Does Female Management Make a Difference?

An Empirical Analysis of Gender Wage Gap in Business Sector

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April 2024

Abstract

This research investigates the effect of female leadership representation on gender equality in terms of wages in the corporate sector. It specifically examines the influence of female CEO share on the gender wage gap across various industries. Utilizing data from Executive Composition, Annual Fundamentals, and Current Population Survey, this research employs empirical analysis to examine the directions and levels of influence from female leaders. After implementing baseline OLS, joint estimation, mediating sequential model, and instrumental variables, this research finds that an augmented presence of female CEOs in the corporate sphere will bring more gender equality in terms of labor wages and executive compensations.

Keywords: gender wage gap, workplace equality, female leadership

Acknowledgement

First and foremost, I owe my deepest gratitude to Dr. Luca Flabbi and Dr. Klara Peter, without whose guidance this thesis wouldn't have been achievable. Dr. Flabbi has been an exceptional advisor who always challenges me to explore more aspects of my research and offers inspirational revision suggestions. The opportunity to gain insights into the field of labor economics under his expertise has been one of the most rewarding experiences of my academic journey. Also, I am appreciative of Dr. Peter's endless support. Her course in advanced labor economics opened a new realm for me, allowing me to discover and pursue my personal academic interests. I consider myself privileged to have been a part of her classes for two years; her passion for economics research will forever be a guiding light for me.

This thesis represents the apex of my research experience as an undergraduate at UNC. It encapsulates four years of academic exploration and growth. I would like to extend my sincere thanks to all my professors and the economics faculty who have mentored me and shaped my academic journey.

Last but most importantly, a heartfelt thank you goes to my family, whose unwavering support has been my foundation. I also wish to express my deepest appreciation to my friends and my thesis program classmates. This thesis is a long journey, and the process has been immeasurably enriched by their companionship and support.

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1 Introduction

In the last century, as women gradually entered the workforce, gender is impossible to ignore in shaping various aspects of employment and the labor market. People's working styles, occupational choices, career preferences, and labor market outcomes are distinctly influenced by their gender identity. Women are often considered favoring more flexible work arrangements and entering family-friendly industries. Their career trajectories are also more likely to be influenced by their family decisions, such as marriage and childbirth. One of the important aspects reflective of the differences in treatment employees receive is the gender wage gap. As discussions surrounding the gender wage gap gained traction, an intriguing question arose: Does the "women help women" phenomenon happen in the workplace? More specifically, will firms or industries with female leaders have a significantly narrowed wage gap?

According to one Bloomberg research in early 2023, the number of Women CEOs finally outnumbered CEOs named "John" (Boyle and Green). Their finding uncovers that S&P 500 female CEOs still have a widened gap with popular male name CEOs. The exceedance of CEOs named "John" is considered as a vague milestone of female achievement of leadership representation. This anecdotal finding reflects one implication: nowadays, even though the representation of female CEOs and female executives is still low compared with their male comparatives, their representation is gradually increasing. The effects brought by the increasing leadership representation is the aspect this research majorly focuses on.

In light of these issues, this paper aims to examine the effects of female leadership representation on the gender wage gap in the workplace. Specifically, I seek to understand whether the relatively larger female leadership representation at the executive level will positively or negatively influence the wage gap between executives and non-managerial workers.

My research is mainly based on 2012-2022 Executive Compensation data and Current Population Survey. Since most previous research is focused on one particular industry, this research's concentration on the interplay effects of female leaders and industry will help expand the avenue. Among the current academic conversation, this research will also help enrich it by adding perspectives on the newest situation in the United States through conducting analysis based on the latest available dataset. This analysis is important for policymakers and practitioners seeking to promote gender equality and "equal wage for equal work" in the workplace. It is significant to acknowledge whether the phenomenon of "women helping women" exists in the workplace, offering insights for both female job seekers and firm organizers who aim to promote gender equality. According to previous scholarship, the existence of a gender wage gap is a signal of unproductivity. This research will also help reveal potential solutions to improve productivity for both genders at firms.

In this study, I aim to investigate the effect of female leadership representation on the gender wage gap in the workplace. This thesis is structured as follows: firstly, I review the existing research on the impacts of female leadership on workplace equality, along with the studies of females' career and occupation choices. Following this, I present an overview of my data sources, data cleaning process, and key variables' summary statistics. Then, I introduce my empirical model and analytical framework (baseline empirical model, sequential mediating model, joint estimation, and instrumental variable) of the potentially causal relationship. Particularly, I separate my empirical research into two parts: examining the impact of female executive share at each firm on the corresponding firm's compensation gap at the executive level and studying the effect of female representation in industries on the gender wage gap for non-managerial workers in those industries. To back my empirical analysis result, I also add one

robustness check session, which includes the results of modified categorization methods and choices of instrumental variables. Finally, I present my results and discuss their implications for policies aimed at promoting gender equality in the workplace.

My estimation results imply the positive effects of female leadership on mitigating the female compensation gap at the executive level. The consistent and statistically significant results indicate a promising effect for women's empowerment in the workplace.

2 Literature Review

2.1 Gender Difference Outcome in Labor Market

The main topic in this research, gender difference in labor outcome, has been an extensively debated topic in labor economics since last century. Women's participation in labor market was not proceeded all at once. It was a long process, where at first only young and unmarried females were accepted for jobs. Gradually, the participation of married labor increased, along with more job flexibility, human capital accumulation, and career growth opportunities for women. Up to now, the trends of female labor market outcomes indicate that they have more agency, decision-making power, and plans for careers (Goldin).

In gender literature, economists and social scientists put forward multiple unique female labor characteristics they observed and analyzed. Their heavy family duties cause them to work shorter hours and tend to encounter more workforce interruptions (Blau and Kahn). Women's psychological traits are considered more risk-averse, especially in competitive job settings (Azmat and Petrongolo). These labor characteristics, along with historical gender discrimination, lead to a structurally unequaled situation in the labor market for males and females.

2.2 Female Leadership Representation Discussion

Over the last three decades, there has been a notable increase in the number of women occupying managerial roles. However, the proportion of female leaders remains relatively low compared to their male comparatives (Cohen and Huffman, 2007). The effects of female leadership in workplace settings gradually draw the academia's attention. One of the curiosities they shared is whether the gradual prevalence of female leaders will bring more gender equality. It is generally believed that female leaders are largely in favor of their female employees, which helped break workplace inequality and give more opportunities to women in their previously underrepresented occupations. Yet, it is also crucial to explore whether the "Queen Bee" effect exists, which is, when women stepped into leadership positions in a traditionally male-dominated industry, they would indeed avoid their female under-level employees from achieving opportunities (Kunze and Miller, 2014).

Scholar's focus on the key indicators of gender equality in the workplace are various. Two of the key focuses are the gender wage gap and the promotion rates, as these two stands for two dimensions reflecting if females are rewarded equally based on their performance in the workplace.

In the theoretical aspect, regarding the potential positive effects of female leadership on the gender wage gap and promotion rates, there exist multiple economic theories offering explanations. For example, it is considered that female leaders are more sensitive toward the signals of female employees' good performance (Flabbi et al, 2019), and thus females with high productivity are more likely to be rewarded. The gender preference theory also provides an alternative explanation: executives have a preference towards employees of the same gender, and female leaders are more willing to provide opportunities for female workers. The spill-over

effect is also plausible in that female executives work as role models or mentors, which helps improve the performance of female workers and help them achieve better evaluation and promotion rates ultimately (Kunze and Miller, 2014).

Empirically, about this issue, scholars employ various empirical models to prove the theories and assess the effects of female leadership representation on gender equality. The empirical research approach appeared even as far as 20 years ago. In "Working for the Woman? Female Managers and the Gender Wage Gap," Cohen and Huffman performed a three-level hierarchical linear model based on Census 5- and 1-percent Public Use Microdata Samples (PUMS). They nested workers with their jobs and local industries. The regression analysis result suggests that the greater share of female managers did narrow down the gender wage gap of non-managerial workers. Cohen and Huffman's research is more related to the field of Sociology. In the field of Economics, there also exist multiple pieces of literature to study the female leader's effect on the gender wage gap. For example, in "Do Female Executives Make a Difference? The Impact of Female Leadership on Gender Gaps and Firm Performance," Flabbi et al. perform a regression analysis with two-way fixed effects and instrument based on regional trends. Their empirical analysis is based on a matching dataset, which contains information on both female executives and female workers, and the leaders and employees in one firm are paired up. To build an employer-employee matching dataset, they primarily combine three data sources: data from the Bank of Italy's annual survey of manufacturing firms, the National Social Security Institute, and the Company Accounts Data Service. The primary model they used is to predict the wages and productivity at the firm level, and influential workers and executives are aggregated accordingly. Focusing on Italian manufacturing firms, their results suggest that female leadership

imposes a positive effect on the top of female wage distribution while having a negative impact on the one at the bottom.

Differently, Kunze and Miller pay their attention to promotion rates as the indicator of gender equality. In their paper "Women helping women? Evidence from private sector data on workplace hierarchies," instead of performing regression analysis on the firm level, their main model is on the individual level to study the effect of female share of peer workers and leaders on promotion rates. Similar to Flabbi et al.'s research, they organize a matching dataset that combines the data from Statistics Norway and Plant-level Job Survey by Norwegian Enterprise. To ensure both genders have significant portions of representation in the workplace, they only use white-collar workers as their sample size. Their major finding reflects that with more female leaders, there are fewer gender gaps in terms of promotion rates for workers.

Meanwhile, the disparities between female and male occupation choices should not be ignored. According to Cortes and Pan's comprehensive literature review, there are multiple reasons that account for gender segregation across occupations, including women's stronger preference for family-friendly jobs, the effects of social norms, and psychological traits (Cortes and Pan, 2017). Their descriptive analysis uses O*NET and the American Community Survey (ACS) to examine the relationship between job characteristics and the proportion of female workers in each occupation, reflecting that females' considerations of occupations are different and complicated. Complementarily, in "The Effect of Job Flexibility on Female Labor Market Outcomes: Estimates from a Search and Bargaining Model," Flabbi and Moro use the counterfactual policy experiments and the search model to prove that gender wage gap may be related to flexibility (Flabbi and Moro, 2010), which is varied across occupations. Both research

indicates the labor market outcomes may vary across occupations and it is worth studying the potentially different female leader's effects across occupations.

The studies discussed in this literature review collectively suggest that female leadership representation can have a significant impact on gender equality in the workplace, but the nature of this impact varies across contexts. There also exist limitations in that most present literature focuses on one over-arching occupation and the diversified influence across occupations has not been fully studied. Further research is needed to understand the nuanced mechanisms through which female leadership influences the gender wage gap in various occupational settings.

