

Standing shoulder-to-shoulder: Female solidarity and CEO–employee pay gap

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Abstract

Drawing on an international sample of 20,576 observations between 2002 and 2021, we find that greater female employment is positively associated with a higher salary gap, implying that firms employing more women are more prone to a higher salary gap. However, a greater proportion of female executives and directors per se are not associated with the salary gap. Considering the outputs of interaction effects, the solidarity of female executives with female employees, female directors with female employees, and female directors with female executives diminishes the firm's salary gap. Besides, smaller firms having more female employees are more afflicted by the salary gap than larger firms, and female solidarity is less functional in smaller firms. Lastly, firms domiciled in high-Worldwide Governance Indicator (WGI) countries with more female employees are more beset by salary gaps than those in low-WGI countries. Although female solidarity is functional in both institutional environments, it is stronger in high-WGI countries.

Keywords

social capital theory, homophily theory, female solidarity, salary gap

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Introduction

Chief Executive Officer (CEO)-to-employee wage disparities remain staggeringly high, reflecting a troubling pattern that shows little sign of narrowing. In the United States, the average CEO in S&P 500 companies earns approximately 268 times more than their median worker, underscoring the scale of this inequality (Reuters, 2024). This gap is not unique to the United States; similar figures are evident globally, such as India with a ratio of 229:1 and the United Kingdom at 201:1 (Statista, 2018). Even in countries like the Netherlands, known for more equitable social policies, the ratio remains high at 171:1 (Statista, 2018). Analysis of Financial Times Stock Exchange (FTSE) 350 companies reveals that the UK's gap has barely shifted, with a median CEO-to-median employee pay ratio of 57:1, rising to 80:1 in FTSE 100 firms (High Pay Centre, 2022). These persistent gaps highlight a structural trend that continues to place excessive financial rewards at the executive level, with minimal progress towards equity for the broader workforce.

Why does the magnitude of the pay gap within firms matter? Two theoretical traditions give competing answers. Tournament theory treats steep pay differentials as incentive devices that motivate effort and competition for advancement, implying that a degree of vertical dispersion is efficient (Lazear and Rosen, 1981; Lin et al., 2013). Equity and relative deprivation perspectives counter that employees evaluate their pay against referents above them, and that differentials perceived as illegitimate erode satisfaction, morale, commitment and cooperation (Adams, 1963; Georgellis et al., 2019). The empirical record indicates that both accounts hold under different conditions: pay dispersion that reflects observable differences in inputs and performance can improve firm performance, whereas excessive or unexplained dispersion lowers employee engagement, weakens research and development efficiency, and depresses productivity, innovation, and performance (Chan et al., 2020; Cowherd and Levine, 1992; Luo et al., 2020; Mueller et al., 2017; Rouen, 2020; Shaw, 2014; Xu et al., 2017), with effects that vary across countries, labour markets, and cultural settings (Wang and Li, 2010). It follows that there is no single optimal pay gap; the legitimate spread of pay varies across firms, industries and institutional environments. The concern of this study is with the excessive and unexplained component of vertical pay dispersion, which offends fairness and impairs efficiency at the same time, and with the mechanisms through which firms may curb it.

Female solidarity can potentially help reduce the wage gap, as collective action and solidarity-based wage bargaining have historically contributed to narrowing pay disparities in settings like Sweden (Grand, 1991). Additionally, framing pay equity as a solidarity solution reinforces the social and policy commitment to fair pay practices, which can address structural wage biases in the workforce (Olson, 2020). Prior studies often overlook the role of collective social mechanisms, such as female solidarity and solidarity wage bargaining, in addressing the pay gap, focusing instead on individual factors like job segregation and market discrimination (Grand, 1991). This gap can be addressed by researching how solidarity-focused strategies, as suggested by Olson (2020), could systematically improve wage equity in diverse cultural and economic contexts, enhancing our understanding of social influences on pay equity (Olson, 2020).

Against this background, we ask two research questions. First, does the representation of women per se, among employees, executives and directors, reduce the CEO–employee pay gap in firms? Second, does female solidarity, which we conceptualise as mutually

supportive relations among women across hierarchical levels and operationalise as the joint presence of women at pairs of organisational levels, reduce the CEO–employee pay gap, and how do firm size and the quality of national governance condition this relationship? We answer these questions by drawing on social capital theory and homophily theory and by testing our hypotheses on an international sample of 20,576 firm-year observations from 61 countries between 2002 and 2021.

Our findings show that while higher proportions of female employees within firms are associated with an increase in the CEO–employee pay gap, a distinct pattern emerges when focusing on solidarity among women across roles: interactions between female employees, executives and directors are found to effectively narrow this gap.

The study's findings suggest that the mere presence of women in the workforce or leadership roles does not suffice in addressing salary inequities. Instead, the collaborative effect – when female leaders and employees support each other – demonstrates a significant gap-mitigating impact, especially in larger firms (cf. Flabbi et al., 2019). This indicates that female solidarity across hierarchical levels plays a critical role in alleviating gender-related income inequalities (Cohen and Huffman, 2007). However, smaller firms and those in less regulated environments experience fewer benefits from this solidarity, highlighting the importance of institutional support in fostering equity (Droganova, 2018).

This study makes three contributions. First, it extends research on gender and pay by shifting attention from the representation of women at single organisational levels to the relational dynamics among women across levels, showing that the joint presence of women across employee, executive and director levels is associated with a narrower CEO–employee pay gap, whereas presence at any single level is not. Second, it contributes to social capital and homophily theorising by demonstrating boundary conditions of female solidarity: cross-level solidarity operates more strongly in larger firms and in countries with higher governance quality. Third, it offers policy insight for debates on industrial democracy and fair pay, suggesting that interventions which enable women's cross-level networks and voice can complement transparency mandates and board representation targets. The remainder of the article proceeds as follows. Section 'Theoretical framework and hypotheses' develops the conceptual and theoretical framework and the hypotheses. Section 'Research methodology' describes the data and methods. Section 'Results' reports the results. Sections 'Discussion and conclusions' and 'Implications for human resource management' discuss the findings and their implications for human resource management.

Theoretical framework and hypotheses

Conceptualising the vertical pay gap and female solidarity

Pay inequality within firms takes two analytically distinct forms. The gender pay gap is a horizontal disparity: earnings differ across genders within comparable levels of the organisational hierarchy (Salminen-Karlsson and Fogelberg Eriksson, 2022), with women earning approximately 20% less than men globally (International Labour Organization, 2022) and national gaps exceeding 20% in some countries (OECD, 2023). The CEO–employee pay gap is a vertical disparity: compensation rises sharply at the

executive apex relative to the broader employee base (Peters et al., 2024). Our focus in this study is the vertical pay gap. The two forms are nevertheless connected. Policy instruments developed to narrow horizontal gaps, such as pay transparency mandates and ratio disclosure requirements exemplified by the Dodd-Frank Act in the United States, are increasingly proposed as templates for curbing excessive vertical disparities (OECD, 2021; Peters et al., 2024), although the evidence suggests that transparency alone is a limited remedy for entrenched wage inequality (Coron, 2020; Pochic and Chappe, 2019). Increasing the number of women in leadership positions has positive effects, yet it is insufficient on its own, and organisations need to set and monitor gender diversity objectives across all levels of management, since gains at the apex do not cascade automatically (Stainback et al., 2024). Equality and diversity scholarship likewise cautions that formal equality initiatives do not translate automatically into substantive organisational change, as responsibility for equality has been progressively individualised and rendered voluntary (Erbil et al., 2024; Özbilgin and Tatli, 2011; Pas et al., 2014).

