5	438	372**	152	93*	589	465**	54	49***	4.4	3.9
Healthcare	771	104	11.9	1.4	100.0	347	292***	81	50**	428	342***	50	51	3.8	4.0
Restaurants, hotels, motels	1,077	133	11.0	4.3	85.0	382	307***	133	71***	514	378***	51	46***	4.7	4.3*
Personal services	761	88	10.4	2.8	95.5	353	285***	100	76	453	361**	52	50***	4.6	4.1
Communication	1,041	116	10.0	4.3	93.1	561	411***	379	113***	940	524***	52	50***	4.1	4.4
Apparel	855	90	9.5	1.4	98.9	442	352***	138	56***	580	408***	51	49***	4.6	3.6***
Printing and publishing	326	33	9.2	16.0	100.0	481	544***	205	226	686	770**	54	54	5.5	5.4
Utilities	2,203	218	9.0	1.6	99.1	386	326***	73	43	459	370***	53	51***	4.8	4.1***
Entertainment	524	50	8.7	4.0	100.0	510	592**	360	258	870	850	50	46***	4.8	3.8**
Pharmaceutical products	2,116	197	8.5	4.6	95.4	409	416*	146	146	556	562*	52	49***	4.6	3.8***
Business services	5,414	472	8.0	3.3	92.6	359	356***	141	103***	500	458***	50	48***	4.1	3.7***
Insurance	2,013	174	8.0	1.8	94.3	458	393***	276	112**	734	506***	52	51*	5.1	3.6***
Metal mining	144	12	7.7	0.0	100.0	457	526	204	57	661	583	54	48***	5.3	3.5
Banking	3,979	316	7.4	1.8	95.9	394	361***	248	188	642	549*	53	52***	4.6	3.9***
Food products	1,032	77	6.9	2.4	100.0	423	454	207	286	630	740	54	53	5.2	4.5
Medical equipment	1,572	114	6.8	0.0	100.0	312	279**	69	55	381	335*	51	49***	4.7	4.0***
Construction	665	48	6.7	0.0	100.0	452	296***	534	144**	987	440***	54	46***	6.1	2.7***
Transportation	1,421	102	6.7	0.6	100.0	309	306	172	89**	481	395**	52	49***	5.3	4.1**
Computers	1,812	127	6.5	0.3	99.2	358	345	119	118**	476	462	50	50	3.9	3.1***
Trading	1,274	85	6.3	0.0	100.0	376	375	1,177	624	1,553	998	51	48***	4.1	2.9***
Wholesale	1,834	122	6.2	0.1	100.0	351	266***	147	78***	498	344***	52	48***	4.8	4.1***
Defense	225	13	5.5	19.1	100.0	339	427	214	420	552	847	56	51**	6.2	2.7*
Coal	106	6	5.4	0.0	100.0	443	451	77	35	520	486	51	53	4.5	3.5
Chemicals	1,416	76	5.1	1.0	100.0	364	319***	113	25***	478	344***	53	53	5.0	4.4
Recreation	312	16	4.9	1.6	100.0	494	437	256	212	751	649	53	47**	4.9	2.8**
Electrical equipment	607	30	4.7	0.0	100.0	344	235***	107	12**	452	247***	53	49**	4.7	3.7
Beer and liquor	213	10	4.5	10.3	80.0	605	712	330	1,009**	935	1,721**	55	50***	4.2	6.0
Measuring and control equip	1,157	55	4.5	0.7	85.5	299	278**	71	40***	370	318***	52	53	4.7	5.4
Automobiles and trucks	986	45	4.4	0.2	100.0	329	255*	196	39***	525	293***	53	49***	5.2	2.3***
Electronic equipment	3,475	154	4.2	0.8	98.7	308	295	106	39***	414	334***	52	49***	4.8	3.4***
Machinery	1,963	84	4.1	2.0	94.0	335	277**	84	11	418	288**	53	49***	4.6	4.1**
Rubber and plastic products	290	12	4.0	3.4	83.3	362	323	121	93	482	416	53	46***	4.4	3.6
Business supplies	749	28	3.6	0.0	100.0	416	387**	91	3	507	390**	54	50***	5.1	3.7**
Aircraft	337	12	3.4	0.0	100.0	550	495	306	15	856	510	56	51**	5.5	4.9
Textiles	212	7	3.2	1.9	100.0	369	293	104	71	473	364	55	49**	4.2	3.9
Construction materials	924	31	3.2	2.7	100.0	326	329***	140	19***	466	348***	55	53	5.1	3.9***
Petroleum and natural gas	2,275	74	3.2	0.8	95.9	381	390	281	238	662	627	52	51	4.7	4.3**
Almost nothing	286	9	3.1	0.0	100.0	366	416	138	9*	504	425	50	53	4.7	3.3
Steelworks, etc.	1,003	32	3.1	2.0	90.6	339	324	150	32	489	356	54	50***	4.9	5.2
Candy and soda	81	2	2.4	0.0	100.0	469	298**	148	0	617	298*	52	48	5.1	1.0**
Agriculture	168	3	1.8	0.0	100.0	312	213	104	48	416	261	52	48	4.5	4.0
Precious metals	116	2	1.7	0.0	100.0	391	295**	118	0	509	295**	52	44	3.2	1.5
Shipbuilding, rail equipment	129	2	1.5	0.0	100.0	375	427	123	0	498	427	54	53	4.4	1.5
Shipping containers	315	3	0.9	0.0	100.0	380	229***	92	0*	472	229***	56	50	5.3	2.7**

a middle-aged male CEO earn on average $85,880 more per year than do their female peers. Providing further support to our H1, Table 4 also suggests that an average female CEO compensates female officers better than male ones, but the resulting gender pay gap is much smaller.

Second, consistent with H2, the gender pay gap increases with the age of a male CEO. The difference in compensation of male and female officers is $78,390 in firms headed by young male CEOs and increases to $103,040 in firms headed by old CEOs. The pay gap also increases with the age of female CEOs. Whereas young and middle-aged women compensate their female subordinates more richly than male ones, older women actually pay men more. We caution, however, that the female CEOs/female officers category contains a small number of observations (0.4% of the entire sample).

Table 2 (Continued)