3 Theoretical Framework

Regarding my research question, I will discuss three theoretical channels that could be used to explain a potential causal relationship between the proportion of female CEOs and the gender compensation gap: Statistical Discrimination Model with human capital investment, Mentoring Effect Model, and Labor Supply and Demand Model.

In this research, the Statistical Discrimination Model with human capital accumulation addresses the mechanism of how female leadership representation influences labor's human capital investment decision and finally leads to gaps in individual productivity and gender wage gap. Pioneered by Kenneth Arrow (Arrow, 1973) and Edmund Phelps (Phelps, 1972), the Statistical Discrimination Model suggests that certain labor groups are discriminated against the labor market, given that employers or other economic agents have imperfect information about individuals. Based on this framework, I assume laborers are acknowledged the statistical discrimination situation and make their decision about human capital investment based on their expectations.

In the Mentoring Effect Model, the basic idea is that having a mentor is important for moving up in one individual's career, especially true for women. Previously proposed by Susan Athey et al., this theory the capability of entry-level firm employees would be improved by mentors of the same type (Athey et al., 2000). In this research's case, with more female CEOs, there can be a stronger support system for women in business. This can help women develop their careers and negotiate better pay, leading to a smaller pay gap between men and women.

As a fundamental concept in economics, the labor supply and demand framework is also an unignorable one to consider. Initially formulated by economist David Ricardo (Ricardo, 1817) in the 19th century, this framework was expanded by Gary Becker (Becker, 1957) to explain the discrimination and affected wages in labor market. The labor supply and demand model explains that when there are more female CEOs, it can encourage other non-managerial women to aim for and get ready for jobs. It can also make companies more open to hiring and promoting women for these roles. This could help close the pay gap because it increases women's participation and opportunities in the workforce.

Statistical Discrimination Model

This research presents a statistical discrimination model that explains the gender wage gap related to the gender composition of leadership representation in the workplace. Under this framework, there are two major periods: in period 1, individual labor determines their human capital investment, and in period 2, individual labor enters the labor markets.

In period 1, the individual determines whether they will invest in their human capital based on their expectation of benefits gained from wages after they enter the labor market in the second period. If they decide to invest, their individual productivity at period 2 will be high

level *(denoted by h)*. If they choose not to invest, their productivity in period 2 will be low level *(denoted by l)*.

$$\begin{cases} Invest \gg S_i = h \\ Not\ Invest \gg S_I = l \end{cases}$$

We assume the cost of human capital investment *(denoted by c)* and productivity with or without investment are all the same for both genders.

$$\begin{cases} C_f = C_m = C \\ S_i \mid Female\ and\ Invest = S_i \mid Male\ and\ Invest\ = h \\ S_i \mid Female\ and\ Not\ Invest = S_i \mid Male\ and\ Not\ Invest = l \end{cases}$$

Additionally, both males and females have the perception of CEO gender composition in the future based on the current situation. The estimated share of female CEOs is p, and the estimated share of male CEOs is 1-p. Their expected benefits will depend on p. For simplicity, we assume the estimated share of female CEOs is roughly the same as the true share of female CEOs in the future.

In period 2, individuals enter the labor market and their employer decides their wages. The punchline is that one individual's wage is determined by his or her productivity, the average productivity of the belonging labor group, and the percussiveness of signaling of his or her employer. According to this theory, one worker's wage is equal to:

$$\mathrm{W}\big(\mathrm{S_i}, \mathrm{r}, \mathrm{E(X)}\big) = (1 - \mathrm{r}) * \mathrm{E(X)} + \mathrm{r} * \mathrm{S_i} \qquad \text{(Equation 1)}$$

For each individual worker, $\mathrm{S_i}$ stands for the marginal productivity of one single worker. If $\mathrm{S_i}$ is large, it implies that an individual can bring more benefits in terms of productivity to the firm. $\mathrm{E(X)}$ indicates the average marginal productivity of the labor group, in this case, the groups of males or females.

In this equation, wage is equal to the weighted average of one individual labor's own productivity and the average productivity in that gender group. The variable r indicates the preciseness of the employer's signaling of his or her productivity at firms. If the employer can evaluate labor productivity accurately, the r will be large. That is to say, the weight of an individual's own productivity will be counted more in the determination of his or her wage. On the contrary, if the employer cannot sense an individual's productivity precisely, the small r will deprive the weight of the individual's productivity. For computing simplicity, we assume the group average perceived by employer is equal to $\frac{h+l}{2}$. That is, the employer assumes half of the group invest in human capital, and half of them don't.

In this period, the probability of encountering a female CEO is p. We assume CEOs with the same gender will weigh more on individual productivity. They can detect one individual's productivity more precisely and count that in the wage determination model. If labor encounters CEO of different genders, we assume their wage will be determined completely by group average productivity. That is to say, the employer cannot signal individual productivity and will solely count group average productivity. In this case, r is equal to 0, and $wage = E(X) = \frac{h+l}{2}$.

Under this framework, the wages under each circumstance are:

Female Labor:

$$\begin{cases} wage = (1-r) * \dfrac{h+l}{2} + r * h \ (Invest\ and\ with\ female\ CEO) \\ wage = (1-r) * \dfrac{h+l}{2} + r * l \ (Not\ Invest\ and\ with\ female\ CEO) \\ Wage = \dfrac{h+l}{2} \ (With\ male\ CEO) \end{cases}$$

Male Labor:

$$\begin{cases} wage = (1-r) * \dfrac{h+l}{2} + r * h \ (Invest\ and\ with\ male\ CEO) \\ wage = (1-r) * \dfrac{h+l}{2} + r * l \ (Not\ Invest\ and\ with\ male\ CEO) \\ Wage = \dfrac{h+l}{2} \ (With\ female\ CEO) \end{cases}$$

In this theoretical framework, both male and female labor have the knowledge of statistical discrimination they are likely to encounter and make their decision of human capital investment accordingly. Their expectation of benefits at period 2 is listed below.

For female:

$$\begin{cases} Exp_{Invest} = p * \left[(1-r) * \dfrac{h+l}{2} + r * h\right] + (1-p) * \dfrac{h+l}{2} - \mathrm{c} \\ Exp_{NotInvest} = p * \left[(1-r) * \dfrac{h+l}{2} + r * l\right] + (1-p) * \dfrac{h+l}{2} \end{cases}$$

For male:

$$\begin{cases} Exp_{Invest} = (1-p) * \left[(1-r) * \dfrac{h+l}{2} + r * h\right] + p * \dfrac{h+l}{2} - \mathrm{c} \\ Exp_{NotInvest} = (1-p) * \left[(1-r) * \dfrac{h+l}{2} + r * l\right] + p * \dfrac{h+l}{2} \end{cases}$$

According to this expectation framework, there is one point that individual labor is indifferent about whether to invest human capital or not. This could be calculated by taking the difference of expected benefits with and without investment. After calculation, the point is:

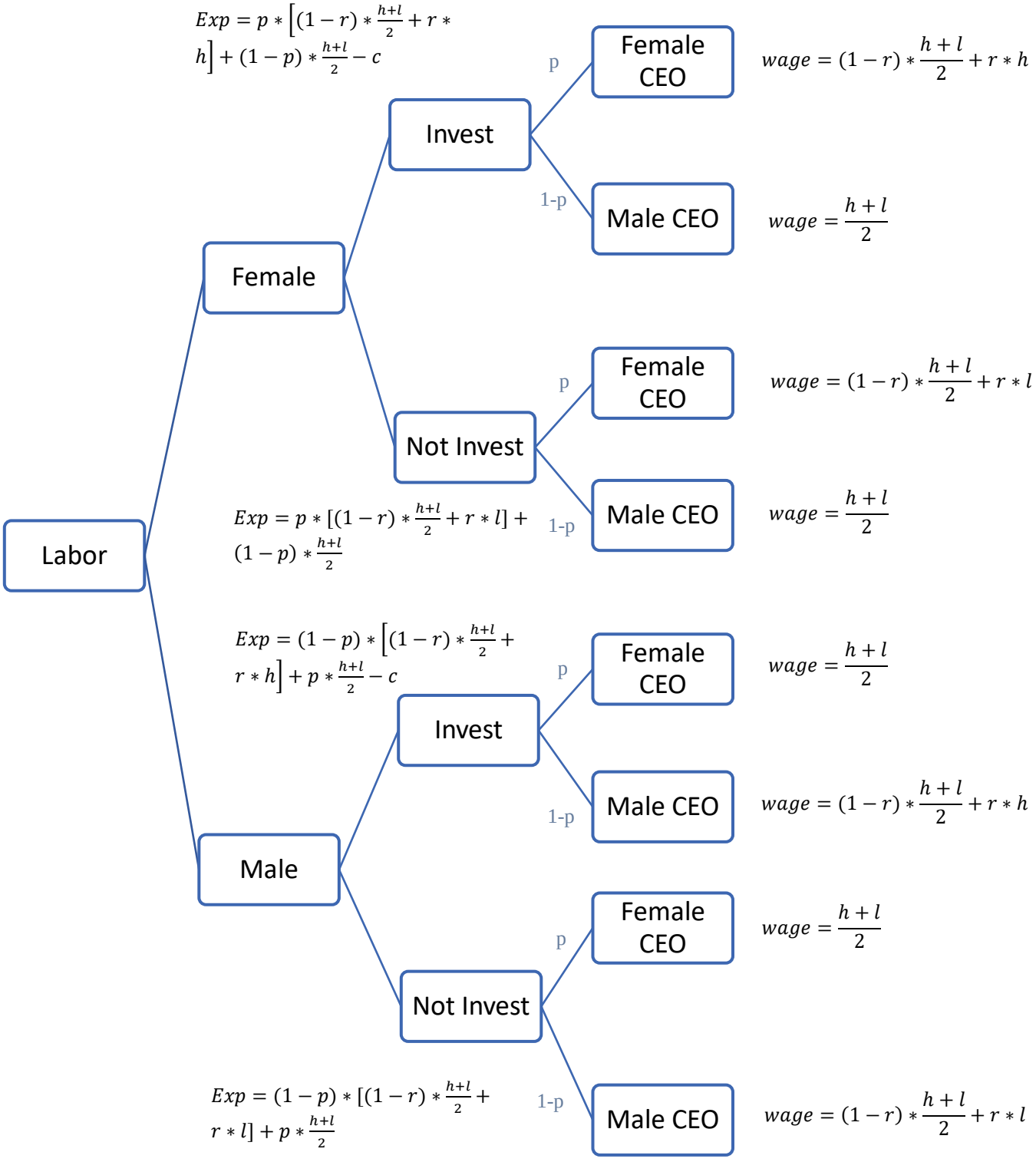
$$\begin{cases} c_{female} = r * p * (h-l) \\ c_{male} = r * (1-p) * (h-l) \end{cases}$$

This equation indicates that if the cost of investment is larger than the right-hand side component, the individual will then refuse to invest in human capital.