Solidarity is a foundational concept in the study of industrial democracy, yet it is often invoked without definition. Following the workplace relations literature, we define solidarity as mutually supportive orientations and actions among members of a group who recognise shared interests and act to advance them collectively (Hodson et al., 1994). Solidarity in this sense is relational: it resides in ties between people and is distinct from the mere numerical presence of a group within an organisation. Research on workplace relations shows that employee participation strengthens worker solidarity and heightens workers' sensitivity to organisational injustice (Hodson et al., 1994). Historically, solidarity has narrowed pay differentials where it has been institutionalised, most visibly through solidaristic wage bargaining in Sweden (Grand, 1991), and framing pay equity as a solidarity project strengthens social and policy commitments to fair pay (Olson, 2020). We extend this tradition by specifying female solidarity as cross-level solidarity among women, that is, mutually supportive relations linking women employees, women executives and women directors. Because such relations are not directly observable in archival data, we operationalise female solidarity as the statistical interaction between the shares of women at pairs of organisational levels. The interaction effect captures whether the association between women's presence at one level and the pay gap is conditioned by women's presence at another level; a negative interaction coefficient indicates that the joint presence of women across two levels narrows the gap beyond what either level achieves alone. We treat this joint presence as a structural precondition of, and proxy for, solidarity, an approach consistent with prior studies that infer cross-level cooperation among women from their co-presence (Nguyen and Thai, 2022; Song, 2022; Xing et al., 2021), and we acknowledge the limits of this operationalisation in the concluding section.

Finally, we situate the analysis within a relational, multilevel framing (Syed and Özbilgin, 2009), which holds that workplace equality outcomes are produced jointly by macro-level institutional arrangements, meso-level organisational structures and micro-level relations among actors. In our research design, the quality of national governance captures the macro level, firm size and corporate governance characteristics capture the meso level, and cross-level solidarity among women captures the micro-relational level. Organisations themselves are structured by inequality regimes, that is, interlocked practices and processes that reproduce class, gender, and racial disparities,

including disparities in compensation (Acker, 1990, 2006). Complementing this perspective, Taser-Erdogan (2022) shows that women's career advancement is shaped by macro-level societal conditions, meso-level organisational practices and micro-level career dynamics operating together, and that women's perceptions of barriers differ across organisational contexts even within the same national setting. A multilevel framing therefore leads us to expect that the effects of female solidarity will vary across organisational and institutional contexts, an expectation we test through subgroup analyses by firm size and governance quality.

Theoretical foundations

The theoretical framework of this study builds upon literature that examines the role of gender dynamics and female representation in shaping organisational outcomes, particularly pay disparity. A consistent lesson of this literature is that female representation alone may not produce equitable outcomes in the absence of supportive workplace structures and interactions (Goldin, 2014). We extend this insight by positing that female solidarity, understood as supportive relations among female employees, executives and directors, can moderate the CEO–employee pay gap.

Drawing on theories of social capital and homophily, the framework suggests that women in organisations can leverage shared experiences and supportive networks to advocate for fairer pay practices. Social capital theory has deep roots: Bourdieu (1986) conceives of social capital as resources embedded in durable networks of relationships, Coleman (1988) treats it as a relational structure that facilitates collective action, and Lin (2001) theorises it as resources accessed and mobilised through social ties for purposive action. These formulations converge on the proposition that actors gain capacity for advocacy and claims-making through connection. Social capital is the collection of resources and advantages accessible through social connections that enable individuals to gain access to mentorship and advocacy, which can be essential for career progression and addressing pay inequalities (Carter et al., 2003). Homophily, that is, the tendency to form bonds with similar others, allows women to build networks with colleagues who understand and support their goals for equity, often reinforcing advocacy efforts within male-dominated settings (Ibarra, 1992). The homophily principle, that similarity breeds connection, is among the most established regularities in network research (McPherson et al., 2001), and it has particular consequences in organisations where women are a numerical minority: women's networks tend to yield differential returns, and access to influential circles is constrained by the composition of the dominant coalition (Ibarra, 1992, 1993). Research indicates that marginalised women, in particular, benefit from these networks to overcome structural barriers to pay equity (Kohout and Singh, 2018). By drawing on both social capital and homophilous networks, women in organisations can build a stronger collective voice to address compensation disparities (Timberlake, 2005). Prior research in behavioural economics and organisational studies reveals that women often exhibit a higher propensity for cooperation and advocacy when collaborating with other women (Bear and Woolley, 2011; Peshkovskaya et al., 2018). Additionally, findings indicate that female leaders are more likely to act as mentors and sponsors for female employees, which can positively influence organisational outcomes and reduce

wage inequalities (American Psychological Association, 2022; Ely et al., 2011). By examining the interaction effects between female employees, executives and directors, this framework hypothesises that these networks of support, or ‘female solidarity’, can mitigate the structural challenges that perpetuate pay disparities.

Theory does not uniformly predict that women’s presence generates solidarity, and this tension motivates our first hypothesis. Kanter’s (1977) analysis of tokenism shows that women in numerically skewed groups face heightened visibility, performance pressures and incentives to distance themselves from other women, and that only when women approach a critical mass do their voices begin to alter group processes and decisions (Konrad et al., 2008; Torchia et al., 2011). The queen bee literature similarly documents that some senior women, having advanced within male-dominated settings, respond to social identity threat by emphasising their difference from junior women and by resisting measures designed to assist them (Derks et al., 2016; Faniko et al., 2017; Mavin, 2008). At a structural level, organisations operate through inequality regimes that reproduce gendered hierarchies irrespective of the identities of individual incumbents (Acker, 1990, 2006). Taken together, these perspectives caution that the presence of women at any single organisational level may leave vertical pay disparities untouched, and they imply that it is the relational connection of women across levels, where social capital can be mobilised and homophilous ties activated, that carries equalising potential. Our hypotheses reflect this theoretical tension.

The theoretical framework thereby provides a foundation to explore the hypotheses that female solidarity within hierarchical relationships has the potential to reduce salary inequalities. It also positions female solidarity as a mechanism for fostering equity, especially in firms and contexts where structural biases persist, contributing to a more nuanced understanding of how gender representation and relational dynamics collectively shape income distribution in corporate environments.

Hypothesis development

Nobel prize-winning Goldin’s (2014) work suggests that women’s presence in education, employment and positions of power does not directly close the gender pay gap. Goldin explains that flexible work arrangements have led to marked differences in closing gender pay gaps. Normative workplaces with rigid regimes of work time and place disproportionately disadvantage women. In this article, Goldin argues that inflexible work arrangements and a premium on working long, continuous hours contribute significantly to the gender pay gap, especially in high-paying occupations. She emphasises that workplace restructuring to promote flexibility could play a critical role in reducing wage disparities. Based on this seminal work, we posit that female employees, female executives and female directors per se do not lessen the salary gap in firms. Additionally, Ciappei et al. (2023) argue that the prevalence of women in various roles can shed light on the internal dynamics of female empowerment and elucidate the ways in which women impact decision-making processes within organisations. Given the foregoing discussion, we propose the first hypothesis as follows:

H1: Female employees, female executives and female directors per se do not lessen the salary gap in firms.