Industry	Observations			Salary		Bonus		Total comp.		Age		Tenure	
	M	F	%F	M	F	M	F	M	F	M	F	M	F
B: Summary by officer title													
Senior VP human resources	97	78	44.6	274	281	42	22	316	303	53	52	1.8	2.7**
Executive VP merchandising	16	7	30.4	417	544	56	27	473	571	51	45**	4.1	2.6
VP human resources	109	42	27.8	227	226	23	11	251	238	53	51**	2.9	3.3
Executive VP human resources	31	8	20.5	303	318	124	46	427	364	51	53	3.8	2.1
Chief marketing officer	84	19	18.4	340	380	122	94	462	474	50	44***	5.1	1.9***
VP administration	31	7	18.4	139	173*	44	0*	183	173	57	60	3.9	3.6
Chief administration officer	161	36	18.3	409	355*	313	183	722	539	53	51	4.1	4.0
Controller	72	15	17.2	202	226	49	24	251	250	49	47	2.1	3.0
Co-CEO	64	10	13.5	409	590**	433	743	842	1,333	52	52	5.5	7.2
General counsel	1,874	260	12.2	344	353	102	77	446	430	52	50***	4.1	3.4**
Co-chairman	62	8	11.4	435	688**	459	906	894	1,593	56	55	5.8	8.5**
Secretary	1,705	220	11.4	310	319	95	89	405	408	51	50***	4.6	4.0**
Senior VP marketing	105	13	11.0	249	353***	77	166**	326	519***	50	47	4.2	5.0
Executive VP sales	34	4	10.5	260	204	142	179	401	383	53	38***	6.1	4.5
Senior VP of corporate development	44	5	10.2	267	195***	77	19	344	214**	48	41*	3.2	4.0
Principal accounting officer	729	74	9.2	364	368	49	24	413	392	49	48	5.4	4.7
VP	1,750	164	8.6	272	268	99	56**	371	323**	50	49	3.5	3.4
Chief information officer	108	10	8.5	301	256	165	36	466	292	51	49	2.0	1.8
VP research and development	11	1	8.3	157	142	41	78	199	220	48	54	0.0	0.0
Treasurer	1,047	93	8.2	305	302	98	92	403	394	50	46***	4.9	4.8
Other	27,370	2,326	7.8	382	373*	170	116***	552	489***	52	50***	4.7	3.9***
Executive VP, finance	71	6	7.8	386	262*	219	12	605	274*	52	49	4.7	3.5
Senior VP operations	217	17	7.3	276	270	95	41	371	311	52	51	3.7	2.8
Executive VP	6,392	480	7.0	393	405	170	140	563	545	51	49***	4.7	4.1***
VP marketing	80	6	7.0	185	211	56	57	242	268	49	40***	3.6	2.5
Chief financial officer	7,412	554	7.0	368	363	136	121	504	484	50	48***	4.5	3.9***
Senior VP	3,632	259	6.7	339	329	104	74**	443	403**	51	49***	4.3	3.5***
Executive director	111	7	5.9	717	779	36	0	753	779	54	52	8.5	7.3
Consultant	39	2	4.9	407	615	62	0	469	615	56	50	7.8	10.0
Senior VP (world) sales	104	5	4.6	259	289	66	347***	326	636***	49	47	3.3	3.6
Director, managing	1,365	64	4.5	669	662	209	84	878	746	53	52	7.3	6.8
VP, group	92	4	4.2	369	431	168	105	537	536	55	61*	4.3	3.3
Executive VP, operations	232	10	4.1	359	358	124	25	483	383	51	53	5.0	5.7
VP manufacturing	27	1	3.6	263	149	99	0	362	149	56	45	3.9	4.0
VP (world) sales	140	5	3.4	214	255	65	283***	279	538***	49	44*	3.1	2.4
VP finance	283	10	3.4	254	214	91	240***	345	454	51	46**	4.1	2.4
Chief operating officer	4,670	158	3.3	464	515***	344	254	808	769	51	50**	5.0	4.8
Vice chairman	1,092	33	2.9	542	515	541	437	1,084	951	57	52***	5.9	4.8
President	15,384	418	2.6	589	620**	439	310**	1,028	929*	54	51***	6.1	6.0
CEO	22,442	502	2.2	675	692	526	260***	1,202	952***	56	53***	6.9	6.9
Senior executive VP	226	5	2.2	420	413	406	60	826	473	53	46**	4.8	4.0
Chief technology officer	92	2	2.1	330	303	96	0	426	303	53	59	3.6	6.0
Senior VP finance	119	2	1.7	363	174	105	25	468	199	51	42*	4.1	2.5
Chairman	12,749	191	1.5	701	763**	665	359**	1,366	1,122*	58	54***	7.1	7.7*
VP operations	152	2	1.3	240	213	62	0	302	213	51	47	3.6	0.0
Executive chairman	132	0	0.0	787	—	381	—	1,168	—	61	—	9.7	—
President, group	50	0	0.0	538	—	176	—	715	—	52	—	3.3	—
Chief investment officer	12	0	0.0	365	—	791	—	1,157	—	50	—	4.7	—
Executive VP marketing	45	0	0.0	295	—	76	—	371	—	51	—	3.4	—
Executive VP corporate development	23	0	0.0	321	—	33	—	354	—	52	—	3.9	—
Senior VP administration	17	0	0.0	288	—	51	—	339	—	55	—	3.7	—
VP engineering	50	0	0.0	198	—	43	—	241	—	49	—	3.3	—
VP of corporate development	50	0	0.0	200	—	62	—	261	—	49	—	2.6	—

Notes. This table reports in panel A the number of male (M) and female (F) officer-year observations, the proportion of female officer-year observations (%F), and the proportions of observations when a male officer works for a female CEO (%MF) and a female officer works for a male CEO (%FM). The table also shows the breakdown by officer gender of average salary, bonus, and total compensation (in thousands of dollars) as well as of age and tenure (in years). The results are reported for each of the 48 industries as defined in Ken French's data library. Panel B shows summary statistics by officer title. Because of a lack of variation in %MF and %FM in panel B, these variables are omitted. The panels are sorted by the proportion of female officer-years (%F). The sample period is 1996–2011.

*, **, and *** correspond to characteristics for which the *F*-test indicates that the difference between men and women is statistically different from zero at better than 10%, 5%, and 1%, respectively.

Table 3 Officer and Firm Summary Statistics

	Mean	25th percentile	Median	75th percentile	Standard deviation
		A: CEO characteristics			
Age (years)	55.49	51	55	60	7.52
Fraction male	0.98	1	1	1	0.13
Tenure (years)	6.91	2	4	9	7.22
Salary (thousands)	675	440	630	875	367
Bonus (thousands)	520	0	150	583	1,524
Total compensation (thousands)	1,195	578	875	1,333	1,643
		B: Officer characteristics			
Age (years)	51.50	46	51	57	7.84
Fraction male	0.94	1	1	1	0.23
Tenure (years)	3.95	2	3	5	3.04
Salary (thousands)	327	201	283	400	201
Bonus (thousands)	205	0	75	216	622
Total compensation (thousands)	531	260	385	595	702
		C: Firm characteristics			
Tobin's Q	1.70	0.82	1.22	1.98	1.75
Sales (million of dollars)	4,699	426	1,125	3,455	14,648
Employees (thousands)	17.91	1.69	4.96	14.4	56.84
Return on assets	0.13	0.08	0.13	0.19	0.12
Volatility of return on assets	0.05	0.02	0.03	0.06	0.06
Three-year stock return run-up	0.63	−0.13	0.28	0.85	2.03
Stock return volatility (annual)	0.43	0.28	0.38	0.52	0.22
R&D expense-to-assets ratio	0.03	0.00	0.00	0.03	0.06
Advertising expense-to-assets ratio	0.01	0.00	0.00	0.01	0.04
Debt-to-assets ratio	0.22	0.06	0.20	0.33	0.19
PPE-to-assets ratio	0.28	0.09	0.21	0.41	0.23
Capital expenditures-to-assets ratio	0.05	0.02	0.04	0.07	0.06
Number of directors	9.50	8.00	9.00	11.00	2.69
Proportion of female directors	0.10	0.00	0.10	0.15	0.09
Directors on comp. committee	3.29	3.00	3.00	4.00	1.56
Prop of women on comp. committee	0.11	0.00	0.00	0.25	0.16

Notes. This table reports summary statistics for officer and firm characteristics. Panel A provides statistics for CEOs, and panel B provides statistics for all officers other than CEOs. Panel C provides summary statistics on firm characteristics. Detailed variable definitions are provided in Table A.1 of the appendix. The sample period is 1996–2011.

Finally, the age of male CEOs is highly correlated with the total compensation of both male and female officers. For example, male officers earn on average $80,000 per year more when the firm is headed by an older male CEO than they do when it is headed by a younger male CEO. The corresponding number for female officers is also large, at almost $55,000 per year, or over 14% of median officer compensation.