Consider that the greater the value of the right-hand side component, the more pronounced the benefits of investing in human capital become, prompting a higher propensity for such investment. For female employees, a larger share of female CEOs could signify that individual ability is more highly valued, thereby amplifying the perceived returns from investing

in one's own skills. This differential in productivity gains due to human capital investment (represented by the difference between high and low, h-l) could increase their inclination to invest in personal development and education.

The decision tree of the game below illustrates the decision-making process female and male labor experience at each stage.


$Exp = p * \left[(1-r) * \frac{h+l}{2} + r * h\right] + (1-p) * \frac{h+l}{2} - c$
p
Female CEO
$wage = (1-r) * \frac{h+l}{2} + r * h$
Invest
1-p
Male CEO
$wage = \frac{h+l}{2}$
Female
p
Female CEO
$wage = (1-r) * \frac{h+l}{2} + r * l$
Not Invest
1-p
Male CEO
$wage = \frac{h+l}{2}$
$Exp = p * [(1-r) * \frac{h+l}{2} + r * l] + (1-p) * \frac{h+l}{2}$
Labor
$Exp = (1-p) * \left[(1-r) * \frac{h+l}{2} + r * h\right] + p * \frac{h+l}{2} - c$
p
Female CEO
$wage = \frac{h+l}{2}$
Invest
1-p
Male CEO
$wage = (1-r) * \frac{h+l}{2} + r * h$
Male
p
Female CEO
$wage = \frac{h+l}{2}$
Not Invest
$Exp = (1-p) * [(1-r) * \frac{h+l}{2} + r * l] + p * \frac{h+l}{2}$
1-p
Male CEO
$wage = (1-r) * \frac{h+l}{2} + r * l$

After presenting the theoretical framework's setting, the parts below will discuss how this framework helps explain the effect of female CEO share on the gender wage gap.

Because this framework assumes the channel to differentiate wage is through individual productivity (S, h, l) and employer's weight on individual productivity (r), whether potential labor decides to invest human capital or not is significant for their wage determination.

As we previously discussed, if the share of female CEOs is larger, female labor is more willing to invest in human capital as their expected benefits become larger. That is to say, if female labor perceives the share of female CEOs is large in the future, they will be more likely to invest in their human capital and achieve high productivity in period 2. As a result, their wage in period 2 will also be higher according to the wage determination model we discussed earlier. To sum it up, the larger share of female CEOs will make female labor more willing to invest in human capital and therefore obtain higher wages after they enter the labor market.

To make the illustration clearer, the next part will plug in some numbers to test the model hypothesis:

Case 1: r=0.5, h=3, l=1, p=0.1

$$\begin{cases} Expect(Female\ and\ Invest) = 2.05 - c \\ Expect(Female\ and\ Not\ Invest) = 1.95 \\ Expect(Male\ and\ Invest) = 2.45 - c \\ Expect(Male\ and\ Not\ Invest) = 1.55 \end{cases}$$

Case 2: r=0.5, h=3, l=1, p=0.2

$$\begin{cases} Expect(Female\ and\ Invest) = 2.1 - c \\ Expect(Female\ and\ Not\ Invest) = 1.9 \\ Expect(Male\ and\ Invest) = 2.4 - c \\ Expect(Male\ and\ Not\ Invest) = 1.6 \end{cases}$$

The aforementioned scenarios suggest that as the proportion of female CEOs increases, so does the difference in expected benefits for women in terms of human capital investment—from 0.1-c to 0.2-c. This implies that a rise in female CEO share could incentivize women in the workforce to invest more in their own human capital. Such investments are likely to manifest in the form of higher wages, contributing to the reduction of the gender wage gap.

This thought experiment also proposes that as female CEO representation grows, the expected returns from human capital investments diminish for men—from 2.45-c to 2.4-c. Eventually, if the costs of such investments outstrip the expected benefits, males may become less inclined to invest. This underscores that the expanding presence of female CEOs may influence not only the professional development of female employees but could also impact male laborers' investment decisions.

In conclusion, the adopted framework adeptly captures the dynamic nature of investment decisions up to the point of employee entering the labor market. Post-hire, employers have additional methods to assess employee productivity, such as through performance evaluations and assignment test. As CEOs and other leaders accumulate experience with the male and female laborers, their ability to accurately examine an individual's productivity improves and they will tend to place a higher emphasis on individual capabilities, thus adding layers of complexity to wage determination. However, the theoretical model utilized in this research is restricted to the stages of human capital investment and labor market entry, operating under the simplifying assumption that all employers possess equivalent levels of experience.

Difference in Individual Productivity – Mentoring Effect

In this channel, the main source of wage discrimination derives from the individual productivity. We assume that the ability to signaling good performance now become the same for male and female leaders.

According to previous literature, the same gender's mentoring effect is unignorable in the workplace. Female CEOs or prominent leaders can take the roles of role models for their fellow female employees. Their working styles and work performance work as the booster to promote female employee's productivity. That is to say, given the same personal characteristics, female individuals from firms with female leaders are likely to have higher performance compared with female individuals from firms without female leaders. As an outcome, those female workers with female leaders are more likely to be rewarded with a higher wage, resulting in a smaller gender wage gap in that firm.

Difference in Marginal Productivity – Supply Shock

This channel presents a picture of the supply side effect. Firms with a higher portion of female leaders are considered female-friendly and are more attractive to female workers. The presence of female leaders also signals a type of firm inclusiveness. Thus, the number of female applicants in the job market will be larger for firms with a larger share of female leaders. In labor economics terminology, the supply of female leaders in those firms will be larger compared with their comparatives.

$$S_i = \frac{Y_1 - Y_0}{L_1 - L_0} \qquad \text{(Equation 2)}$$

However, according to the marginal productivity formula, the MRP is determined by the number of labors. The marginal productivity delivers a decreasing trend: it decreases as the

number of workers increases. For that reason, the marginal productivity of individual workers becomes lower given the presence of larger amounts of female fellow workers. Therefore, according to equation 1, the wage for those female workers will be lower based on the smaller S_i .

The classic labor supply and demand theory can also help explain this channel. As the female labor supply experiences a right-direction shock resulting from a higher female leadership representation, the firm and employers are able to pay less to retain those female workers. On the graph, a right-shifting supply curve with a standing demand curve will result in a lower wage correspondingly. As an outcome, the gender gap could be enlarged, given the presence of female leaders in one firm.

Difference in Marginal Productivity –Demand Shock

As building one firm's public image becomes increasingly important in the era of social media, some firms have implemented diversity hiring to intentionally hire more under-representative groups and present their inclusive image.

In this channel, the presence of female executives could be seen as a signal of the firm's placement of attention on building an inclusive public image. Those firms with female leaders are more likely to have a higher demand for female employees. That is, they have a right-shifting demand curve. In this case, the wage of female employees could become higher, given that firms intend to pay more to retain female labors. Simultaneously, we assume the number of workers needed to maximize the firm's profits remain the same. Therefore, as the demand for female workers increases, the demand for male labor will decrease, resulting a lower wage for male correspondingly. That is to say, those firms will substitute away from male workers and towards

female workers due to their consideration of public image, resulting in a higher female labor wage and a lower male labor wage, and ultimately, a smaller gender wage gap.

Additionally, on the public image perspective, a higher demand for female workers will incur a smaller gender wage gap, which is beneficial to build the inclusive organization image.

4 Empirical Model

To study the impacts of female leaders on the gender equality, this research primarily takes two overarching directions: examining the effects of female CEOs representation on both the executive's compensation gap and non-managerial workers' gender wage gap. Combining these two tracks, this study aims to explore how female CEOs in senior and top positions radiate their influence on management and salaried employees, and how this influence works to improve gender equality. Both tracks are analyzed based on an employer-employee matching dataset at the industry level, which reflects both industry executives and labor information.

4.1 Baseline Empirical Model

Direction One: Industry-level executive compensation gap:

In the baseline OLS model, our dependent variable is the gap between the average executive's total compensation in each industry at a certain time period. Executive compensation is reported in thousands of dollars. Three measurements of compensation are taken into consideration: total compensation, current compensation, and incentive compensation. The current compensation is the sum of the current salary and bonus, while the total compensation is the sum of salary, bonus, restricted stock grants, LTIP payouts, the value of option grants, and all other annuls. The incentive compensation measures the difference between current and total compensation.

In this direction, the baseline empirical model is below:

$$\ln\left(\frac{Average\ Female\ Compensation_{jt}}{Average\ MaleCompensation_{jt}}\right) = \beta_0 + \beta_1 * FemaleCEO_{jt} + Control_{jt} + \theta_t + u_j + \varepsilon_{jt} \quad (Equation\ 3)$$

Where the outcome variable calculated the log of ratio of female executive compensation to male executive compensation per industry. The key treatment variable is continuous and reflects the average share of female CEO in each industry. If one industry doesn't have any female CEO, it is coded as 0. Measurements of industry's financial performance, including total accumulated revenue, net income, assets, retained earnings, and equity, along with the number of firms and the gender composition of executives, are considered as the control variables. Additionally, θ_t denotes the time fixed effect, while u_j denotes the industry fixed effect.

Direction Two: Industry-level executive compensation gap:

This model is mainly based on the current population survey and employ Executive Compensation data as supplementary to provide information on the share of female executives in each industry.

In this direction, the baseline OLS model is listed as the following:

$$\ln\left(\frac{Average\ Female\ Wage_{jt}}{Average\ Male\ Wage_{jt}}\right) = \beta_0 + \beta_1 * FemaleCEO_{jt} + Control_{jt} + \theta_t + u_j + \varepsilon_{jt} \quad (Equation\ 4)$$

The dependent variable is the log of wage ratio between female labor to male labor per industry in a given year. The wage at the industry level is calculated by taking the average of

male and female non-managerial worker's wages during a certain period and then calculating the corresponding ratio difference. It is worth noticing that some industries are niched and have an extremely low number of firms. To address this problem, this research employs the 2-digit industry classification system to ensure an appropriate size of each industry.

The key treatment variable is the share of female CEOs in a certain industry, calculated by nesting the firm-level female leadership share into the industry level. By linking the Executive Compensation data with the Current Population Survey via matched industry code, it presents the whole picture of both employer and employee side. As the female CEO share is small for most industries, to catch the exact influence, this research divides industries into 3 categories: industry without any female CEO is coded as 0, with female CEO share smaller than 10 percent is coded as 1, and with female CEO share larger than 10 percent is coded as 3.

The control variables include average worker's wage, number of employments in the industry, share of minority, college, and fulltime labor, industry's financial performance (log of industry total assets and profits. To control for the industry and time trend difference, this model will also add industry sector and time fixed effects.