Female solidarity plays a central role in narrowing the salary gap within organisations. Previous studies suggest that female managers help mitigate the gender wage gap among employees (Zimmermann, 2022). Additionally, behavioural economics research reveals that women tend to exhibit a greater inclination towards cooperation when engaging with other women (Kunze and Miller, 2017). Kirsch's (2022) survey of female executives shows that most women in leadership feel a duty to support other women, enhance their career prospects and improve their treatment within the workplace. Supporting this perspective, Martín-Zamora et al. (2025) show that executive team gender diversity's effect on firm reputation become stronger at the existence of higher board gender diversity.

Drawing on recent research that highlights the influence of executives' personal traits on firm policies and outcomes, as well as traditional discussions on gender disparities in the labour market, Flabbi et al. (2019) explore the impact of female executives on gender-specific wage distribution and firm performance. The study finds that female leadership is associated with greater wage dispersion among women in firms, notably increasing wages at the upper end of the distribution. Specifically, female CEOs correlate with an approximate 10-percentage-point increase in wages for women in the top 25% of the wage distribution. Thus, we formulate the second hypothesis as:

H2: Female solidarity lessens the salary gap in firms.

While the body of research on gender diversity and female executives' roles in influencing organisational outcomes is growing, the specific impact of female executives on employment relations outcomes, especially related to gender wage equity, remains underexplored (Yuan et al., 2024). The evidence on the role of female managers in promoting pay equality is mixed. A cross-national study using linked employer–employee data from nine countries finds that neither the share of female managers in an organisation nor being supervised by a female manager significantly affects women's or men's earnings. These findings support a 'women as cogs in the machine' perspective, suggesting that female managerial representation alone does not necessarily translate into greater pay equality. This implies that the equality-enhancing potential of female leadership may depend less on numerical presence and more on relational dynamics and interaction processes within organisations (Van Hek and Van der Lippe, 2019). However, Song (2022) investigates the influence of female representation in senior management on advancing gender equality within South Korean firms. The study provides strong empirical evidence that a higher percentage of women in senior roles is linked to reduced gender disparities in salary and employment. The research also suggests that as barriers to female advancement in senior management decrease, women are increasingly likely to reach top corporate leadership positions, thereby fostering a more inclusive leadership pipeline.

Zimmermann (2022), using German-linked employer–employee data, found that female employees benefit from interactions with female managers through mechanisms like homophily and mentorship. The findings highlight that female managers play a crucial role in narrowing the gender wage gap, primarily due to the interactions between managers and employees. Similarly, Hultin and Szulkin (2003) show that organisations with multiple management tiers see significant reductions when lower-level female managers are present. In line with these findings, Hirsch (2013) reports

that female managers in mid-level positions substantially reduce the pay gap within German firms. Yuan et al.'s (2024) study indicates that companies led by female executives demonstrate a higher propensity for adherence to labour regulations and staff development. Moreover, these companies provide more opportunities for promotion of female staff compared to their male counterparts. Given the foregoing discussion, we propose the second hypothesis (a) as follows:

H2a: The interaction effect of female employees and female executives lessens the salary gap in firms.

Nguyen and Thai (2022) explore how gender diversity on corporate boards affects the representation of women in lower organisational levels and the performance of corporate social responsibility efforts. Analysing a panel of over 1000 publicly listed Japanese firms from 2005 to 2014, they focus on organisations that introduced female directors onto previously male-dominated boards. Their findings reveal that this initial inclusion of female directors correlates with an increase in the number of female managers and officers within these firms, indicating that board-level gender diversity can help elevate female representation across subordinate levels. These findings provide a clear board-to-organisation mechanism through which female directors may influence outcomes below board level. By reshaping opportunity structures and increasing women's representation in managerial ranks, female directors can facilitate stronger alignment and responsiveness to women employees' concerns, making it more likely that female directors' presence translates into pay-related outcomes when women are also present among employees. Accordingly, we expect the interaction between female employees and female directors to be associated with a smaller salary gap. Additionally, companies with their first female board appointments tend to employ a higher percentage of female employees overall. Similarly, Faniko et al. (2017) show that female managers perceive themselves as distinct from other women and are resistant to gender quotas, particularly when the focus is on promoting junior women. Given the foregoing discussion, we propose the second hypothesis (b) as follows:

H2b: The interaction effect of female employees and female directors lessens the salary gap in firms.

Although we argued in the preceding discussions that the interaction of women employees with women executives and directors is helpful in alleviating vertical pay gap, we posit that the interaction of women executives and directors is also beneficial in mitigating pay gap in creating greater synergy to decrease vertical salary gap. This is because while directors are mostly engaged with board-level policymaking, executives are change agents in the position of implementing these policies. Women executives may also assist women directors in shaping wage policies. Hence, the joint existence of female executives and directors at the hierarchy facilitates information exchange between the bottom and up (Xing et al., 2021). Eventually, the information flow and exchange may enrich boards' advising role in remuneration policies leading to a more peaceful work environment.

Concerning the empirical evidence, Arvate et al. (2018) investigate how female leadership affects gender disparities in both public and private organisations. Using a quasi-experimental approach based on data from mayoral elections, the study analysed 8.3 million organisations across 5600 Brazilian municipalities. The results show that municipalities led by female mayors experienced an increase in female representation within top and middle management roles in public organisations. The findings suggest that female leaders often serve as role models, influencing the appointment of middle managers and promoting greater managerial discretion, leading to supportive behaviour towards female subordinates.

Ismail and Wahab's (2024) study supports the homophily argument that similar characteristics (gender) promote cooperation and reveals the cooperation between female Chief Financial Officers and directors and impact of these relationships on investment efficiency. Additionally, Flabbi et al.'s (2019) study shows that the impact of female executives is positive on women at the top of the wage distribution. The study conducted by You (2021) demonstrates a clear positive impact of bottom-up processes. Through an analysis of 3669 CEO succession events in large US firms from 1997 to 2017, the scholar found that the probability of selecting a female CEO substantially rises when a board consists of at least three female directors. Gould et al. (2018) examined 1387 organisations listed on the Australian Securities Exchange from 2003 to 2012, revealing the presence of a nonlinear trickle-down effect between board and executive levels. This effect was most pronounced within the first year but remained significant even after a 5-year period. Lastly, Xing et al. (2021) found that the interaction of female executives and directors results in higher financial performance in Chinese firms. Supporting this interactional view, a longitudinal study of 2658 US firms observed over a 14-year period finds an inverted *U*-shaped relationship between board gender composition and the gender pay gap in top management teams. While modest increases in female board representation initially widen the pay gap, higher levels of female representation substantially narrow it, and this narrowing effect is further strengthened when the firm is led by a female CEO. These findings highlight that gender diversity across governance and executive levels jointly shapes compensation outcomes (Raina et al., 2024).

Lastly Maume et al. (2019) indicated that female directors in Europe were instrumental in reducing gender wage gap in managerial positions. Given the foregoing discussion, we propose the second hypothesis (c) as follows:

H2c: The interaction effect of female directors and executives lessens the salary gap in firms.