To test the significance of the reported differences in compensation of various groups, we conduct nonparametric Wilcoxon–Mann and Kruskal–Wallis tests. In all cases the differences in means are significant at better than 1%, establishing that compensation is affected by CEO gender, CEO age, and officer gender, both independently and jointly.

5.3. Gender Wage Gap: Evidence from Regression Analysis

The sort-based approach used above is simple and informative, but such an analysis is limited because it only controls for differences in compensation across industries and time when calculating the gender wage gap. Undoubtedly, other factors play important roles in determining officer pay, and we now turn to studying gender wage differences in a multivariate regression setting.

Table 5 reports the results of several specifications of our regression (see §4.1). In specification (1), the positive and statistically significant coefficient on the *Male officer* dummy suggests that male officers receive significantly higher compensation than their female peers do. This result holds robustly even after controlling for a variety of officer and firm characteristics and suggests that gender wage gap is as present in corporate offices as it is in other settings studied in prior literature.

The remaining specifications provide strong evidence that age and gender of wage setters affect the compensation of wage receivers. Specification (2) validates our H1. The inclusion of the *Opposite gender* dummy nullifies the significance of the *Male officer* dummy, suggesting that the gender interaction has a greater effect on compensation than does officer gender alone. The *Opposite gender* dummy is negative and significant, indicating that CEOs pay officers of the opposite gender less than they do officers of their own gender.

Table 4 Excess Compensation Conditional on CEO Age and Gender

	Female CEOs			Male CEOs		
	Young	Middle-aged	Old	Young	Middle-aged	Old
Female officers	83.91	86.92	−90.50	8.59	65.75	63.64
Male officers	25.84	73.15	−79.40	86.98	151.63	166.68
Gender pay gap	−58.08	−13.77	11.10	78.39	85.88	103.04

Notes. This table reports mean total compensation in excess of industry-year median level. For each officer-year observation, excess compensation is computed as the difference between officer compensation and matched industry-year median pay. The average excess compensation is then calculated and reported, in thousands of dollars, for male and female non-CEO officers conditional on CEO age-tertile and gender. The bottom row shows the gender pay gap: the difference in excess compensation of male and female officers conditional on CEO gender and age. The sample period is 1996–2011.

The relative statistical significance of the *Misogyny* variable in regression (3), compared with *Misandry* in specification (4), indicates that the gender pay gap is primarily driven by male CEOs paying female officers less than they do male officers. The *Misandry* dummy in specification (4) suggests that female CEOs also favor officers of their own gender, but this effect is significant only at the 10% level. These results echo the sort-based findings summarized in Table 4 and provide new evidence on the sources of the gender pay gap. Gender of the wage setter affects the compensation of the wage receiver, with male employers compensating male workers richly and female employers paying more to female subordinates.

Regression (5) confirms H2. The coefficient on the *Generational sexism* variable is negative and highly significant, suggesting that the difference in compensation of male and female officers increases with CEO age. This effect could be attributed to either a CEO's ageing or to older CEOs' having been raised in a cohort with different societal norms. To differentiate between these two possibilities, in unreported results, we replace the year dummies with a variable equal to the calendar year as a control in the model specifications of Table 5. The inclusion of this variable permits compensation to be determined by the passage of time allowing the *Generational sexism* variable to strictly capture the effect of male CEOs' ageing. The statistical and economic significance of all variables of interest is unchanged when calendar years are included in the regression, suggesting that the level of discrimination is primarily due to a CEO's growing older rather than to evolving social norms.

Economically speaking, our gender variables have greater impact on officer compensation than do firm characteristics we might expect to be important. For example, the coefficient on Tobin's Q has a lower p-value than do the gender variables, but its economic effect is much smaller. A company's Q ratio would need to nearly triple to induce as large an effect on officer salary as having an opposite-gender CEO. Statistically speaking, our measures are significant, whereas the three-year stock return run-up, stock volatility, and lagged return on assets are not.

As we mentioned earlier, corporate offices, and hence our sample, are dominated by men. To ensure that our results are not driven by this gender imbalance, we not only conduct the robustness tests described in §4.3 but also split the sample by male and female CEOs in specifications (6) and (7), respectively. Doing so decreases the power of our tests but allows us to replace the *Misogyny* and *Misandry* variables with a simpler-to-interpret variable that is equal to the *Opposite gender* dummy in each subsample. We find that the economic and statistical significance of the *Misogyny* variable is greatly increased in this alternative specification, whereas the coefficient on the *Misandry* variable decreases in economic significance and becomes statistically indistinguishable from zero. This evidence confirms that our results are primarily driven by male CEOs paying female officers less.

In specifications (8) and (9), we change the dependent variable from total compensation to either salary or bonus respectively. To the degree that bonus—not being explicitly written as a set dollar value in the employment contract—varies relatively more with officer productivity than salary does, we can use this decomposition to determine whether female officers are less productive when working for a male CEO. Although separating our sample weakens the strength of our results, the effect remains economically and weakly statistically significant in both salary and bonus. The misogyny effect in the bonus pay is consistent with female officers being less productive or being perceived by male CEOs as less productive. However, effects in the salary component of compensation suggest that productivity-based explanations do not account entirely for the disparity in total compensation. Rather, a genuine opposite-gender effect outside of perceived productivity appears to be in play.

5.4. Quantifying Effects of Age and Sex on Officer Compensation

In line with prior literature, we use a log of total compensation as the dependent variable in the regressions of Table 5. Consequently, the dollar-level effects of a marginal change in each variable of interest on officer compensation cannot be readily interpreted. We thus report in Table 6 the estimated dollar-level effects of each regressor from Table 5 by reconstructing each officer's log compensation observation from the estimated regression model and marginally adjusting the variable before exponentiation to recover dollar units. Since this reconstruction is done observation by observation, it provides a distribution of dollar values. In Table 6 we