In the baseline model for the two tracks, the assumption is that the error terms are not correlated with observed factors. However, some unobserved factors, such as the underlying industry culture, its friendliness to female labor, and industry required skills might influence the compensation and wage gap. The employed control variables and fixed effects may not control the difference because those characteristics might change over time. Moreover, it is worth concerning that the share of female CEO is endogenous, that is, an industry that is mostly female dominated is more likely to have more top female leaders. The reverse causality issue also needs to be taken into consideration, as the reduced gender wage gap might be a cause of higher female

leadership representation, instead of the outcome. To solve those internal validity threats problem, this research presents three advanced model: joint estimation, sequential mediating model, and instrumental variables to make the causal inference clearer.

4.2 Joint Estimation Model

The joint estimation model measures the effect of female CEO share both on labor market and compensation simultaneously. The model of common shock is listed below:

$$\ln\left(\frac{Average\ Female\ Wage_{jt}}{Average\ Male\ Wage_{jt}}\right) = \beta^{y} * FCEO_{jt} + \beta^{y} * Control_{jt} + \theta_t + u_j + \varepsilon_{it}^{y}\ (Equation\ 5)$$

$$\ln\left(\frac{Average\ Female\ Compensation_{jt}}{Average\ MaleCompensation_{jt}}\right) = \beta^{c} * FCEO_{jt} + \beta^{c} * Control_{jt} + \theta_t + u_j + \varepsilon_{jt}^{c}\ (Equation\ 6)$$

This model assumes that the error terms in two equations are correlated with each other. The model's consideration for the endogeneity of variables and correlation between error terms help mitigate internal validity threats due to omitted variable bias and simultaneous causality.

4.3 Sequential Mediating Model

This model emphasizes a hierarchical and ordered process, where the outcome is determined through a sequence of stages. In this case, the influence of female CEO share is manifested in two channels: firstly, the leadership composition influences compensation gap (Female CEO Share ➔ Comp Gap), and subsequently, these compensation gap affects earning gaps (Comp Gap ➔ Earn Gap). The total effect of female CEO share on earning gaps is disaggregated into its direct effect (female leaders directly influence wage gap) and the sum of its mediated effects via the aforementioned channels. The empirical specification is represented as below:

$$ln\left(\frac{Average\ Female\ Wage_{jt}}{Average\ Male\ Wage_{jt}}\right) = f(FCEO, ln\left(\frac{Female\ Comp_{jt}}{MaleComp_{jt}}\right), \dots)\ (Equation\ 7)$$

$$ln\left(\frac{Female\ Comp_{jt}}{MaleComp_{jt}}\right) = f(FCEO, \dots)\ (Equation\ 8)$$

By explicitly modeling the influencing process in stages, sequential models can account for selection bias and unobserved heterogeneity that may affect subsequent outcomes.

4.4 Instrumental Variable

The two-stage least square model with instrumental variables is used to address the endogeneity problem by providing a source of exogenous variation that are correlated with the independent variable of interest but do not with the error terms in the outcome equation. The assumption is that there is no direct relationship between instrumental variables and the outcome, but only via the channel of the endogenous regressor. It is a widely-used econometrics methodology to address the problem of reverse causality and omitted variable bias.

In this research, two options of instrument variable are employed. The first one is the lagged female CEO share in the previous year and the lagged log of the industry's assets. These two lag values represent the employer side information in previous years. This instrument choice assumes the previous year condition would not directly influence the present year's wage gap but works as a channel to help the present year's female CEO improve gender equality.

The second option is Bartik instrument (Bartik, 1991). As the causal relationship might be muddled by industry factors that change over time or differential industry-related factors between groups, Bartik instrument can be used to clear this confusion through analyzing historical characteristics of an industry and using them to predict future trends exogenously. In this research, the Bartik instrument is formed as an interaction term of the lag value of previous year female executive share and the average change of female executives share across all industries.

The empirical specifications are listed as below:

$$\ln\left(\frac{Average\ Female\ Wage_{jt}}{Average\ Male\ Wage_{jt}}\right) = \alpha(\hat{P})_i + \beta X_i + \varepsilon_i * \qquad (Equation\ 9)$$

$$(\hat{P})_i = (\hat{\delta})X_i \qquad (Equation\ 10)$$

5 Data Description

The primary dataset used in this research is the Executive Composition, an organized firm financial data containing S&P 1500 executive's compensation, base salary, bonus, and stock option data. This data source is collected on a yearly basis from the company's annual report through Form 10-K and organized by Wharton Research Data Services. This research is interested in recent 10 year's workplace situation. The same company accounting standard across past time years (FAS 123R) ensures the persistency in data collection. The single observation is individual based, which reports various measurements of compensation as well as personal characteristics such as gender, age, title, and region for one executive. This data covers only North American firms and contains information for the executive's base location. The Executive Composition is a longitudinal data source, as a large portion of executives are reported multiple times over periods. The individual is trackable throughout the years based on the executive.

Additionally, the Current Population Survey (CPS), as a prominent source of labor force statistics, provides extensive sources of non-managerial worker information, such as wages, demographic information, and working industry. This source is also longitudinal, as about half of the people interviewed this year will be interviewed next year. The NACIS code and standard industry classification system make the crosswalk of the two data sources possible. According to the crosswalk standard provided by the Bureau of Labor Statistics, I paired these two sources

together, providing a holistic industry-level picture of both the employer and employee side. As the 6-digit NAICS classification is too niche, to ensure the sample size of each industry is big enough, this research will use 2-digit NAICS and CPS industry code.

Furthermore, Fundamentals Annuals organized by Wharton Research Data Services provides a detailed measurement of the S&P 1500 firm's financial performance, such as its annual revenues, retained earnings, and stocks. This research aggregates the firm's financial data into industry level and merges it with Executive Comp. As financial assets are considered as the firm's resources, and firms with higher annual revenues tend to offer higher wages, this measurement will help control the employer side's financial differences.

Together, the Executive Composition, Current Population Survey, and Fundamentals Annuals provide a comprehensive view of both employer and employee side information.

6 Summary Statistics

In this research, the major outcome variables are the labor earning gap and executive's average compensation gap in each industry, which is derived by taking the average of male and female wages and then calculating their log of difference. The industry is classified according to the 2-digit CPS industry code, with six overarching industry sectors. For the executive's compensation gap, three payment forms are taken into consideration are total compensation, current compensation, and incentive compensation.

This research is interested in the sample spans from 2012 to 2022 fiscal year. The first two tables display the basic summary statistics for labor earnings, total, current, and incentive compensation. For labor earnings, most industries reveal the wage structure that male worker

obtain higher wages than their female comparatives, as the negative sign indicates male workers have higher pay. However, there also exists industries that female labor are paid more in general.

Among these three types of compensation, the current compensation has the smallest gender difference. This implies the most significant part of the gender gap is derived from the incentive elements of compensations. It is also interesting to see the incentive compensation gap has the largest standard deviation, suggesting that incentive components such as option grants and stocks have the largest difference among executives.

Table 1: Summary Statistics for Outcome Variable "Labor Earnings Gap"

Summary Statistics for Earnings Gap						
	Min	1st Quantile	Mean	3rd Quantile	Max	Sd
Earning	−1.98	−0.37	−0.23	−0.10	0.69	0.26

Notes: this table shows summary statistics for wage gap between female and male. It is calculated according to this equation: ln(female wage) – ln(male wage).

Table 2: Summary Statistics for Outcome Variable "Executive Compensation Gap"

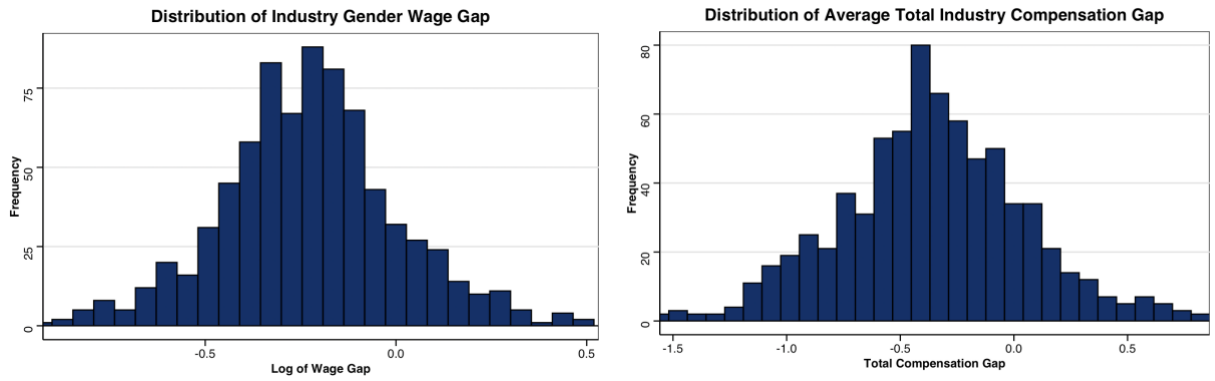
Summary Statistics for Compensation Gap						
	Min	1st Quantile	Mean	3rd Quantile	Max	Sd
Total	−2.34	−0.60	−0.36	−0.10	1.69	0.43
Current	−1.16	−0.32	−0.17	−0.02	1.01	0.25
Incentive	−2.68	−0.72	−0.43	−0.13	2.14	0.54

Notes: this table shows summary statistics for total compensation gap, current compensation gap, and incentive compensation gap. It is calculated according to this equation: ln(female executive compensation) – ln(male executive compensation).

The below graphs display the distribution of the labor earnings gap and total executive compensation gap. We can find the two histograms are almost symmetrical. For wage gap, most

samples are centered in the range between -0.5 to 0.0 ratio, with some outlier suggests that female or male wage is fifty percent higher than their comparatives. For the total compensation gap, the histogram also reveals a symmetric distribution, with most observation centered around -0.8 to 0. However, there also exist extremely large compensation gaps for some industries, with the most extreme minimum even less than -1.5. Same as Table 1 suggests, some industry gender gaps are larger than 1 or lower than -1.5, with the maximum at 1.69 and the minimum at -2.34. Prominently, some industries also have a positive total compensation ratio, indicating in those industries, women have a higher average annual compensation. Compared with non-managerial labor, the compensation gap is far larger, indicating the phenomenon of unequal pay is more prominent in the leadership groups.