Research methodology

Sample

Our sample covers an international sample of 20,576 observations between 2002 and 2021. Our data source for all firm-level variables (i.e. financial, board and ownership data) is the London Stock Exchange Group (LSEG) Workspace database (earlier known as Asset4, Thomson Reuters Eikon, Refinitiv). The LSEG is a British global data

provider for financial markets which collects firm-level data from various sources such as financial reports, annual reports, sustainability reports, news releases, among others. As our set of variables involve certain measurements such as pay gap, gender diversity among employees, executives, board members, and involve financial data drawn from financial reports, we posit that these measurements are mostly stable across data providers. Although comparability of sustainability data provided by different data sources such as the LSEG, Bloomberg, Kinder, Lydenberg, and Domini (KLD) data is discussed in the literature (Berg et al., 2022), our dataset does not involve such measurements that may change from one data provider to another data provider. The only country-level variable we use in our study is the Worldwide Governance Indicators (WGIs) data, which were fetched from the World Bank. It is a reliable source of WGI data which is consistently used in the literature (Uyar et al., 2026).

The research sample comprises observations from non-financial sectors and includes case-wise available observations of the dependent, testing, and control variables. Before testing the research hypotheses, we purified our raw sample through data preprocessing steps and prepared it for forthcoming analysis, a critical step in preparing data for reliable analysis (Gujarati and Porter, 2009).

Firstly, we examined the preliminary descriptive statistics and decided to winsorise certain research variables, as this technique can mitigate the influence of outliers and enhance the reliability of statistical estimates. Specifically, we applied winsorisation to Salary gap, Board size, Profitability, Profitability_alt, Leverage, Leverage_alt, Capex (Capital expenditure), Capex_alt, R&D (Research and Development intensity), R&D_alt and Market-to-book ratio (M/B)¹ due to either the substantial variability around mean values or the presence of extreme values at both tails. Winsorisation was implemented at the 1% level of the two tails, following the recommendation of Cox (2006).

We employed two sampling constraints in our research. Initially, the sample size consisted of 75,042 observations. First, we excluded observations from the financial sectors, amounting to 12,023 observations. Additionally, we applied another sampling constraint by excluding observations with missing values for the salary gap (dependent variable), three testing variables of interest namely female employees (F_employees), female executives (F_executives) and female directors (F_directors), as well as the control variables, resulting in the exclusion of 42,443 records. By excluding these case-wise missing values, we aimed to ensure that our results are not influenced by potential sources of bias. The final sample size is reported as 20,576 in Table 1 (Panel A).

We provided sampling distributions based on sectors, years and country levels. Concerning the sector-level distributions (Table 1, Panel B), industrials have the largest share at 19.72%, followed by consumer cyclicals at 16.31%, basic materials at 14.69%, technology shares at 11.82%, healthcare at 9.21%, consumer non-cyclicals at 8.99%, real estate at 7.09% and energy and utilities with the lowest contributions at 6.84% and 5.33%, respectively. Concerning the year-level distributions (Table 1, Panel B), the research data encompasses observations spanning from 2002 to 2021, with percentages ranging from 0.39% (Year 2002) to 16.50% (Year 2020).

Finally, the country-level distributions are detailed in the Appendix section (see Table A1). Our dataset comprises 61 countries, encompassing 4370 unique firms and 20,576 data points. While countries with fewer than 10 firms are included in the main analysis,

Table 1. Sampling distributions.

Panel A			
Initial sample			75,042
(-) Financials			12,023
(-) Case-wise missing observations of dependent, test and control variables			42,443
Final sample			20,576
Panel B			
Variable	Categories	Freq.	Percent
Sector	Basic materials	3023	14.69
	Consumer cyclicals	3355	16.31
	Consumer non-cyclicals	1850	8.99
	Energy	1408	6.84
	Healthcare	1895	9.21
	Industrials	4057	19.72
	Real estate	1459	7.09
	Technology	2433	11.82
	Utilities	1096	5.33
	Total	20,576	100.00
Year	2002	81	0.39
	2003	94	0.46
	2004	154	0.75
	2005	205	1.00
	2006	247	1.20
	2007	326	1.58
	2008	244	1.19
	2009	301	1.46
	2010	422	2.05
	2011	563	2.74
	2012	856	4.16
	2013	1040	5.05
	2014	1144	5.56
	2015	1324	6.43
	2016	1470	7.14
	2017	1859	9.03
	2018	2233	10.85
	2019	2888	14.04
	2020	3396	16.50
	2021	1729	8.40
	Total	20,576	100.00

we also conducted additional robustness tests involving countries with more than ten unique firms in section of the robustness tests. Including as many countries as possible offers several advantages. Firstly, it enhances the generalizability of our findings,

extending their applicability beyond specific contexts. Secondly, it promotes sample diversification by encompassing countries with diverse economic conditions, legal systems, and accounting standards.

In terms of the ratios of unique firms, China, the United States and the United Kingdom made the largest contributions to our sample, accounting for 18.86%, 13.87% and 10.30%, respectively. Similarly, regarding the distribution of data points, the United Kingdom, China and the United States exhibited the highest ratios, representing 13.21%, 13.16% and 11.08%, respectively.

Variables

Dependent variable: We measure CEO–employee pay gap (*Salary gap*) by the natural logarithm of the CEO's total salary (or the highest salary), comprising base salary, long-term incentive payout, bonus, grant date value of restricted stock and stock options' value divided by the employees' average salaries and benefits (Alan et al., 2020; Ye et al., 2022; Zhu et al., 2023). Higher value indicates greater salary gap.

Independent variables: We use three independent variables namely the percentage of female employees within the total number of employees of the company (*F_employees*), the percentage of female executive members (*F_executives*) and the percentage of female directors on the board (*F_directors*) (Nguyen and Thai, 2022; Song, 2022; Xing et al., 2021).

Interaction variables: To measure female solidarity in firms, we use three interaction effects. While the interaction term *F_employees***F_executives* assesses the solidarity of female employees and executives, *F_employees***F_directors* assesses the solidarity of female employees and directors, and *F_directors***F_executives* assesses the solidarity of female directors and executives (Nguyen and Thai, 2022; Song, 2022; Xing et al., 2021). As set out in section 'Conceptualising the vertical pay gap and female solidarity', these interaction terms operationalise female solidarity as the joint presence of women at pairs of organisational levels. A significantly negative coefficient on an interaction term indicates that women's presence at one level narrows the salary gap more strongly when women are also present at the other level, which we interpret as evidence consistent with cross-level female solidarity.

Control variables: Following past research (Alan et al., 2020; Kong et al., 2022; Ye et al., 2022; Zhu et al., 2023), a battery of factors that are likely to predict salary gap is controlled. We control board size, the percentage of non-executive board members (NE directors), and CEO duality as corporate governance structure is a major determinant of employment and payment policies. We also control firm financial characteristics such as firm size, firm profitability, leverage, capital expenditures scaled by total assets (Capex), research and development expenditures scaled by total assets (R&D), and M/B ratio. Larger firms may have greater hierarchies, which may lead to a greater salary gap. Investment (Capex) and growth opportunity (M/B) may increase the salary gap due to executives' greater managerial capabilities and risk-taking. Innovative firms' (R&D) salary gap may tighten as innovative employees might be well-paid. Lastly, ownership structure (Free float) and institutional quality controlled by the WGI might predict salary gap since shareholders and regulators are important stakeholders playing a role on firm policies and practices including employment. All the variables are defined in Table 2.