Table 5 Determinants of Officer Compensation: Effects of CEO and Officer Gender

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable =	*Total comp.*	*Total comp.*	*Total comp.*	*Total comp.*	*Total comp.*	*Total comp.*	*Total comp.*	*Salary*	*Bonus*
Sample restriction =	None	None	None	None	None	Male CEOs	Female CEOs	None	None
Constant	3.226*** [0.145]	3.335*** [0.152]	3.257*** [0.145]	3.337*** [0.152]	3.254*** [0.145]	3.252*** [0.145]	1.385*** [0.433]	3.634*** [0.116]	−0.002 [0.319]
Male CEO	0.054 [0.035]	0.006 [0.033]	0.061* [0.035]	−0.027 [0.047]	0.061* [0.035]			0.042 [0.034]	0.261*** [0.080]
CEO age (years)	0.002*** [0.001]	0.002*** [0.001]	0.002*** [0.001]	0.002*** [0.001]	0.002*** [0.001]	0.003*** [0.001]	−0.012 [0.010]	0.001* [0.001]	0.000 [0.002]
CEO tenure (years)	0.008*** [0.002]	0.008*** [0.002]	0.008*** [0.002]	0.008*** [0.002]	0.008*** [0.002]	0.008*** [0.002]	−0.034 [0.033]	0.005** [0.002]	0.014** [0.006]
Log CEO total compensation	0.178*** [0.023]	0.177*** [0.023]	0.178*** [0.023]	0.177*** [0.023]	0.178*** [0.023]	0.177*** [0.023]	0.625*** [0.063]	0.079*** [0.020]	0.342*** [0.044]
Number of directors	0.017*** [0.003]	0.017*** [0.003]	0.017*** [0.003]	0.017*** [0.003]	0.017*** [0.003]	0.019*** [0.003]	0.010 [0.026]	0.013*** [0.002]	0.016** [0.006]
Prop. of female directors	−0.268*** [0.070]	−0.268*** [0.070]	−0.266*** [0.070]	−0.284*** [0.070]	−0.267*** [0.070]	−0.263*** [0.073]	−0.007 [0.225]	0.210*** [0.072]	−0.050 [0.216]
Directors on comp. committee	−0.019*** [0.004]	−0.019*** [0.004]	−0.019*** [0.004]	−0.019*** [0.004]	−0.019*** [0.004]	−0.022*** [0.004]	0.032 [0.063]	−0.001 [0.005]	−0.013 [0.012]
Prop of women on comp. committee	0.040 [0.035]	0.039 [0.035]	0.039 [0.035]	0.042 [0.035]	0.040 [0.035]	0.045 [0.035]	0.177 [0.126]	0.011 [0.036]	−0.206** [0.102]
Officer age (years)	0.003*** [0.001]	0.003*** [0.001]	0.003*** [0.001]	0.003*** [0.001]	0.003*** [0.001]	0.002*** [0.001]	0.010 [0.007]	0.004*** [0.001]	0.006*** [0.002]
Officer tenure (years)	0.021*** [0.001]	0.021*** [0.001]	0.021*** [0.001]	0.021*** [0.001]	0.021*** [0.001]	0.026*** [0.001]	0.028*** [0.006]	0.021*** [0.001]	0.024*** [0.005]
Male officer	0.038** [0.017]	−0.026 [0.031]							
Opposite gender		−0.071** [0.031]							
Misogyny			−0.045** [0.017]			−0.068*** [0.017]		−0.028* [0.015]	−0.103* [0.057]
Misandry				−0.098* [0.059]			−0.033 [0.051]		
Generational sexism					−0.001** [0.000]				
Tobin's Q	0.025*** [0.004]	0.025*** [0.004]	0.025*** [0.004]	0.025*** [0.004]	0.025*** [0.004]	0.025*** [0.004]	0.049** [0.021]	0.001 [0.004]	0.061*** [0.009]
Log sales	0.162*** [0.011]	0.163*** [0.011]	0.162*** [0.011]	0.163*** [0.011]	0.162*** [0.011]	0.163*** [0.011]	0.023 [0.034]	0.164*** [0.011]	0.263*** [0.026]
Log number of employees	0.017** [0.007]	0.017** [0.007]	0.017** [0.007]	0.017** [0.007]	0.017** [0.007]	0.019** [0.008]	0.020 [0.028]	−0.003 [0.007]	0.056** [0.022]
Return on assets, previous year	0.032 [0.084]	0.031 [0.084]	0.032 [0.084]	0.029 [0.084]	0.032 [0.084]	0.043 [0.084]	−0.806* [0.485]	−0.067 [0.063]	0.148 [0.198]
Return on assets, 3-year average	−0.375*** [0.098]	−0.375*** [0.098]	−0.375*** [0.098]	−0.376*** [0.098]	−0.374*** [0.098]	−0.370*** [0.097]	0.367 [0.537]	−0.207** [0.085]	−0.513** [0.222]
Volatility of return on assets	0.243** [0.115]	0.243** [0.115]	0.244** [0.115]	0.240** [0.115]	0.243** [0.115]	0.217** [0.116]	0.452 [0.797]	0.261** [0.106]	0.921*** [0.264]
Three-year stock return run-up	0.010 [0.006]	0.010 [0.006]	0.010 [0.006]	0.010 [0.006]	0.010 [0.006]	0.013** [0.007]	0.017 [0.022]	−0.001 [0.002]	0.017* [0.009]
Stock return volatility	−0.021 [0.018]	−0.021 [0.018]	−0.021 [0.018]	−0.021 [0.018]	−0.021 [0.018]	−0.001 [0.018]	−0.206 [0.127]	−0.006 [0.014]	0.067 [0.060]
R&D expense-to-assets ratio	0.094 [0.141]	0.093 [0.141]	0.093 [0.141]	0.098 [0.141]	0.094 [0.141]	0.098 [0.142]	0.041 [1.184]	0.045 [0.134]	0.762** [0.309]
Advertising expense-to-assets ratio	0.260* [0.139]	0.261* [0.139]	0.259* [0.139]	0.266* [0.139]	0.260* [0.139]	0.239* [0.141]	0.228 [0.648]	0.443*** [0.158]	−0.263 [0.429]
Debt-to-assets ratio	0.157*** [0.028]	0.156*** [0.028]	0.157*** [0.028]	0.159*** [0.028]	0.157*** [0.028]	0.177*** [0.029]	0.368 [0.230]	0.013 [0.025]	0.361*** [0.073]
PPE-to-assets ratio	−0.176*** [0.039]	−0.175*** [0.039]	−0.176*** [0.039]	−0.175*** [0.038]	−0.176*** [0.039]	−0.160*** [0.040]	−0.125 [0.118]	−0.077** [0.037]	−0.684*** [0.127]
Capital expenditures-to-assets ratio	0.533*** [0.109]	0.531*** [0.109]	0.532*** [0.109]	0.533*** [0.109]	0.532*** [0.109]	0.563*** [0.111]	0.308 [0.493]	0.195*** [0.085]	1.457*** [0.284]
Adjusted R^2	0.382	0.383	0.382	0.382	0.382	0.369	0.277	0.312	0.361
Observations	38,360	38,360	38,360	38,360	38,360	38,947	990	38,349	16,480
Clusters	13,758	13,758	13,758	13,758	13,758	13,586	455	13,754	7,666
Title, year, industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes. This table reports results of regressions of log of annual officer compensation on CEO, officer, board of directors, and firm characteristics. Standard errors are clustered by officer. Regressions (6) and (7) restrict the sample to firm-years with male and female CEOs, respectively. The combined number of observations in these regressions is larger because of a reduction in restrictions imposed by title dummies. Regressions (8) and (9) use log of salary and log of bonus of the officer as dependent variables. The *Opposite gender* dummy is set to 1 if the CEO and the officer are of opposite genders. *Misogyny* and *Misandry* are computed as products of dummy variables based on the CEO's being male or female and the opposite gender dummy. *Generational sexism* is the product of the *Misogyny* dummy and *CEO age*. Regressions include year, industry, and officer title fixed effects. For each regressand, the table reports parameter estimates, standard errors in brackets, and asterisks indicating significance. The sample period is 1996–2011. Table A.1 in the appendix provides variable definitions.

*, **, and *** correspond to 10%, 5%, and 1% levels of significance, respectively.

therefore report not only the mean but also the selected percentiles of the distribution to provide a better sense of the dollar-level effect of a marginal change in each factor on officer compensation.

The results indicate that male officers receive on average $2,960 more in annual compensation than female officers do.[17] Although this value is significant, at better than 5%, and its sign is consistent with prior literature, the economic significance is low after including all of our controls. An important insight of our findings is that the opposite gender, rather than the gender alone, is an influential determinant of officer compensation. Officers who are of the opposite gender to their CEO earn $34,240 per year less, and the effect is even more pronounced when the CEO is male. The results suggest that female officers working for a male CEO earn on average $46,500 per year less than male officers do. Female CEOs exhibit less evidence of gender pay disparity. Male officers working for women earn $21,960 less than female officers do. We also estimate that male CEOs pay $15,210 per year more than female CEOs pay.

An unconditional increase in one year of CEO age is associated with an increase in officer compensation of $970 per year. However, male CEOs reward female officers $360 less per year of age than they do male officers, as implied by the *Generational sexism* coefficient. Female officers are therefore estimated to receive only $610 per year for each year of male CEO age, or 62% of the benefit that male officers receive from a CEO's age.