Figure 1: Distribution of Outcome Variable "Non-Managerial Gender Wage Gap" and "Total Executive Compensation Gap"

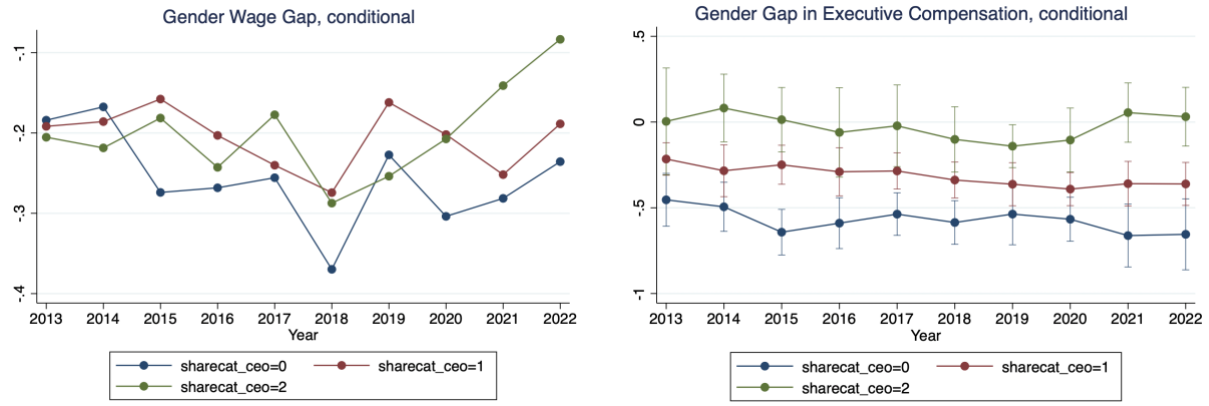


Notes: this figure displays the histogram of total wage and compensation gap between genders. For presentation purposes, this graph eliminates data below 1 percentile and 99 percentiles.

Figure 2 demonstrates the yearly trend of the labor earnings gap and total executive compensation gap. The three lines represent the trend for industries without any female CEOs, with female CEO share less than 10 percent, and with female CEO share higher than 10 percent. For gender wage gap, industries with no female CEOs (sharecat_ceo=0) show a more pronounced wage gap against females. In contrast, those with more representation of females in

the CEO position (sharecat_ceo=2) tend to have a smaller wage gap, which suggests that female leadership might be associated with a reduction in the wage gap within these industries. Compared with earnings gap, the gender gap in executive compensation is smoother over years, with only slight fluctuations. While also below zero, these lines show less variance over time. Interestingly, we can still find industries with a greater share of female CEOs (**sharecat_ceo=2**) display a smaller compensation gap than those without female CEO representation. The two graphs lead to a hypothesis that a higher presence of women in top management roles may be associated with policies or cultures that favor wage parity.

Figure 2: Trend of Outcome Variable "Gender Wage Gap" and "Total Executive Compensation Gap" from 2013 to 2022



Notes: this figure displays yearly trend of average gender wage gap and total executive compensation gap, categorized by female CEO composition in each industry.

Table 3 displays the compensation gaps between genders for each industry sector. Regarding total compensation gap, despite the other services sector, "Agriculture, Mining, Construction, Manufacturing" and "Finance, Insurance, Rental, Leasing" appear to have the largest negative total compensation gap ratio of -0.35. This result is reasonable as manufacturing and mining are traditionally male-dominated industries. Finance and insurance related jobs have the wage structure that top players are paid much higher than those posit as the low distribution,

while male executives are considered more likely to stay in the high distribution positions than their female comparatives. It is also interesting to see all sectors have negative gap ratio, indicating that generally, female executives are rewarded with lower compensation across all industries.

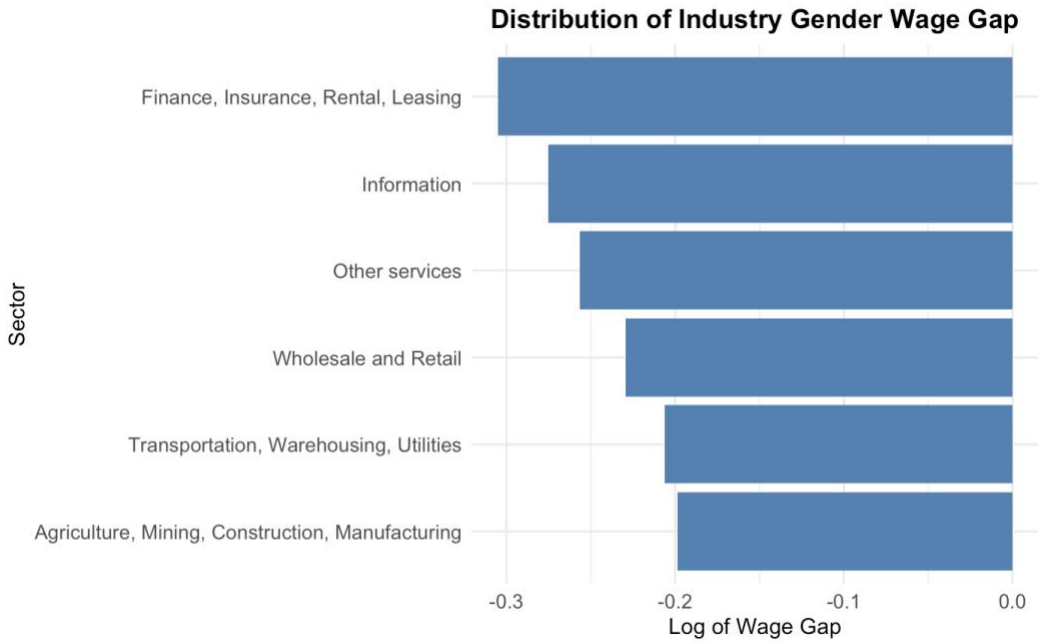
Table 3: Executive's Compensation Gap by Industry Sector

Industry Sector	Total Gap	Current Gap	Incentive Gap
Agriculture, Mining, Construction, Manufacturing	−0.35	−0.19	−0.42
Finance, Insurance, Rental, Leasing	−0.35	−0.28	−0.38
Information	−0.20	−0.10	−0.23
Transportation, Warehousing, Utilities	−0.24	−0.22	−0.59
Wholesale and Retail	−0.31	−0.11	−0.28
Other services	−0.49	−0.09	−0.41

Notes: this table shows the mean value for total compensation gap, current compensation gap, and incentive compensation gap. It is calculated according to this equation: ln(female executive compensation) – ln(male executive compensation).

Figure 3 displays the distribution of gender wage gap, categorized by six general industry sectors. Similar to the situation in leadership groups, "Finance, Insurance, Rental, Leasing" industry sector exhibits the lowest wage gap, with the value around -0.3. It is a little unexpected to see the gap ratio in "Agriculture, Mining, Construction, Manufacturing" sector. One possible explanation is that wage levels in these sectors tend to be lower on average. These industries are typically characterized by a higher demand for unskilled labor, which does not rely heavily on human capital accumulation. Furthermore, the physical nature of many roles in these sectors might lead to a more direct compensation for labor input, diminishing the impact of gender-based wage differentials commonly present in more human capital-intensive sectors.

Figure 3: Distribution of Outcome Variable "Industry Gender Wage Gap"

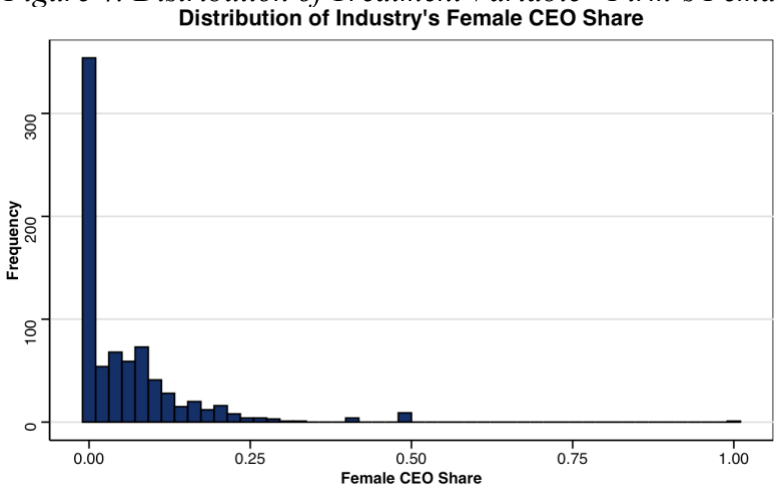


Notes: this figure displays the average log of wage gap for six industry sectors.

This research's main treatment variable is the female CEO's representation in each industry, calculated by dividing the female CEO's number by the total number of CEOs.

The below histogram illustrates the distribution of industry's share of female CEOs. A stark concentration at the leftmost bar suggests that a substantial number of industries have no female CEOs at all. The data reveals a skewed distribution with a long tail to the right, which could signify that while most industries have low to no female CEOs representation, there are a few outliers with a higher proportion. For example, in industry "postal service and massagers", one year the share of female CEO is 1.

Figure 4: Distribution of Treatment Variable "Firm's Female CEO Share"

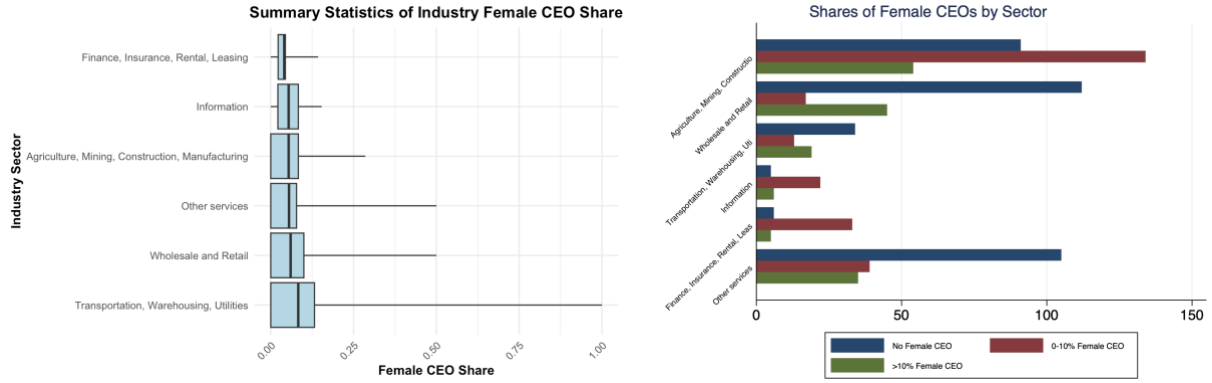


Notes: this figure displays the histogram of the percentage of female CEOs for each industry from 2012 to 2022.

The below two plots provide a visual summary of the distribution of the share of female CEOs across 6 industry sectors. The left plot displays the median, interquartile range, and any outliers, suggesting that most industries have a low median share of female CEOs. It can be inferred that while a few industries have a relatively higher presence of female CEOs, the overall representation remains notably small across the board.