Table 2. List of variables.

Variable	Definition
Dependent variable	
Salary gap	We measure CEO–employee pay gap (Salary gap) by the natural logarithm of the CEO's total salary (or the highest salary), comprising base salary, long-term incentive payout, bonus, grant date value of restricted stock and stock options' value divided by the employees' average salaries and benefits
Independent variables	
F_employees	Percentage of female employees within the total number of employees of the company
F_executives	Percentage of female executive members
F_directors	Percentage of female directors on the board
Control variables	
Board size	Number of board members
NE directors	Percentage of non-executive board members
CEO duality	CEO duality which takes 1 if CEO and the chairman positions are held by the same person, and 0 if not
Firm size	The natural logarithm of total assets
Profitability	Income before tax/total assets
Leverage	Total debt/total assets
Capex	Capital expenditures/total assets
R&D	Research and development expenditures/total assets
M/B	Market capitalisation/total equity
Free float	Free float percentage of shares
WGI	Worldwide Governance Indicators' average includes political stability and absence of violence/terrorism, government effectiveness, control of corruption, voice and accountability, rule of law, and regulatory quality. (All metrics' values range from −2.5 to 2.5)
Alternative control variables	
Firm size_alt	The natural logarithm of the market capitalisation
Profitability_alt	Income before interest and tax/total assets
Leverage_alt	Total liabilities/total assets
Capex_alt	Capital expenditures/net sales
R&D_alt	Research and development expenditures/net sales

CEO: Chief Executive Officer; R&D: research and development; WGI: worldwide governance indicator; M/B: market-to-book; F_employees: female employees; F_executives: female executives; F_directors: female directors; NE: non-executive.

Research models

We utilised a fixed-effects regression approach incorporating country, industry and year fixed effects to investigate our research hypotheses. This approach offers various advantages, including addressing potential time-invariant endogeneity issues (Feenstra et al., 2013) and controlling for omitted variable bias across multiple time periods and country/industry levels (Cameron and Trivedi, 2005). By allowing each entity to have its

Table 3. Summary statistics.

Variable	Observations	Mean	SD	Min	Max
Salary gap	20,576	3.57	1.44	-0.12	8.18
F_employees	13,815	32.93	17.63	0.00	98.00
F_executives	20,576	14.20	14.18	0.00	100.00
F_directors	20,576	19.54	14.14	0.00	80.00
Board size	20,576	9.69	3.28	4.00	21.00
NE directors	20,576	77.49	16.07	0.00	100.00
CEO duality	20,576	0.27	0.44	0.00	1.00
Firm size	20,576	21.98	1.71	14.32	27.13
Profitability	20,576	0.06	0.12	-0.67	0.36
Leverage	20,576	0.24	0.17	0.00	0.84
Capex	20,576	0.05	0.05	0.00	0.25
R&D	20,576	0.01	0.04	0.00	0.37
M/B	20,576	3.60	4.42	0.28	29.44
Free float	20,576	69.97	26.77	0.00	100.00
WGI	20,576	1.02	0.73	-1.08	1.95

CEO: Chief Executive Officer; R&D: research and development; WGI: worldwide governance indicator; M/B: market-to-book; F_employees: female employees; F_executives: female executives; F_directors: female directors.

intercept, this method effectively deals with heterogeneity at different levels such as country, industry and year (Gujarati, 2014). To implement this approach, we included dummy variables for country, industry and year using the Least Squares Dummy Variable model (Gujarati, 2014), which is particularly suitable for handling the specific heterogeneity associated with country, industry and year levels. Overall, this methodology serves as an appropriate tool as it allows us to effectively address unobserved differences between countries, industries and years while analysing our dataset, which comprises multiple observations within each country, industry and year level.

Our proposed hypotheses are tested by both the linear models and moderating effects. Firstly, we formulate the linear models, specifically investigating the influence of female employees, executives and directors on the salary gap (please see Models 1–3 in Table 5). Secondly, we formulate models with moderating effects to investigate the interaction effects between female employees and female executives, between female employees and female directors, and between female directors and female executives on the salary gap (please see Models 4–6 in Table 5).

Results

Descriptive statistics and correlation analysis

We summarise the descriptive statistics of the research variables in Table 3. The results indicate that the average salary gap is 3.57, ranging from -0.12 to 8.18.² Additionally, the mean percentage of F_employees is 32.93%, F_executives is 14.20% and F_directors is 19.54%.

The results of the linear pair-wise correlation analysis, based on Pearson's correlation coefficients, are presented in Table 4. The findings indicate that F_employees exhibit a significantly positive linear correlation with the salary gap, whereas F_executives display significantly negative linear correlations with the salary gap, and F_directors display no significant correlation with the salary gap.

Furthermore, we assess the multicollinearity among the independent variables of the research models. To accomplish this, we computed the variance inflation factors, which range between 1.02 and 1.77. These values are considerably smaller than the suggested cutoff value of 10 (Kennedy, 2008). Consequently, there is no indication of multicollinearity within the independent variables of the research models. Thus, we ensure that the reliability of our research models is upheld, allowing us to confidently rely on the accurate interpretation of the results.

Baseline analysis results

We estimated the coefficients of the linear and moderating models using country, industry and year fixed-effects regression analysis, and the results are reported in Table 5. Concerning the linear associations, F_employees have a significantly positive association with the salary gap, whereas F_executives and F_directors show no significant relationship with the salary gap. The results support H1 positing that female employees, female executives and female directors per se do not lessen salary gap in firms.

We also evaluated the economic significance of the baseline linear analysis results. We multiplied the coefficients of F_employees, F_executives and F_directors by their corresponding standard deviations, then divided the resulting multiplications by the mean value of the salary gap. Consequently, an increase of F_employee, F_executives and F_directors by one standard deviation leads to an increase in the salary gap by 2.02%, 0.01% and 0.79%, respectively.³

Regarding the models with moderating effects, the interaction terms, including F_employees * F_executives, F_employees * F_directors and F_directors * F_executives, exhibit a significantly negative relationship with the salary gap. Namely, the interaction effects of female employees with female executives, female employees with female directors, and female directors with female executives, have a significantly negative impact on the salary gap. In other words, when these combinations of variables are present, they tend to decrease the magnitude of the salary gap. The findings support H2, H2a, H2b and H2c, proposing that female solidarity lessens the salary gap in firms.

Robustness tests

In this section, we conduct several tests with alternative methodologies to examine the robustness of our initial baseline results. We address endogeneity concerns by employing various techniques, run the analysis with alternative sub-samples, and incorporate alternative control variables into the model.