5.5. Effects of CEO Turnover on Officer Compensation

We next consider the impact of changes in chief executives on officer compensation. If CEOs pay officers of the opposite gender less than officers of their own gender, a change in CEO should affect subsequent officer compensation. In particular, we expect male officers to benefit when a male CEO replaces a female CEO, and we expect female officers to benefit when a female CEO replaces a male CEO.[18] To test this conjecture empirically, we introduce a new variable, the *Expected compensation increase* dummy, which we set to 1 if either of the above favorable possibilities occurs and to 0 otherwise. We then regress officer compensation on this variable and other officer- and firm-level characteristics. Our sample contains 11,451 officer-year observations where a CEO changes. A male CEO replaces a male 94.3% of the time and a female 2% of the time; the figures for an incoming female CEO are 3.5% and 0.2% for men and women, respectively.

The results of the analysis of CEO changes are presented in Table 7. In each regression specification, the coefficient on the *Expected compensation increase* dummy is positive and significant, in support of H3, that officer compensation responds predictably to the replacement of a CEO. Even including an exhaustive list of control variables and conservatively estimating standard errors in specification (3) gives results that are statistically significant at better than 10%. These results corroborate the earlier evidence that CEO gender is an important determinant of how male and female officers are compensated. Officers benefit when a departing CEO of the opposite gender is replaced by a CEO of the same gender as themselves.

5.6. Evidence from Officer Pay Increases

The gender pay gap is the sum of the differences between starting wages of male and female officers and the cumulative differences in their pay increases. If characteristics of the wage-setting CEO affect officer compensation as the results presented thus far suggest, then the same characteristics should have predictable implications for officer pay increases. We therefore analyze changes from one year to the next in log officer compensation.[19] Supporting our earlier findings, the results summarized in Table 8 suggest that male officers enjoy more positive raises and that all of our gender variables remain at least weakly significant except for *Misandry*. The coefficients on the *Opposite gender* dummy and *Misogyny* variables suggest that male CEOs give smaller raises to female officers, and the negative sign on the *Generational sexism* variable indicates that this effect is exacerbated if the male CEO is older. Taken together, the evidence is in support of H4, that compensation increases more rapidly when the officer is subordinate to a CEO of the same gender.

Persistent differences in pay increases of male and female officers can over time amount to substantial differences in their compensation and hence result in the gender pay gap. Figure 2 shows how the differences in wages of male and female officers accumulate during their tenure under either a male or a female CEO.[20]

[17] The values here are computed when controlling for a multitude of variables listed in Table 5 and are hence distinct from those reported in Table 4, which are obtained when including only industry and year as determinants of officer compensation.

[18] It is also interesting to consider how officer compensation is affected when an officer moves to another company and starts working for a new CEO. This analysis is limited by two factors. First, the data set contains fewer than 500 observations of such job shifts, and in the vast majority of them, the gender of the CEOs at the old and the new firms of employment is the same. Second, officer compensation is affected by the job change for reasons unrelated to CEO gender and for which no proxies are readily available.

[19] The sample is smaller than in our previous regressions because two consecutive years of officer compensation are needed to compute the change.

[20] We plot only the first five years of cumulative wage gaps under female CEOs. This restriction is necessary because the sample of female officers working for female CEOs for more than five years is very small, and computing the wage gap for the sixth year and beyond becomes untenable.

Table 6 Dollar Effects of Marginal Changes in Characteristics on Officer Compensation

Variable	Mean	Standard deviation	Percentiles						
			1st	5th	10th	50th	90th	95th	99th
Male officer	2.96	1.50	1.09	1.43	1.63	2.62	4.69	5.68	8.13
Male CEO	15.21	7.69	5.61	7.36	8.36	13.44	24.11	29.20	41.76
Opposite gender	−34.24	17.28	−94.47	−65.83	−54.20	−30.25	−18.84	−16.61	−12.65
Misogyny	−46.50	23.52	−127.6	−89.40	−73.72	−41.09	−25.55	−22.51	−17.19
Misandry	−21.96	11.10	−60.31	−42.11	−34.77	−19.41	−12.07	−10.62	−8.10
Generational sexism	−0.36	0.18	−1.00	−0.70	−0.58	−0.32	−0.20	−0.18	−0.13
CEO age	0.97	0.49	0.36	0.47	0.53	0.86	1.54	1.86	2.67
Officer age	1.50	0.76	0.55	0.72	0.82	1.32	2.37	2.87	4.11
CEO tenure	4.08	2.07	1.51	1.97	2.24	3.61	6.47	7.84	11.22
Officer tenure	10.58	5.36	3.90	5.11	5.81	9.35	16.77	20.31	29.07

Notes. This table reports the estimated change in the officer total compensation (in thousands of dollars) stemming from a marginal change in the characteristics of either the officer or the CEO. Since total compensation is log transformed, the regression parameter estimates are not easily interpretable, and the dollar value of each variable is conditional on the level of the predicted compensation. The distribution of marginal effects is therefore computed by subtracting the predicted log compensation after exponentiation from the predicted log compensation after exponentiation and adjusted for a marginal change in the variable of interest. For dummy variables, the reported estimates give an increase in officer compensation due to a dummy increasing from 0 to 1. For all other variables, the reported estimates show the increase in officer compensation as these variables increase by one year. Unreported controls for the predictive model of compensation include the same set of firm and board of directors characteristics as well industry and title dummies identical to those of Table 5. *Opposite gender* is a dummy variable set to 1 if the CEO and the officer are of opposite genders. *Misogyny* and *Misandry* are computed as products of dummy variables based on the CEO's being male or female and the *Opposite gender* dummy. Generational sexism is the product of the *Misogyny* dummy and *CEO age*. Detailed variable definitions are provided in Table A.1 of the appendix. The sample period is 1996–2011.

Table 7 Effects of CEO Turnover on Officer Compensation

Variable	(1)	(2)	(3)
Constant	−0.136 [0.125]	−0.053 [0.154]	−0.033 [0.159]
Expected compensation increase	0.322** [0.156]	0.306** [0.146]	0.289* [0.152]
Officer age (years)	−0.005*** [0.001]	−0.004*** [0.001]	−0.004*** [0.001]
Officer tenure (years)	−0.025*** [0.003]	−0.025*** [0.003]	−0.025*** [0.003]
CEO age (years)	−0.001 [0.001]	−0.001 [0.001]	−0.002 [0.001]
CEO tenure (years)	−0.003 [0.002]	−0.002 [0.002]	−0.003 [0.002]
Log CEO total compensation	0.110*** [0.013]	0.128*** [0.017]	0.126*** [0.017]
Number of directors	−0.016*** [0.003]	−0.009** [0.003]	−0.010*** [0.004]
Directors on comp. committee	−0.003 [0.008]	−0.003 [0.008]	−0.002 [0.008]
Proportion of female directors	0.353*** [0.123]	0.480*** [0.127]	0.406*** [0.125]
Prop. of women on comp. committee	−0.089 [0.063]	−0.080 [0.062]	−0.065 [0.063]
Tobin's Q		0.011 [0.007]	0.014** [0.007]
Log sales		−0.044*** [0.014]	−0.047*** [0.014]
Log number of employees		0.015 [0.012]	0.020 [0.013]
Return on assets, previous year		−1.080*** [0.214]	−1.170*** [0.214]
Return on assets, 3*-year average*		0.585*** [0.225]	0.648*** [0.220]
Volatility of return on assets		0.556*** [0.183]	0.576*** [0.179]
Three-year stock return run-up		−0.018*** [0.005]	−0.019*** [0.005]
Stock return volatility		0.140** [0.070]	0.153** [0.071]
R&D expense-to-assets ratio		−0.396* [0.216]	−0.349 [0.216]
Advertising expense-to-assets ratio		−0.638** [0.253]	−0.527** [0.251]
Debt-to-assets ratio		−0.042 [0.047]	−0.044 [0.047]
PPE-to-assets ratio		0.274*** [0.077]	0.275*** [0.078]
Capital expenditures-to-assets ratio		−0.505** [0.204]	−0.443** [0.192]
Adjusted R^2	0.050	0.050	0.059
Observations	11,451	11,451	11,451
Clusters	5,047	5,047	5,047
Year and industry fixed effects	Yes	Yes	Yes
Title fixed effects	No	No	Yes