As most industries' female CEO share is clustered around 0, to analyze its effect more clearly, this research divides industries into 3 categories for the following empirical research: industries without female CEOs, with female CEO share between 0-10%, and with female CEO share larger than 10%. The right-side bar chart indicates that industries with no female CEO occupy the largest portion of the bars. A small proportion of firms have more than 10% female CEOs, highlighting the rarity of higher female representation at the CEO level within these sectors. Together, these two plots highlight the gender disparity at the highest levels of corporate leadership.

Figure 5: Summary Statistics of Treatment Variable "Firm's Female CEO Share" and "Female CEO Share Category"



Notes: this figure displays the summary statistics graph of female CEOs by industry sector from 2012 to 2022.

7 Results

7.1 Baseline Empirical Model

Firstly, this research implements the baseline empirical with time, industry, and industry sector fixed effects to analyze the effect of female CEO share on the gap non-managerial labor earnings and executive compensations. To figure out the relationship between female leaders and female workers, I also implement the OLS model to assess the effect of compensation gap on gender wage gap.

Table 4 reports the results of the baseline empirical model with nine specifications incorporated. Notably, the coefficients for "0-10% Female CEO" and ">10% Female CEO" are positive and significant across several model specifications for both the labor earning gap and compensation gap, suggesting that an increase in female CEO representation is associated with a relative increase in female wages, a relative decrease of male wages, or a narrowing of the wage gap. This could be interpreted as firms with female CEOs exhibiting more equitable wage practices or at least a general tendency towards gender parity in compensation. Additionally, the observed positive correlation between the compensation gap and the wage gap indicates that a

more equitable compensation structure among leadership may help narrow wage disparities across the broader labor market. The use of a log-differenced outcome variable (ln(female wage) - ln(male wage)) means that the coefficients can be interpreted as the percentage difference in wages between genders, after controlling for various firm characteristics and macroeconomic factors included as controls. The larger the coefficient, the more positive effects female CEOs impose on mitigating gender wage gap. Moreover, the negative coefficients on the constant term in most specifications imply that when all other variables are at their means, the baseline wage setting is in favor of male wages.

However, it is worth noticing that utilizing difference fixed effects indeed lead to divergent observed results. Fixed effects capture the impact of time-invariant characteristics within industries or sectors. Among all specifications, the usage of time and sector fixed effects show the most significant results from female CEO share. One explanation for the insignificant results produced by industry fixed effect is that, as our data is using industry as its minimal unit, employing industry fixed effects can lead to collinearity problem. As female CEO share, financial performance, and wage structure are closely related with the industry itself, industry fixed effects can induce collinearity issues which makes it hard to separate the effect of the variable of interest from the industry effect. For this reason, my advanced model will primarily use sector fixed effect, which capture the time-invariant characteristics of each big sectors but avoid the problems of collinearity.

Table 4: Baseline OLS model for labor wage and executive compensation gap influenced by female CEO share

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Log of Labor Earning Gap						Log of Compensation Gap		
Total compensation gap				0.055**	0.063***	0.041			
				(0.021)	(0.022)	(0.026)			

0-10% Female CEO	0.037*	0.053**	0.005				0.266***	0.268***	0.288***
	(0.022)	(0.024)	(0.035)				(0.033)	(0.036)	(0.049)
>10% Female CEO	0.054**	0.060**	0.052				0.568***	0.549***	0.545***
	(0.024)	(0.025)	(0.036)				(0.037)	(0.038)	(0.053)
Minority workers	0.151	0.148	-0.486	0.131	0.090	-0.653*	0.106	0.356	0.468
	(0.141)	(0.149)	(0.322)	(0.142)	(0.149)	(0.333)	(0.215)	(0.223)	(0.467)
College graduates	-0.104	-0.125	-0.035	-0.067	-0.131	-0.181	0.086	0.342***	0.126
	(0.071)	(0.087)	(0.293)	(0.069)	(0.087)	(0.297)	(0.107)	(0.131)	(0.418)
Full-time	0.381***	0.421***	0.756*	0.455***	0.568***	0.704	-0.341*	-0.578***	0.179
	(0.118)	(0.138)	(0.409)	(0.119)	(0.142)	(0.430)	(0.184)	(0.211)	(0.606)
Mean age	-0.006	-0.005	-0.012	-0.011*	-0.009	-0.016	0.009	0.007	-0.018
	(0.006)	(0.006)	(0.010)	(0.006)	(0.006)	(0.011)	(0.009)	(0.009)	(0.015)
lnassets	-0.018	0.002	-0.082*	-0.023	-0.006	-0.059	0.038*	0.056*	-0.044
	(0.015)	(0.019)	(0.042)	(0.015)	(0.019)	(0.048)	(0.023)	(0.029)	(0.068)
lnprofit	0.015	-0.002	0.024	0.008	-0.002	0.017	0.038*	-0.013	-0.045
	(0.015)	(0.019)	(0.029)	(0.015)	(0.019)	(0.029)	(0.023)	(0.029)	(0.040)
Constant	-0.280	-0.420*	0.306	-0.039	-0.230	0.463	-1.283***	-0.979**	0.516
	(0.213)	(0.251)	(0.622)	(0.216)	(0.248)	(0.672)	(0.334)	(0.388)	(0.948)
Observations	774	774	774	734	734	734	734	734	734
R-squared	0.053	0.059	0.251	0.051	0.058	0.239	0.277	0.300	0.500
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE			Yes			Yes			Yes
Sector FE		Yes			Yes			Yes	

*Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Table reports results of estimation of equation (3) and (4)*

7.2 Joint Estimation Model

Similarly, Table 5 from the Joint Estimation Model reveals the statistically significant effects of the share of female CEOs, suggesting that an increase in the proportion of female CEOs can lead to a narrowing of both the wage and compensation gaps. Specifically, industries with a greater share of female CEOs (>10 %) exhibit a more pronounced narrowing of these gaps than those with a lesser share (0-10%), holding other factors constant.

This positive relationship is also illustrated by the predictive margins plots, which reflects the estimated average effects of the share of female CEOs on the labor earning gap and the total compensation gap. The left plot indicates the pattern that as the share of female CEOs increases, the predicted labor earning gap becomes less negative. The decrease level is smaller when the

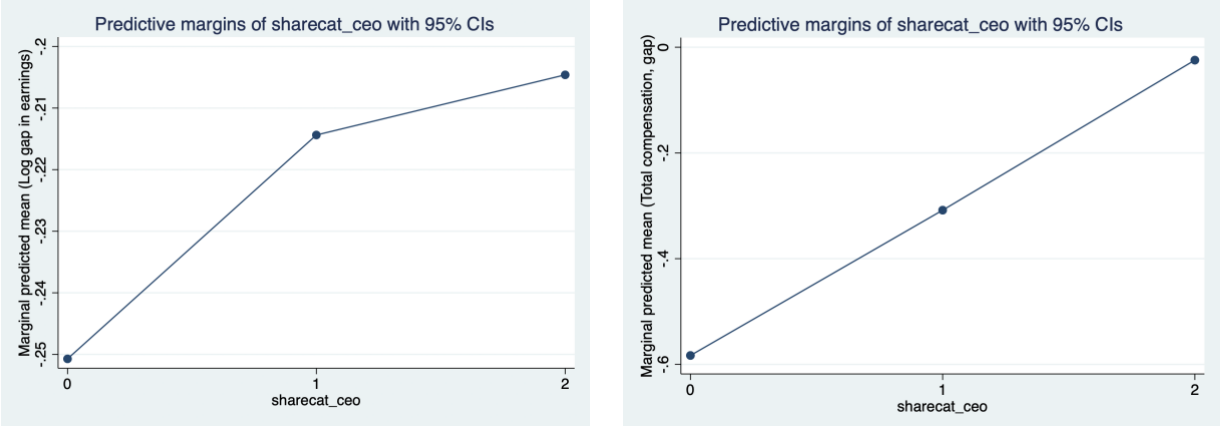
female CEO share exceeds 10%. Conversely, the right plot shows the change in predictive margins is roughly the same when female CEO share is between 0-10% and exceeds 10%. The extent of mitigating gap is also larger for executives.

Table 5: Joint estimation model for labor wage and executive compensation gap influenced by female CEO share

	(1)	(2)
VARIABLES	lgapearn	gap_totcomp
0-10% Female CEO	0.0364	0.275***
	(0.0276)	(0.0493)
>10% Female CEO	0.0461*	0.559***
	(0.0268)	(0.0719)
minority	0.124	0.203
	(0.217)	(0.445)
college	-0.111	0.132
	(0.0884)	(0.202)
fulltime	0.408**	-0.00264
	(0.187)	(0.347)
age	-0.00723	-0.00963
	(0.00825)	(0.0132)
lnassets	-0.0174	0.0398
	(0.0170)	(0.0319)
lnprofit	0.00940	0.00663
	(0.0203)	(0.0292)
Year FE	Yes	Yes
Sector FE	Yes	Yes
Constant	-0.221	-0.652
	(0.277)	(0.526)
Observations	775	775

*Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Table reports results of estimation of equation (5) and (6)*

Figure 6: Predicted wage and compensation gap by female CEO share



Note: Figure reports margins of estimation of equation (5) and (6)

7.3 Mediating Model

The mediating sequential model delineated in Table 6 illustrates that an increase in the share of female CEOs correlates significantly with a rise in the female to male wage ratio. The effect is even more pronounced in the executive compensation arena, where the presence of female CEOs can lead to 0.268 and 0.549 level of changes in wage ratio. The positive coefficient also suggests a mitigated gender gap led by female CEO presence. Compared with baseline OLS and joint estimation model, the coefficients are roughly the same.

It is tricky to see the same control variables lead to divergent effects for executives and non-managerial workers. While full-time employment status is a strong predictor of smaller wage ratios (female earn less to male earn more), the negative coefficient for full-time status in the compensation model suggests an inverse relationship for executive earnings. Additionally, the presence of college graduates within the firm seems to widen the wage ratio (female earn more or male earn less), which might be indicative of educational premiums disproportionately affecting pay scales over non-managerial wages.

Table 7 provides a summary of the direct and indirect effects of female CEO representation on the wage gap. The direct effect suggests that female leadership directly contributes to reducing the wage gap, with a significance level of 90%. The indirect effect, which involves the channel of influencing through executive compensation gap, is positive but not statistically significant at any level. Combining these effects, the total impact of increased female CEO representation is statistically significant and positive, reflecting that when both direct and indirect pathways are considered, female CEOs are highly likely to contribute to the narrowing of gender wage gap.