Countries with at least 10 unique firms. Firstly, we generated an alternative sample with a sampling constraint that includes countries with at least ten unique firms presuming that

Table 4. Correlation coefficients.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Salary gap	1.000														
2 F_employees	0.038*	1.000													
3 F_executives	-0.040*	0.250*	1.000												
4 F_directors	-0.013	0.168*	0.328*	1.000											
5 Board size	0.199*	-0.080*	-0.037*	0.036*	1.000										
6 NE directors	0.032*	-0.026*	-0.027*	0.229*	0.122*	1.000									
7 CEO duality	0.140*	0.008	-0.031*	-0.038*	0.089*	-0.060*	1.000								
8 Firm size	0.306*	-0.104*	-0.059*	0.020*	0.551*	0.133*	0.090*	1.000							
9 Profitability	0.133*	0.029*	-0.018*	0.015*	0.087*	-0.049*	0.009	0.147*	1.000						
10 Leverage	0.049*	0.044*	0.024*	0.063*	0.119*	0.062*	0.003	0.296*	-0.150*	1.000					
11 Capex	0.051*	-0.152*	-0.071*	-0.097*	0.008	0.021*	0.036*	-0.037*	0.060*	0.006	1.000				
12 R&D	-0.062*	0.074*	0.028*	-0.031*	-0.097*	0.033*	0.050*	-0.230*	-0.388*	-0.206*	-0.056*	1.000			
13 M/B	0.037*	0.110*	0.046*	0.033*	-0.107*	-0.030*	0.029*	-0.250*	0.174*	-0.057*	0.042*	0.200*	1.000		
14 Free float	0.174*	0.055*	0.032*	0.143*	-0.090*	0.198*	-0.009	-0.030*	-0.058*	-0.011	0.000	0.090*	0.015*	1.000	
15 WGI	0.052*	0.097*	-0.012	0.196*	-0.141*	0.355*	-0.049*	-0.093*	-0.098*	-0.003	-0.016*	0.032*	-0.047*	0.437*	1.000

The values of variance inflation factors range between 1.02 and 1.77.

CEO: Chief Executive Officer; R&D: research and development; WGI: worldwide governance indicator; M/B: market-to-book; F_employees: female employees;

F_executives: female executives; F_directors: female directors.

*p < 0.05.

Table 5. Female solidarity and salary pay gap.

Variables	(1) Salary gap	(2) Salary gap	(3) Salary gap	(4) Salary gap	(5) Salary gap	(6) Salary gap
F_employees	0.0041*** (2.911)			0.0070*** (7.490)	0.0059*** (5.224)	
F_executives		0.000030 (0.028)		0.0041*** (2.677)		0.0016 (1.378)
F_directors			0.0020 (1.473)		0.0013 (0.812)	0.0034*** (3.515)
F_employees × F_executives				-0.00016*** (-4.398)		
F_employees × F_directors					-0.000073* (-1.950)	
F_directors × F_executives						-0.000084** (-2.165)
Board size	0.011 (1.452)	0.0089 (1.306)	0.0086 (1.258)	0.011*** (2.875)	0.011*** (2.822)	0.0086** (2.504)
NE directors	0.0000093 (0.006)	-0.0015 (-1.043)	-0.0016 (-1.112)	0.000049 (0.058)	0.000025 (0.030)	-0.0017** (-2.392)
CEO duality	0.093** (1.976)	0.099** (2.389)	0.100** (2.411)	0.095*** (3.880)	0.091*** (3.724)	0.100*** (4.908)
Firm size	0.28*** (17.012)	0.28*** (18.724)	0.28*** (18.459)	0.28*** (34.591)	0.28*** (34.625)	0.28*** (40.136)
Profitability	0.96*** (5.789)	0.77*** (5.455)	0.75*** (5.336)	0.96*** (9.211)	0.97*** (9.345)	0.75*** (9.073)
Leverage	0.045 (0.371)	0.11 (0.974)	0.10 (0.967)	0.057 (0.868)	0.050 (0.750)	0.11* (1.896)
Capex	1.06** (2.359)	1.07*** (2.777)	1.08*** (2.814)	1.03*** (4.396)	1.07*** (4.554)	1.08*** (5.711)
R&D	-0.93 (-1.637)	-1.39*** (-3.372)	-1.39*** (-3.360)	-0.91** (-2.531)	-0.93*** (-2.592)	-1.39*** (-5.861)
M/B	0.016*** (3.922)	0.016*** (4.250)	0.016*** (4.185)	0.016*** (6.290)	0.016*** (6.261)	0.016*** (7.487)
Free float	0.0041*** (4.238)	0.0034*** (4.090)	0.0033*** (3.927)	0.0041*** (9.076)	0.0041*** (9.138)	0.0033*** (8.367)
WGI	0.40* (1.866)	0.34* (1.839)	0.34* (1.888)	0.39*** (2.610)	0.38** (2.563)	0.33*** (2.863)
Constant	-3.81*** (-9.958)	-3.37*** (-9.908)	-3.35*** (-9.790)	-3.84*** (-16.425)	-3.85*** (-16.417)	-3.34*** (-18.452)
Country, industry and year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	13,808	20,569	20,569	13,808	13,808	20,569
Adjusted R ²	0.374	0.364	0.364	0.375	0.374	0.364
F-stat.	63.719***	84.935***	85.552***	174.325***	172.647***	259.810***

t statistics are reported in parentheses. Standard errors clustered by firms.

CEO: Chief Executive Officer; R&D: research and development; WGI: worldwide governance indicator; M/B: market-to-book; F_employees: female employees; F_executives: female executives; F_directors: female directors.

* $p < 0.10$. ** $p < 0.05$. *** $p < 0.01$.

countries with a few firms might distort the results. The baseline models were re-evaluated using this new sample, and the results are presented in Table 6. Overall, the findings are largely consistent with the initial analysis results. However, the interaction term, $F_employees * F_directors$, became non-significant in the robustness check, which might imply that female directors' interaction with female employees are not influential in reducing pay gap. This makes our three-layered investigation more meaningful such that female executives between female employees and directors in the hierarchy is essential to reduce wage gap.

Addressing endogeneity. We tackle the endogeneity concern through various methods, including Two-Stage Least Square (2SLS) regression, entropy balancing and Propensity Score Matching (PSM) approaches.

2SLS: Firstly, we mitigate endogeneity using the 2SLS regression analysis. Endogeneity can arise from the correlation between independent variables and the error term, stemming from sample selection, measurement error or omitted variables (Hill et al., 2021). The 2SLS approach addresses endogeneity by employing instrumental variables, which provide exogenous sources of variation for the independent variable, thereby enabling the accurate isolation of causal effects (Angrist and Krueger, 2001).

To conduct the 2SLS regression analysis, we incorporated 1-year lag of the testing variables of interest, including $F_employees(t-1)$, $F_executives(t-1)$ and $F_directors(t-1)$. Schreck (2011) and Gupta (2018) argue that using the lag of independent variables as instruments addresses the relevancy and exclusion criteria since the correlation between the lag of independent variables ($F_employees(t-1)$, $F_executives(t-1)$ and $F_directors(t-1)$) and contemporaneous independent variables ($F_employees$, $F_executives$ and $F_directors$) should be strong, whereas the correlation between lag of independent variables ($F_employees(t-1)$, $F_executives(t-1)$ and $F_directors(t-1)$) and contemporaneous dependent variable (i.e. salary gap) should be weak. Confirming this perspective, in the first stage of the 2SLS regression reported in Table 7, the coefficients of $F_employees(t-1)$, $F_executives(t-1)$ and $F_directors(t-1)$ are statistically significant. The selected instruments are deemed relevant as they exhibit significant correlations with the endogenous variables. Furthermore, the instruments demonstrate adequate magnitude, indicating a substantial effect on the endogenous variables.