Notes. This table reports results of regressions of log of annual officer compensation on CEO, officer, board of directors, and firm characteristics. Standard errors are clustered by officer. The *Expected compensation increase* dummy is set to 1 if either (i) the officer is male, and a male CEO replaces a female CEO, or (ii) the officer is female, and a female CEO replaces a male CEO; it is set to 0 otherwise. Regressions include year and industry fixed effects. Regression (3) also includes officer title fixed effects. For each regressand, the table reports parameter estimates, standard errors in brackets, and asterisks indicating significance. Detailed variable definitions are provided in Table A.1 of the appendix. The sample includes all firm-year observations when CEO turnover happened during the period 1996–2011.

*, **, and *** correspond to 10%, 5%, and 1% levels of significance, respectively.

Table 8 Changes in Officer Compensation: Effects of CEO and Officer Gender

Variable	(1)	(2)	(3)	(4)	(5)
Constant	0.232*** [0.086]	0.272*** [0.088]	0.269*** [0.087]	0.265*** [0.087]	0.258*** [0.087]
CEO age (years)	−0.002** [0.001]	−0.002** [0.001]	−0.002** [0.001]	−0.002** [0.001]	−0.002** [0.001]
CEO tenure (years)	−0.002* [0.001]	−0.002* [0.001]	−0.002* [0.001]	−0.002* [0.001]	−0.002* [0.001]
Log CEO total compensation	0.060*** [0.009]	0.060*** [0.009]	0.060*** [0.009]	0.060*** [0.008]	0.060*** [0.008]
Number of directors	−0.004 [0.002]	−0.004 [0.002]	−0.004 [0.002]	−0.004 [0.002]	−0.004* [0.002]
Proportion of female directors	0.170* [0.098]	0.175* [0.099]	0.166* [0.097]	0.157 [0.099]	0.208** [0.099]
Directors on comp. committee	−0.012** [0.006]	−0.012** [0.006]	−0.013** [0.006]	−0.013** [0.006]	−0.012** [0.006]
Prop. of women on comp. committee	−0.064 [0.052]	−0.066 [0.053]	−0.063 [0.052]	−0.064 [0.053]	−0.086* [0.052]
Officer age (years)	−0.002* [0.001]	−0.002* [0.001]	−0.002* [0.001]	−0.001* [0.001]	−0.001* [0.001]
Officer tenure (years)	−0.025*** [0.002]	−0.025*** [0.002]	−0.025*** [0.002]	−0.025*** [0.002]	−0.025*** [0.002]
Male officer	0.039* [0.020]				
Opposite gender		−0.034* [0.019]			
Misogyny			−0.035* [0.020]		
Misandry				−0.019 [0.047]	
Generational sexism					−0.001* [0.000]
Tobin's Q	0.017** [0.007]	0.017** [0.007]	0.017** [0.007]	0.017** [0.007]	0.018** [0.007]
Log sales	−0.024*** [0.007]	−0.024*** [0.007]	−0.024*** [0.007]	−0.024*** [0.007]	−0.024*** [0.007]
Log number of employees	0.018*** [0.006]	0.018*** [0.006]	0.017*** [0.006]	0.018*** [0.006]	0.017*** [0.006]
Return on assets, previous year	−0.595*** [0.170]	−0.596*** [0.170]	−0.595*** [0.170]	−0.596*** [0.170]	−0.616*** [0.170]
Return on assets, 3-year average	0.321* [0.192]	0.321* [0.192]	0.320* [0.192]	0.321* [0.192]	0.326* [0.192]
Volatility of return on assets	0.288* [0.148]	0.288* [0.148]	0.289* [0.148]	0.289* [0.148]	0.290* [0.148]
Three-year stock return runup	−0.009** [0.004]	−0.009** [0.004]	−0.009** [0.004]	−0.009** [0.004]	−0.009** [0.004]
Stock return volatility	0.123*** [0.040]	0.123*** [0.040]	0.123*** [0.040]	0.123*** [0.040]	0.130*** [0.040]
R&D expense-to-assets ratio	−0.169 [0.168]	−0.169 [0.168]	−0.168 [0.168]	−0.163 [0.168]	−0.211 [0.169]
Advertising expense-to-assets ratio	−0.545*** [0.149]	−0.544*** [0.149]	−0.545*** [0.149]	−0.548*** [0.150]	−0.527*** [0.149]
Debt-to-assets ratio	−0.038 [0.032]	−0.038 [0.032]	−0.038 [0.032]	−0.036 [0.032]	−0.038 [0.033]
PPE-to-assets ratio	0.081*** [0.031]	0.082*** [0.031]	0.082*** [0.031]	0.081*** [0.031]	0.075** [0.030]
Capital expenditures-to-assets ratio	−0.372*** [0.110]	−0.372*** [0.110]	−0.372*** [0.110]	−0.370*** [0.110]	−0.349*** [0.110]
Adjusted R^2	0.032	0.032	0.032	0.032	0.032
Observations	11,385	11,385	11,385	11,385	11,385
Clusters	5,038	5,038	5,038	5,038	5,038
Title, year, industry fixed effects	Yes	Yes	Yes	Yes	Yes

Notes. This table reports results of regressions of percent change in total officer compensation on CEO, officer, board of directors, and firm characteristics. Standard errors are clustered by officer. The *Opposite gender* dummy is set to 1 if the CEO and the officer are of opposite genders. *Misogyny* and *Misandry* are computed as products of dummy variables based on the CEO being male or female and the *Opposite gender* dummy. *Generational sexism* is the product of the *Misogyny* dummy and *CEO age*. Regressions include year, industry, and officer title fixed effects. For each regressand, the table reports parameter estimates, standard errors in brackets, and asterisks indicating significance. Detailed variable definitions are provided in Table A.1 of the appendix. The sample period is 1996–2011.

*, **, and *** correspond to 10%, 5%, and 1% levels of significance, respectively.

The plot clearly indicates that male CEOs compensate male officers more richly than they do female officers. The cumulative gender pay gap under male CEOs widens for every year of officer employment. Similarly, female CEOs set higher pay for officers of the same gender, although the effect is muted.