Table 6: Mediating sequential model for labor wage and executive compensation gap influenced by female CEO share

	(1)	(3)
VARIABLES	earngap_mean	compgap_mean
gap_totcomp	0.0389	
	(0.0264)	
0-10% Female CEO	0.0584**	0.268***
	(0.0259)	(0.0318)
>10% Female CEO	0.0517*	0.549***
	(0.0269)	(0.0394)
minority	0.104	0.356
	(0.153)	(0.231)
college	-0.167**	0.342***
	(0.0797)	(0.122)
fulltime	0.545***	-0.578**
	(0.137)	(0.225)
age	-0.00606	0.00739
	(0.00611)	(0.00861)
lnassets	-0.00130	0.0563**
	(0.0207)	(0.0224)
lnprofit	-0.00386	-0.0134
	(0.0167)	(0.0252)
Year FE	Yes	Yes
Sector FE	Yes	Yes
Observations	734	734

*Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Table reports results of estimation of equation (7) and (8)*

Table 7: *Mediating sequential model results: direct and indirect effects*

	Coefficient	z	P>|z|
[earngap_mean] share_3			
Direct	0.0517	1.93	0.054
[earngap_mean] gap_totcomp * [compgap_mean] share_3			
Indirect	0.0214	1.48	0.138
[earngap_mean] share_3 + [earngap_mean] gap_totcomp * [compgap_mean] share_3			
Total	0.0731	2.89	0.004

Note: Table reports direct and indirect effects of estimation of equation (7) and (8)

7.4 Instrumental Variable

Table 8 presents the 2SLS regression results, utilizing two sets of instruments: lagged values of the female CEO share in the previous year and the Bartik instrument (the multiplication of female CEO share in previous year with the change of female executives across all industries). The first stage of the 2SLS model indicates that both instruments are strong predictors of the current year's female CEO share, evidenced by the significant coefficients on lagged shares (L.share_2 and L.share_3). This result is based on assumption that past female CEO representation is a relevant determinant of present dynamics. The second stage (IV-2nd) reveals that an increase in female CEO share in present year is associated with a statistically significant reduction in the gender wage gap (female earn more or male earn less). Compared with previous model, especially baseline OLS, the magnitude of coefficients becomes larger, suggesting the instruments work in favor of this research's hypothesis.

Table 9 outlines the results of three tests for validating the instrumental variables used in the 2SLS model. The tests of endogeneity check whether the explanatory variables are correlated with the error term of the regression. The high p-values (0.6276 for the Lag Instrument and 0.3980 for the Bartik Instrument) fail to reject the null hypothesis of exogeneity at all confidence level, which is desirable in the instrument test. The tests of relevance, indicated by the F-

statistics for the first stage, exceed the conventional threshold of 10, confirming that the instruments are relevant and not weak. Finally, the overidentification test yields a large p-value (0.6564), implying that the null hypothesis cannot be rejected. This is a desirable outcome since it confirms the validity of the exclusion restriction.

Table 8: 2SLS model for labor wage and executive compensation gap influenced by female CEO share

	(1)	(2)	(3)		(1)	(2)	(3)
	Instrument -Previous Year Share				Bartik Instrument		
	IV-2nd	IV-1st	IV-1st		IV-2nd	IV-1st	IV-1st
VARIABLES	lgapearn	share_2	share_3	VARIABLES	lgapearn	share_2	share_3
L. 0-10% FCEO		0.701***	0.118***	Bartik 0-10%		49.856***	8.233***
		(0.037)	(0.029)			(3.841)	(2.675)
L. >10% FCEO		0.000	0.830***	Bartik >10%		-0.851	64.270***
		(0.029)	(0.033)			(2.943)	(3.711)
L.lnassets		0.011	0.016	L.lnassets		0.023	0.004
		(0.039)	(0.043)			(0.057)	(0.063)
0-10% FCEO	0.050			0-10% FCEO	0.045		
	(0.037)				(0.051)		
>10% FCEO	0.073**			>10% FCEO	0.092**		
	(0.032)				(0.040)		
Constant	-0.272	0.050	0.323	Constant	-0.321	0.566	1.620***
	(0.274)	(0.301)	(0.304)		(0.287)	(0.377)	(0.357)
Observations	702	702	702	Observations	702	702	702
R-squared	0.057	0.638	0.623	R-squared	0.054	0.451	0.388

*Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Table reports results of estimation of equation (9) and (10)*

Table 9: Three tests for instrumental variables

		Instrument Methods	
Instrument Test		Lag Instruments	Bartik Instruments
Tests of endogeneity		P value=0.6276	P value=0.3980
Tests of relevance	FCEO 0-10%	F=134	F= 64
	FCEO >10%	F=218	F=100
Overidentification test		P value=0.6564	P value=0.6467

Note: Table reports results for three tests of instrumental variables used in 2SLS model.

While the statistical tests suggest that the chosen instruments are robust, a thoughtful assessment of the underlying assumptions is necessary for ensuring internal validity. In the baseline model, a prominent threat to internal validity arises from the potential that industries with a narrower gender wage gap may not directly attribute this to the prevalence of female CEOs, but rather to industry characteristics that inherently favor women, such as traditionally higher female employment rates. The use of lagged values as instruments depends on the assumption of persistency in industry characteristics. Should this persistency be disrupted, the reliability of lagged values in correcting for endogeneity may be compromised. Furthermore, the usage of previous year assets as an instrument rest on the assumption of non-discriminatory expansion, implying that industry growth leads to random hiring practices, including the proportionate hiring of female labor. If, however, expansion is accompanied by selective hiring that does not reflect a random distribution of gender, the instrument may still be subject to validity concerns despite satisfactory performance in statistical tests. Overall, although there are concerns for choice of instruments, the good statistical performance of the instrumental variables suggests that the instruments are well-suited for addressing potential endogeneity in the model.

8 Robustness Check

To supplement the empirical analysis, I also performed the robustness check via using different categorization methods and choices of instrument variables. First, I implemented the baseline OLS model with only 2 categories of industries: industries with female CEO share less than 10% and female CEO share larger than that threshold. The regression Table 10 indicates a statistically significant result across specifications. Compared with the previous model, the coefficient magnitude becomes slightly larger for specifications with fixed sector effect. With the

same categorization, I also performed another instrument model, obtaining the result with less magnitude of female influence.

Table 10: Baseline OLS model for labor wage and executive compensation gap influenced by female CEO share

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Log of Labor Earning Gap						Log of Compensation Gap		
Total compensation gap				0.055**	0.063***	0.041			
				(0.021)	(0.022)	(0.026)			
>10% Female CEO	0.039*	0.039*	0.050				0.458***	0.433***	0.391***
	(0.023)	(0.023)	(0.032)				(0.036)	(0.036)	(0.048)
Minority workers	0.146	0.147	-0.486	0.131	0.090	-0.653*	0.088	0.369	0.500
	(0.141)	(0.149)	(0.322)	(0.142)	(0.149)	(0.333)	(0.224)	(0.231)	(0.479)
College graduates	-0.080	-0.080	-0.032	-0.067	-0.131	-0.181	0.246**	0.573***	0.246
	(0.069)	(0.085)	(0.293)	(0.069)	(0.087)	(0.297)	(0.109)	(0.133)	(0.429)
Full-time	0.422***	0.441***	0.750*	0.455***	0.568***	0.704	-0.067	-0.512**	-0.086
	(0.116)	(0.138)	(0.407)	(0.119)	(0.142)	(0.430)	(0.188)	(0.219)	(0.620)
Mean age	-0.007	-0.007	-0.012	-0.011*	-0.009	-0.016	0.001	-0.005	-0.018
	(0.006)	(0.006)	(0.010)	(0.006)	(0.006)	(0.011)	(0.009)	(0.009)	(0.016)
lnassets	-0.016	0.000	-0.082*	-0.023	-0.006	-0.059	0.051**	0.046	-0.056
	(0.015)	(0.019)	(0.042)	(0.015)	(0.019)	(0.048)	(0.024)	(0.030)	(0.069)
lnprofit	0.014	-0.000	0.024	0.008	-0.002	0.017	0.029	-0.007	-0.026
	(0.015)	(0.019)	(0.028)	(0.015)	(0.019)	(0.029)	(0.024)	(0.030)	(0.041)
Constant	-0.271	-0.331	0.309	-0.039	-0.230	0.463	-1.187***	-0.461	0.793
	(0.214)	(0.249)	(0.621)	(0.216)	(0.248)	(0.672)	(0.348)	(0.396)	(0.972)
Observations	774	774	774	734	734	734	734	734	734
R-squared	0.050	0.053	0.251	0.051	0.058	0.239	0.212	0.245	0.472
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE			Yes			Yes			Yes
Sector FE		Yes			Yes			Yes	

*Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Table reports results of estimation of equation (3) and (4). Industries are divided into 2 categories: with female CEO share >10% and <10%*

Table 11: 2SLS model for labor wage and executive compensation gap influenced by female CEO share

	(1)	(2)		(1)	(2)
	Instrument -Previous Year Share			Bartik Instrument	
	IV-2nd	IV-1st		IV-2nd	IV-1st
VARIABLES	lgapearn	shareceo_10	VARIABLES	lgapearn	interact_10

L. >10% FCEO		0.782***	L. Bartik>10%		0.281***
		(0.033)			(0.054)
L.lnassets		0.013	L.lnassets		0.001
		(0.044)			(0.001)
>10% Female CEO	0.054*		>10% Female CEO	0.076**	
	(0.029)			(0.035)	
Constant	-0.191	0.565*	Constant	-0.251	0.013***
	(0.264)	(0.295)		(0.274)	(0.005)
Observations	703	703	Observations	703	632
R-squared	0.052	0.611	R-squared	0.049	0.209

*Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Table reports results of estimation of equation (9) and (10). Industries are divided into 2 categories: with female CEO share >10% and <10%*

Beside than the difference in categorization, I also performed the instrument variable model with the choice of lag is past 2 years. In this case, I'm interested in if the previous 2 year's share of female CEO can work as an instrument and how the results might change. The result in Table 12 indicates that the female representation in past 2 years indeed have a significantly positive impacts on present year's female CEO share (1st stage results). However, the results in second stage almost not statistically significant.

Table 12: 2SLS model for labor wage and executive compensation gap influenced by female CEO share

	(1)	(2)	(3)		(1)	(2)	(3)
	Instrument -Previous Year Share				Bartik Instrument		
	IV-2nd	IV-1st	IV-1st		IV-2nd	IV-1st	IV-1st
VARIABLES	lgapearn	share_2	share_3	VARIABLES	lgapearn	share_2	share_3
L2. 0-10% FCEO		0.531***	0.151***	L2.Bartik 0-10%		38.893***	8.937***
		(0.046)	(0.035)			(4.264)	(3.229)
L2. >10% FCEO		-0.079**	0.759***	L2.Bartik >10%		-6.371**	55.583***
		(0.033)	(0.040)			(3.230)	(4.411)
L2.lnassets		-0.036	0.004	L2.lnassets		-0.054	0.037
		(0.039)	(0.065)			(0.049)	(0.061)
0-10% Female CEO	0.075*			0-10% Female CEO	0.075		
	(0.045)				(0.056)		

>10% Female CEO	0.011			>10% Female CEO	0.014		
	(0.040)				(0.058)		
Constant	-0.106	0.503	0.405	Constant	-0.113	0.710*	1.431***
	(0.293)	(0.364)	(0.387)		(0.309)	(0.407)	(0.419)
Observations	630	630	630	Observations	630	630	630
R-squared	0.055	0.509	0.507	R-squared	0.055	0.409	0.321

*Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Table reports results of estimation of equation (9) and (10).*

9 Conclusion

This research, leveraging an employer-employee matching dataset extracted from Executive Composition and Current Population Survey spanning the years 2012 to 2022, sheds light on the evolving workplace dynamics over the past decade. By focusing on the female CEO representation derived from S&P 1500 companies, the analysis offers insights into the broader influence that female leaders from high-performing firms exert on the average industry performance and labor market.