In the second stage, we utilize the predicted values of $F_employees$, $F_executives$ and $F_directors$ obtained from the first stage to examine their relationship with the salary gap, addressing endogeneity by substituting the endogenous variables with the selected instruments. Furthermore, we present several diagnostic tests supporting the appropriateness of the 2SLS regression analysis. Specifically, the Kleibergen–Paap rk Lagrange Multiplier (LM) statistic findings are significant, indicating that $F_employees(t-1)$, $F_executives(t-1)$ and $F_directors(t-1)$ are not under-identified. Additionally, the Cragg–Donald Wald F statistic and Kleibergen–Paap rk Wald F statistic results are significant, confirming the robustness of the selected instruments. Moreover, the Stock–Yogo weak ID test critical values at four IV sizes are lower than the values of the Cragg–Donald Wald F statistics, validating the strength of the selected instrumental variables.

Table 6. Countries with less than 10 unique firms.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Salary gap	Salary gap	Salary gap	Salary gap	Salary gap	Salary gap
F_employees	0.0039*** (2.807)			0.0070*** (7.481)	0.0055*** (4.807)	
F_executives		-0.000029 (-0.027)		0.0044*** (2.830)		0.0014 (1.199)
F_directors			0.0019 (1.408)		0.00071 (0.451)	0.0033*** (3.343)
F_employees × F_executives				-0.00017*** (-4.606)		
F_employees × F_directors					-0.000060 (-1.580)	
F_directors × F_executives						-0.000078** (-1.993)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country, industry and year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	13,619	20,281	20,281	13,619	13,619	20,281
Adjusted R ²	0.370	0.360	0.360	0.371	0.370	0.360
F-stat.	64.398***	85.158***	85.748***	176.204***	174.250***	261.210***

t statistics are reported in parentheses. Standard errors clustered by firms.
F_employees: female employees; F_executives: female executives; F_directors: female directors.
p < 0.05, *p < 0.01.

Table 7. Two-stage least squares regression analysis.

	(1)	(2)	(3)	(4)	(5)	(6)
F_employees		Salary gap	F_executives	Salary gap	F_directors	Salary gap
First stage		Second stage	First stage	Second stage	First stage	Second stage
F_employees (t-1)	0.963*** (283.062)					
F_executives (t-1)			0.865*** (135.695)		0.833*** (154.632)	
F_directors (t-1)						
F_employees		0.005*** (2.884)		0.000 (0.321)		0.002 (0.994)
F_executives						
F_directors						
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country, industry and year FE		Yes		Yes		Yes
N	11,286	11,286	17,569	17,569	17,551	17,551
F-stat.	7585.159***	54,262***	1658.724***	65,967***	2457.994***	66,261***
Under-identification test						
Kleibergen-Paap rk LM statistic		479.862		736.434		931.670
Weak identification tests						
Cragg-Donald Wald F statistic		1.9e + 05		4.1e + 04		4.0e + 04
Kleibergen-Paap rk Wald F statistic		8.0e + 04		1.8e + 04		2.4e + 04
Stock-Yogo weak ID test critical values						
10% maximal IV size		16.38		16.38		16.38
15% maximal IV size		8.96		8.96		8.96
20% maximal IV size		6.66		6.66		6.66
25% maximal IV size		5.53		5.53		5.53

t statistics are reported in parentheses. Standard errors clustered by firms.

F_employees: female employees; F_executives: female executives; F_directors: female directors.

***p < 0.01.

Table 8. Entropy balancing and propensity score matching.

	(1)	(2)	(3)	(4)	(5)	(6)
	Salary gap	Salary gap	Salary gap	Salary gap	Salary gap	Salary gap
Variables	Entropy	Entropy	Entropy	PSM	PSM	PSM
F_employees	0.0060*** (4.034)			0.0061*** (3.776)		
F_executives		−0.00034 (−0.312)			−0.0010 (−0.809)	
F_directors			0.00064 (0.448)			0.0013 (0.809)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country, industry, and year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	13,808	20,569	20,569	6051	9280	9031
Adjusted R ²	0.436	0.395	0.404	0.443	0.409	0.422
F-stat.	87.155***	87.053***	91.918***	66.110***	74.341***	65.786***

t statistics are reported in parentheses. Standard errors clustered by firms.
F_employees: female employees; F_executives: female executives; F_directors: female directors; PSM: propensity score matching.
***p < 0.01.

Finally, the results of the 2SLS regression analysis reported in Table 7 demonstrate consistency with the initial findings.

Secondly, we employed the entropy balancing method (Hainmueller, 2012) to tackle the endogeneity concern. This method addresses endogeneity by generating balanced samples and minimizing variability among variables in the treatment and control groups (Hainmueller and Xu, 2013). It effectively mitigates self-selection bias that may arise from observable characteristics (Fei, 2022; Hainmueller, 2012). Thus, the entropy balancing method can have several advantages such as balanced samples, minimized variability among variables, mitigate self-selection bias and improved validity of our findings.

When applying the entropy balancing method, we constructed the treatment groups using the top quartiles of the testing variables of interest, including F_employees, F_executives and F_directors, assigning a value of one to observations falling into the top quartile. Conversely, we generated the control groups by assigning a value of zero to the remaining observations. We re-ran the baseline linear models using the entropy balance method. The results, reported in Table 8 (Columns #1, 2, and 3), align with the initial findings.

Finally, we address the endogeneity issue using the PSM approach (Leuven and Sianesi, 2003). We employed PSM with a one-to-one method. PSM can mitigate endogeneity by creating treatment and control groups that are balanced in terms of observable characteristics, thereby mitigating selection bias (Rosenbaum and Rubin, 1983). Moreover, PSM can eliminate biases associated with all observed covariates and may also mitigate the impact of any hidden biases (Rosenbaum, 2005).

Table 9. Alternative controls (Firm size_alt, Profitability_alt, Leverage_alt, Capex_alt and R&D_alt).

Variables	(1) Salary gap	(2) Salary gap	(3) Salary gap	(4) Salary gap	(5) Salary gap	(6) Salary gap
F_employees	0.0033** (2.344)			0.0060*** (6.328)	0.0044*** (3.870)	
F_executives		0.000010 (0.009)		0.0036** (2.246)		0.0016 (1.411)
F_directors			0.00057 (0.418)		-0.0013 (-0.785)	0.0017* (1.763)
F_employees × F_executives				-0.00014*** (-3.946)		
F_employees × F_directors					-0.000039* (-1.732)	
F_directors × F_executives						-0.000073* (-1.848)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country, industry, and year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	12,979	19,295	19,295	12,979	12,979	19,295
Adjusted R ²	0.385	0.375	0.375	0.386	0.385	0.375
F-stat.	63.873***	83.362***	83.674***	178.405***	177.308***	248.966***

t statistics are reported in parentheses. Standard errors clustered by firms.

F_employees: female employees; F_executives: female executives; F_directors: female directors.

* $p < 0.10$. ** $p < 0.05$. *** $p < 0.01$.

To conduct the PSM, we designated the treatment group by assigning a value of one to observations in the top quartiles of F_employees, F_executives and F_directors, while the control groups were created by assigning a value of zero to the remaining observations of these testing variables of interest. Subsequently, we reassessed the linear baseline models and presented the results in Table 8 (Columns #4, 5 and 6). The findings are consistent with the initial results.