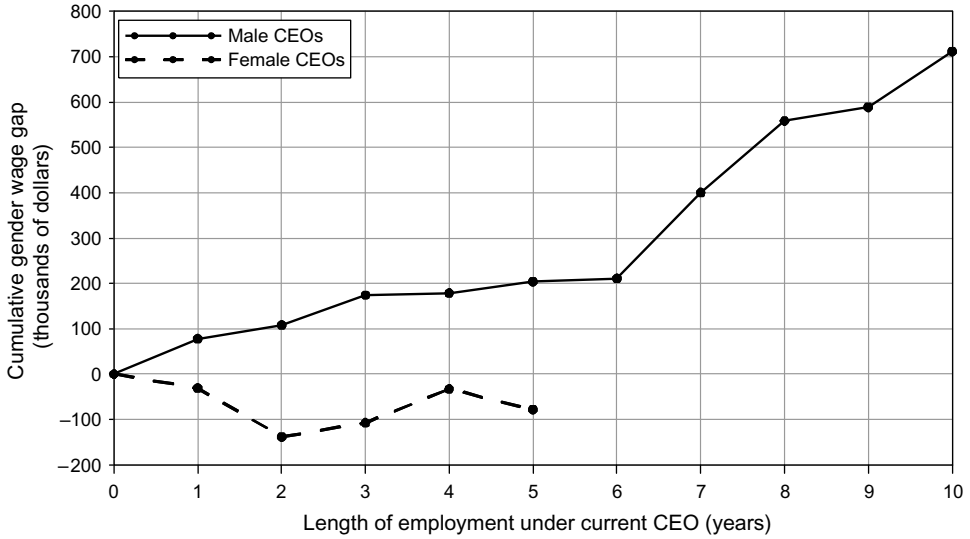
5.7. Possible Interpretation of Results

The results of our analysis provide strong evidence that CEOs pay officers of the opposite gender less than officers of their own gender. Although the evidence is suggestive of discrimination, it is also consistent with alternative explanations. In particular, our results could be linked to differences in (1) productivity, (2) bargaining power, or (3) nonwage benefits of male and female officers. We now consider these possibilities.

Several pieces of evidence suggest that the observed gender wage gaps are unlikely to be fully explained by the above alternatives. First, the AKM method we use allows for the inclusion of firm and officer fixed effects. Persistent compensation differences resulting from differences in productivity, bargaining power, or nonwage benefits of men and women should be absorbed by the officer-level fixed effect. The strong gender effects that we observe even after controlling for the AKM individual fixed effects (see Table A.2 in the appendix) suggest that none of the alternatives is likely to be responsible for our results.

Second, we examine the pay gap conditional on the gender of the wage setter. For our results to be explained by differences in productivity, bargaining power, or nonwage benefits, women would have to be less productive, have lower bargaining power, and/or extract lower nonwage benefits when working for male CEOs but not so when working for female CEOs. Although such relations are plausible, the literature

Figure 2 Cumulative Wage Gap by Employment Length Under Male and Female CEOs



Notes. This figure plots the cumulative wage gap between male and female officers by years of employment under male and female CEOs. Wage gap is computed as the difference in the mean excess pay for male and female officers. Excess pay is defined as the difference between the predicted and realized officer compensation, each transformed to dollar amounts, from regression (1) of Table 5. The cumulative wage gap is the sum of the excess pay for each year with the same CEO. The series under Female CEOs is shown only for five years because the sample of female officers working for female CEOs for more than five years is very small, and computing the wage gap for the sixth year and beyond becomes untenable.

suggests they are unlikely. For example, Stitt et al. (1983) and Komives (1991) find that manager gender has no differential effect on productivity of male and female subordinates. Within bargaining, Sutter et al. (2009) find more competition and retaliation when the bargaining partners are of the same gender, which is inconsistent with a bargaining-based explanation of our results.[21] Although Ayres and Siegelman (1995) find that car salesmen offer better prices to white males, and that this effect may be due to expectations of the client reservation price rather than discrimination, they find that the gender or race of the salesperson does not affect the price. This is distinct from our findings where the interaction of genders of the two parties has notable influence on compensation. For a statistical discrimination argument to apply, it would need to explain why male CEOs perceive female officers to have lower reservation wages than female CEOs perceive them to have.

Third, we find significant gender pay disparity in both the bonus and the salary component of officer compensation (see Table 5). To the extent that bonus is awarded for productivity, and given that we observe the gender wage gap even in the base salary component, where productivity-related effects should be weaker, productivity is unlikely to completely explain our results.[22] Also, the bonus component of compensation is arguably less open to negotiation because its amount need not be written explicitly in an employment contract but is determined ex post conditional on performance. If our findings are driven by bargaining power arguments, we would expect to observe stronger results in the salary than the bonus component, but we find the opposite.

Finally, we find strong evidence that, following a change in the gender of the CEO, the wages of male and female officers are affected in a way consistent with the CEO's affording higher wages to officers of the same gender. It would be surprising for the productivity of workers, their bargaining power, or nonwage benefits to change so rapidly and ubiquitously in response to a new CEO.

It is important to acknowledge that because no reliable proxies exist for productivity, bargaining power, or nonwage benefits of corporate officers, it is not possible to fully rule out all alternative explanations. Hence, our analysis should not be interpreted as definitive evidence of gender discrimination.

6. Conclusion

This paper sheds new light on the determinants of the differences in compensation of men and women. Using a data set on compensation of corporate officers, we

[21] The results in Dittrich et al. (2014) and Eriksson and Sandberg (2012) also suggest that bargaining power arguments are unlikely to drive our results.

[22] The somewhat stronger effects we observe in the bonus component are consistent with the intuition that at least some of the gender wage gap is due to differences in productivity of men and women.

show that the sex and age of the wage setter (the chief executive officer) are crucial drivers of the disparity in wages between male and female wage receivers (corporate officers). We show that CEOs pay officers of the opposite gender less than officers of their own gender and that the difference in compensation of male and female corporate officers increases with CEO age.

We find that officers are paid $34,240 per year less if their firm is headed by an opposite-gender CEO and that this discount increases to $46,500 in the case of a female officer subordinate to a male CEO. Female officers also receive smaller compensation increases when the firm is headed by a male CEO. Although the compensation of officers of both genders benefits as the CEO ages, female officers benefit significantly less. All of these discoveries point to persistent gender pay disparity that is largest when men lead women. Female CEOs also compensate officers of the opposite gender less, but the economic magnitude is substantially smaller and the result is not robust statistically. Our findings imply that female officers can benefit by avoiding positions that report to older male CEOs, whereas male officers can benefit from having positions that report to such wage setters.

Although the gender wage gap has been well documented in other contexts, the explanation for its persistence has been incomplete. Earlier research has proposed employee performance or self-selection arguments to rationalize the differences in compensation of men and women. In our setting, these arguments would be inadequate to resolve why the gender pay gap would be larger with male CEOs than with female CEOs. We find evidence of the gender wage gap even after controlling for officer fixed effects, which strongly suggests that the differences in compensation of men and women are not due to individual characteristics such as risk aversion, negotiation ability, self-selection, or productivity. The findings suggest that the gender wage gap is significantly affected by the interaction of wage-setter and wage-receiver characteristics.

Our results raise the important question of whether gender-based inequity also occurs outside the realm of compensation. In particular, female corporate officers may have less access to resources or may face other challenges when working for a male CEO. This research suggests that gender inequality remains prevalent in corporate offices within the United States.