The evidence from my empirical analysis points to the conclusion that an augmented presence of female CEOs in the corporate sphere help (a) narrow the compensation gap among executive echelons, and (b) diminish the earnings disparities faced by non-managerial labor due to gender. Together, these two pieces of conclusion reflect a promising aspect of female leadership representation, that is, they may introduce a trickle-down influence that potentially fosters gender parity beyond the executive suite into the non-managerial labor force. This emergent picture underscores the ripple effects initiated by female executives, granting more equalized opportunities in terms of wages for non-managerial labor.

Beside reaching the conclusion, this research also explores some crucial aspects of labor economics. For example, from the summary statistics, we can still find that gender segregation is

a common phenomenon. Certain industries, continue to exhibit a male-dominated environment with scant female leadership or workforce representation. Although the trend of female CEO share is slightly uptick in the past decades, still, the number remains slow compared with their male counterparts. The wage and compensation gap remain negative across almost all industries, reflecting that generally, notwithstanding a trend toward convergence, females are still overall paid less.

Methodologically, the study employs a suite of econometric models: baseline OLS, mediating and joint estimation model, instrumental variables. Together they help address some internal validity threats such as becoming female CEO is endogenous. However, the methods employed still have their limitations. The main endogeneity source is whether smaller industry-specific wage gaps in female-intensive sectors are attributable to an inherently more inclusive environment or to the increase in female CEOs. Utilizing lagged data on female CEO share as an instrumental variable rest on the assumption that the friendliness of industries to female labor remains static year-over-year. If the assumption of persistency over time is violated, the choice of lags as instruments will work less to address endogeneity. Additionally, this research measures female leadership representation via female CEO share in S&P 1500 firms due to data availability. A more extensive dataset encompassing a broader range of firms would likely yield a richer and more comprehensive understanding.

In essence, the research highlights a positive influence of increased female leadership representation on narrowing the gender wage gap. This finding underscores the policy implication of advocating for gender-balanced leadership as a means to foster equitable wage practices across the corporate landscape. More broadly, the research suggests that enhancing equality in one domain can initiate broader organizational shifts with the radiating effects

towards gender equality, serving not only as a goal but also as a driving force for extensive organizational transformation.

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Appendix

Appendix 1: Variable Descriptions

Variable Name	Vector	Variable Description	Type/Availability
Executive's Average Compensation Gap at Industry Level	γ_{jt}	The difference between average male and female executive's compensation - Total compensation - Current compensation - Incentive compensation	Continuous
Industry's wage gap	$\gamma 2_{jt}$	The difference between average male and female wages for non-managerial labor for each industry	Continuous
Female CEO Share at Industry Level	P_{jt}	3 levels of average percentage of female CEOs at each industry: - 0 % Female CEOs - 0-10% Female CEOs - >10% Female CEOs	Categorical
Industry Control Variables and Sector Fixed Effect	X_{jt}	Industry level characteristics - Share of minority, college, fulltime workers in the industry - Average ages of industry workers - Average log of annual assets and profits per industry, which indicate the industry's financial performance - Average executives' total compensation gap between genders - Sector fixed effects (categorize 6 overarching industries according to CPS criteria)	Categorical/ Continuous
Year	X_{it}	Time which the records take place - Time fixed effect	Discrete

Appendix 2: Effects of Control Variables on Labor Earnings Gap

	(1)
VARIABLES	Log of Labor Earning Gap
Total Compensation Gap	0.0549**
	(0.0215)
minority	0.0799
	(0.137)
college	-0.0841
	(0.0676)
fulltime	0.445***
	(0.119)
age	-0.00957*
	(0.00568)
lnassets	-0.0219
	(0.0151)

lnprofit	0.00460
	(0.0151)
Constant	-0.0402
	(0.216)
Observations	735
R-squared	0.033

*Notes: Standard errors in parentheses. *** p < 0.001; ** p < 0.01; * p < 0.05. The three control variables that have statistically significant impacts on labor earnings gap are: executive's total compensation gap, share of fulltime workers in industries, and industry average ages.*

Appendix 3: Estimation Result for Total Gender Compensation Gap

	Model 1	Model 2	Model 3
Female CEO Share	-552.88 ***	-610.11 ***	-592.54 ***
	(79.74)	(87.05)	(102.87)
N	1005	1005	1005
R2	0.05	0.07	0.48

*Notes: All continuous predictors are mean-centered and scaled by 1 standard deviation. The outcome variable is in its original units. *** p < 0.001; ** p < 0.01; * p < 0.05.*

Appendix 4: Estimation Result for Current Gender Compensation Gap

	Model 1	Model 2	Model 3
Female CEO Share	-78.03 ***	-74.69 ***	-95.75 ***
	(11.81)	(12.76)	(15.50)
N	997	997	997
R2	0.04	0.09	0.46

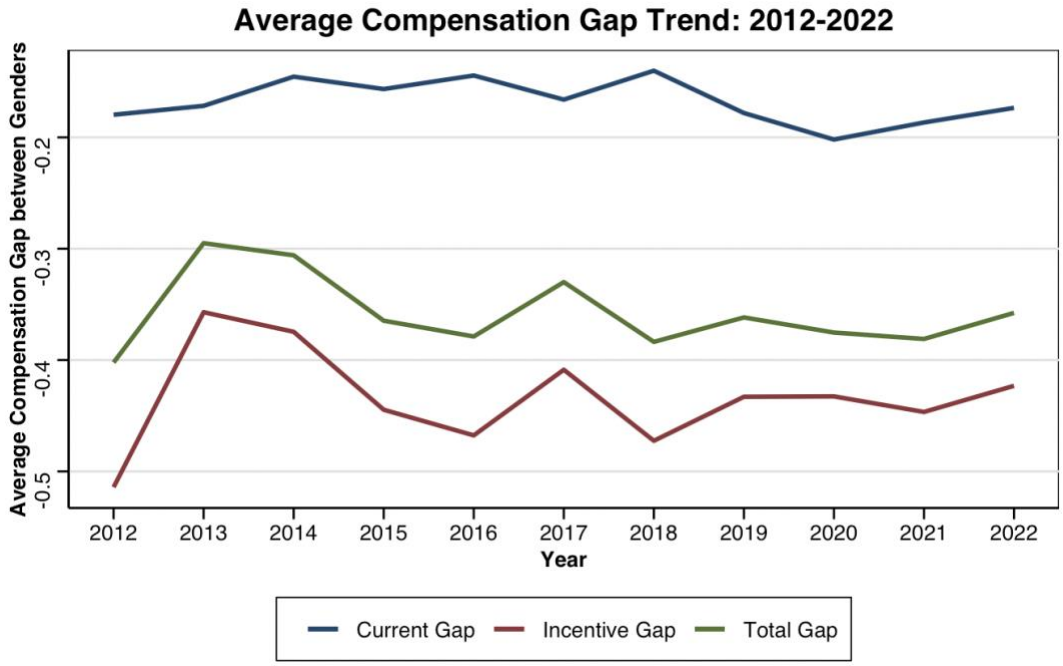
*Notes: All continuous predictors are mean-centered and scaled by 1 standard deviation. The outcome variable is in its original units. *** p < 0.001; ** p < 0.01; * p < 0.05.*

Appendix 5: Estimation Result for Incentive Gender Compensation Gap

	Model 1	Model 2	Model 3
Female CEO Share	-468.58 ***	-540.38 ***	-493.33 ***
	(75.97)	(82.59)	(100.49)
N	992	992	992
R2	0.04	0.07	0.45

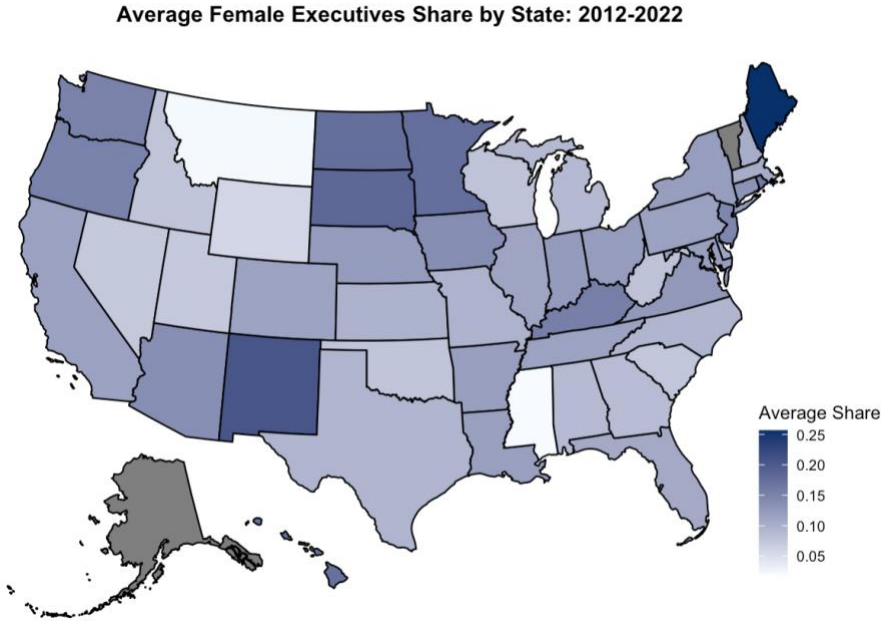
*Notes: All continuous predictors are mean-centered and scaled by 1 standard deviation. The outcome variable is in its original units. *** p < 0.001; ** p < 0.01; * p < 0.05.*

Appendix 6: Trend of Outcome Variable "Total Executive Compensation Gap" from 2012 to 2022



Notes: this figure displays trend of average total compensation gap, current compensation gap, and incentive compensation gap between genders.

Appendix 7: Geometric Distribution of Treatment Variable "Firm's Female Executive Share" by State



Notes: this map displays the average female executive share for the firms within each state. The darker color represents higher percentage of female executives.