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Appendix

Table A.1 Variable Definitions in Alphabetical Order

Variable	Definition
Advertising expense-to-assets ratio	The firm's advertising expense divided by total assets; missing advertising expense values are set to zero.
Capital expenditures-to-assets ratio	The ratio of capital expenditures to total assets.
CEO/officer tenure	Uninterrupted years the CEO/officer has held a position at the firm.
Debt-to-assets ratio	The ratio of the sum of long-term debt and short-term debt to total assets.
Directors on comp committee	Number of directors on the compensation committee.
Expected compensation increase	Equals 1 if either (i) the officer is male, and a male CEO replaces a female CEO, or (ii) the officer is female, and a female CEO replaces a male CEO; otherwise equals 0.
Generational sexism	Age of CEO when CEO is male and officer is female; otherwise, 0.
Misandry	Equals 1 if the CEO is female and officer is male, otherwise equals 0.
Misogyny	Equals 1 if the CEO is male and officer is female, otherwise equals 0.
Number of directors	Number of board of director officers.
Opposite gender	Equals 0 if the officer and CEO are of the same gender, otherwise equals 1.
PPE-to-assets ratio	The ratio of property, plant, and equipment to total assets.
Prop. of female directors	Proportion of directors who are female.
Prop. of women on comp. committee	Proportion of female directors on the compensation committee.
R&D expense-to-assets ratio	The firm's research and development expense divided by total assets; missing R&D values are set to zero.
Return on assets	The ratio of earnings before interest, taxes, depreciation, and amortization to the firm's total assets.
Sales	Sales in million of dollars.
Standard deviation of return on assets	The standard deviation of first differences in return on assets for the prior eight years.
Stock return volatility	Annualized volatility of daily stock returns measured over the firm's fiscal year.
Three-year stock return run-up	Compounded stock return over the previous three years.
Tobin's Q (market-to-book ratio)	The market value of common stock plus the book value of total debt divided by the book value of total assets. Book equity is calculated as stockholders' book equity plus balance-sheet-deferred taxes plus investment tax credit less the redemption value of preferred stock. If the redemption value of preferred stock is not available, its liquidation value is used. If the stockholders' equity value is not on Compustat, it is computed as the sum of the book value of common equity and the value of preferred stock. Finally, if these items are not available, stockholders' equity is measured as the difference between total assets and total liabilities.

Table A.2 Determinants of Officer Compensation: Abowd et al. (1999) Fixed-Effects Method

Variable	(1)	(2)	(3)	(4)	(5)
Constant	3.232*** [0.148]	3.373*** [0.158]	3.266*** [0.148]	3.373*** [0.158]	3.264*** [0.148]
Male CEO	0.060 [0.036]	−0.004 [0.036]	0.066* [0.036]	−0.050 [0.055]	0.066* [0.036]
CEO age (years)	0.003*** [0.001]	0.003*** [0.001]	0.003*** [0.001]	0.003*** [0.001]	0.003*** [0.001]
CEO tenure (years)	0.007*** [0.002]	0.007*** [0.002]	0.007*** [0.002]	0.007*** [0.002]	0.007*** [0.002]
Log CEO total compensation	0.178*** [0.023]	0.178*** [0.023]	0.178*** [0.023]	0.178*** [0.023]	0.178*** [0.023]
Number of directors	0.019*** [0.003]	0.019*** [0.003]	0.019*** [0.003]	0.019*** [0.003]	0.019*** [0.003]
Proportion of female directors	−0.233*** [0.071]	−0.234*** [0.071]	−0.231*** [0.071]	−0.249*** [0.071]	−0.232*** [0.071]
Directors on comp. committee	−0.022*** [0.004]	−0.022*** [0.004]	−0.022*** [0.004]	−0.022*** [0.004]	−0.022*** [0.004]
Prop. of women on comp. committee	0.046 [0.035]	0.045 [0.035]	0.045 [0.035]	0.048 [0.035]	0.045 [0.035]
Male officer	0.040** [0.019]	−0.039 [0.034]			
Officer age (years)	0.002*** [0.001]	0.002*** [0.001]	0.002*** [0.001]	0.002*** [0.001]	0.002*** [0.001]
Officer tenure (years)	0.026*** [0.001]	0.026*** [0.001]	0.026*** [0.001]	0.026*** [0.001]	0.026*** [0.001]
Opposite gender		−0.088** [0.034]			
Misogyny			−0.049** [0.020]		
Misandry				−0.128* [0.066]	
Generational sexism					−0.001* [0.000]
Tobin's Q	0.026*** [0.004]	0.026*** [0.004]	0.026*** [0.004]	0.026*** [0.004]	0.026*** [0.004]
Log sales	0.154*** [0.010]	0.155*** [0.010]	0.155*** [0.010]	0.155*** [0.010]	0.155*** [0.010]
Log number of employees	0.026*** [0.008]	0.026*** [0.008]	0.026*** [0.008]	0.026*** [0.008]	0.026*** [0.008]
Return on assets, previous year	0.037 [0.084]	0.036 [0.084]	0.037 [0.084]	0.036 [0.084]	0.036 [0.084]
Return on assets, 3-year average	−0.383*** [0.097]	−0.382*** [0.097]	−0.382*** [0.097]	−0.385*** [0.097]	−0.382*** [0.097]
Volatility of return on assets	0.214* [0.116]	0.216* [0.116]	0.215* [0.116]	0.211* [0.116]	0.215* [0.116]
Three-year stock return run-up	0.013* [0.007]	0.013* [0.007]	0.013* [0.007]	0.013* [0.007]	0.013* [0.007]
Stock return volatility	−0.009 [0.018]	−0.009 [0.018]	−0.009 [0.018]	−0.009 [0.018]	−0.009 [0.018]
R&D expense-to-assets ratio	0.066 [0.140]	0.066 [0.140]	0.065 [0.140]	0.073 [0.140]	0.066 [0.140]
Advertising expense-to-assets ratio	0.331** [0.141]	0.331** [0.141]	0.331** [0.141]	0.336** [0.142]	0.332** [0.141]
Debt-to-assets ratio	0.183*** [0.029]	0.183*** [0.029]	0.183*** [0.029]	0.185*** [0.029]	0.183*** [0.029]
PPE-to-assets ratio	−0.162*** [0.039]	−0.161*** [0.039]	−0.162*** [0.039]	−0.161*** [0.039]	−0.162*** [0.039]
Capital expenditures-to-assets ratio	0.563*** [0.110]	0.559*** [0.110]	0.562*** [0.110]	0.559*** [0.110]	0.562*** [0.110]
Adjusted R^2	0.364	0.364	0.364	0.364	0.364
Observations	14,577	14,577	14,577	14,577	14,577
Clusters	5,228	5,228	5,228	5,228	5,228
Year, industry fixed effects	Yes	Yes	Yes	Yes	Yes
Officer and firm fixed effects	Yes	Yes	Yes	Yes	Yes

Notes. This table reports results of regressions of log of annual officer compensation on CEO, officer, board of directors, and firm characteristics. Standard errors are clustered by officer. The method of Abowd et al. (1999) is used to allow for individual and firm fixed effects to be separated for more informative conditioning. The method proceeds by randomly drawing a single executive and identifying all other executives at the same firm. All firms that any of these executives were employed at are then identified, and all executives at all of those firms identified as well. This process repeats iteratively until the group is not enlarged by further iterations. Once a group is identified in this fashion, officers within that group who switched between firms can be used to identify individual and firm fixed effects. The estimate of the firm fixed effect may then be used to estimate the individual fixed effect of officers at the same firms who have not switched. Individual and firm fixed effects can then be used to absorb unobserved officer characteristics such as productivity, risk aversion, and bargaining power. The method is described in detail in Graham et al. (2013), and the sorting algorithm is detailed in Abowd et al. (1999). The *Opposite gender* dummy is set to 1 if the CEO and the officer are of opposite genders. *Misogyny* and *Misandry* are computed as products of dummy variables based on the CEO being male or female and the *Opposite gender* dummy. *Generational sexism* is the product of the *Misogyny* dummy and *CEO age*. Regressions include year, industry, and officer title fixed effects. For each regressand, the table reports parameter estimates, standard errors in brackets, and asterisks indicating significance. The sample period is 1996–2011. Table A.1 provides variable definitions.

*, **, and *** correspond to 10%, 5%, and 1% levels of significance, respectively.

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