Alternative control variables. We substituted five control variables, namely Firm size, Profitability, Leverage, Capex and R&D, with their corresponding alternative forms: Firm size_alt, Profitability_alt, Leverage_alt, Capex_alt and R&D_alt.⁴ The baseline models were re-evaluated using the alternative control variables, and the results are presented in Table 9. The findings are in line with the initial results supporting female solidarity's role in mitigating salary gap.

Alternative samples. To assess the robustness of our findings, we created several alternative samples. Given that the observations from China, the United Kingdom and the United States hold substantial shares in the research sample, they might distort the results. Thus, we generated alternative samples by excluding these countries and re-ran the analysis. The

Table 10. Alternative samples.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Salary gap	Salary gap	Salary gap	Salary gap	Salary gap	Salary gap
Panel A: Excluding United States						
F_employees	0.0042*** (2.913)					
F_executives		0.00028 (0.247)		0.0077*** (8.159)	0.0060*** (5.248)	0.0030** (2.566)
F_directors			0.0030*** (2.286)	0.0053*** (3.417)	0.0022 (1.365)	0.0053*** (5.356)
F_employees × F_executives				−0.00019*** (−5.337)	−0.000076** (−2.006)	
F_employees × F_directors						
F_directors × F_executives						
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country, industry, and year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	13,100	18,290	18,290	13,100	13,100	18,290
Adjusted R ²	0.339	0.317	0.318	0.341	0.339	0.318
F-stat.	63.149***	70.415***	71.190***	173.141***	170.469***	227.950***
Panel B: Excluding China						
F_employees	0.0043*** (2.990)			0.0066*** (6.991)	0.0055*** (4.683)	
F_executives		−0.000048 (−0.042)		0.0024 (1.496)		0.00065 (0.514)
F_directors			−0.000028 (−0.019)		−0.0019 (−1.145)	0.00040 (0.388)
F_employees × F_executives				−0.00012*** (−3.250)	−0.000037* (−1.756)	
F_employees × F_directors						
F_directors × F_executives						
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country, industry, and year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	12,734	17,862	17,862	12,734	12,734	17,862
Adjusted R ²	0.402	0.396	0.396	0.403	0.402	0.396
F-stat.	65.533***	83.524***	83.586***	175.369***	174.862***	252.401***

(continued)

Table 10. (continued)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Panel C: Excluding United Kingdom						
F_employees		0.0040** (2.566)				
F_executives				0.0076*** (7.218)	0.0056*** (4.532)	0.0013 (.035)
F_directors				0.0059*** (3.384)		0.0041 *** (3.789)
F_employees × F_executives			0.0026* (1.785)	-0.00020*** (-4.931)	0.0021 (1.201)	
F_employees × F_directors					-0.000068* (-1.655)	
F_directors × F_executives						-0.000083* (-1.874)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country, industry, and year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	11,719	17,850	17,850	11,719	11,719	17,850
Adjusted R ²	0.373	0.363	0.364	0.374	0.373	0.364
F-stat.	47.843***	67.609***	68.157***	132.147***	130.087***	205.116***

t statistics are reported in parentheses. Standard errors clustered by firms.
F_employees: female employees; F_executives: female executives; F_directors: female directors.
*p < 0.10. **p < 0.05. ***p < 0.01.

findings presented in Table 10 are largely consistent with the initial baseline analysis results supporting female solidarity's role in diminishing the salary gap.

Further tests

We conducted further subgroup analyses based on firm size and the WGI. Firstly, we examined the baseline models for large and small firms (Table 11). For large firms, the interaction terms $F_employees * F_executives$, $F_employees * F_directors$ and $F_directors * F_executives$ showed a significantly negative association with the salary gap, whereas the direct effects were non-significant (Table 11, Panel A). For small firms, $F_employee$ had a significant positive association with salary gap, and only the interaction variable of $F_employees * F_executives$ had a significant negative association with the salary gap (Table 11, Panel B). The findings imply that smaller firms having more female employees are more afflicted by the salary gap than larger firms, and female solidarity is less functional in smaller firms.

Secondly, we examined the high and low levels of WGI in Table 12. Concerning the high-WGI level, the results were mostly consistent with the initial findings, except for the coefficient of $F_employees * F_directors$, which is significantly positive (Table 12, Panel A). This implies that female directors are the potential source of salary gap in firms having more female employees in high-WGI countries. Regarding the low-WGI sample, the coefficients of $F_employees * F_executives$ and $F_employees * F_directors$ were significantly negative, whereas the interaction of $F_directors * F_executives$ is not significant (Table 12, Panel B). Taking together, significance of $F_employees * F_executives$ and $F_employees * F_directors$ but insignificance of $F_directors * F_executives$ may imply that female directors and executives are substitutes of one another in low-WGI countries in mitigating salary gap.

Discussion and conclusions

Although prior studies have investigated the role of female directors or executives on firm outcomes such as corporate social responsibility, earnings management, corporate transparency, firm performance and risk, the female solidarity's effect on firm practices is limited. Thus, we advance the existing literature by exploring the interaction effect of female employees, executives and directors on reducing CEO–employee pay gap. Salary disparity between ordinary employees and the CEO or top executive disrupts employee morale and commitment and augments employee dissatisfaction and turnover (Weng and Yang, 2024), so we hope that our investigation helps alleviates the salary gap in firms.

We find that greater female employment is positively associated with more salary gap implying that firms employing more women are more prone to a wider salary gap. However, greater proportion of female executives and directors per se are not associated with salary gap. Considering the outputs of interaction effects, female solidarity helps mitigate salary gap in firms. More specifically, the solidarity of female executives with female employees, female directors with female employees and female directors with female executives diminish salary gap in firms. Our findings confirm utility of homophilous network of women in workplace to overcome structural barriers to pay equity

Table 11. Large-small firm size.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Salary gap	Salary gap	Salary gap	Salary gap	Salary gap	Salary gap
Panel A: Large firm size ($\geq$ median of firm size)						
F_employees	0.0031 (1.468)					
F_executives		-0.0011 (-0.608)		0.0057*** (3.959)	0.0062*** (3.673)	0.0052*** (2.731)
F_directors			0.00010 (0.047)	0.0020 (0.800)	0.0021 (0.906)	0.0042*** (2.781)
F_employees $\times$ F_executives				-0.00015** (-2.434)	-0.00013** (-2.320)	
F_employees $\times$ F_directors						
F_directors $\times$ F_executives						
Controls	Yes	Yes	Yes	Yes	Yes	-0.00027*** (-4.058)
Country, industry, and year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	7666	10,283	10,283	7666	7666	10,283
Adjusted R ²	0.353	0.349	0.349	0.354	0.353	0.350
F-stat.	11.749***	9.923***	9.874***	34.731***	34.233***	38.045***
Panel B: Small firm size ($<$ median of firm size)						
F_employees	0.0055*** (3.244)			0.0082*** (6.689)	0.0048*** (3.185)	-0.00091 (-0.651)
F_executives		0.00064 (0.517)		0.0042*** (2.150)	-0.0044** (-2.064)	0.00070 (0.557)
F_directors			0.0016 (0.952)			
F_employees $\times$ F_executives				-0.00013*** (-3.079)		
F_employees $\times$ F_directors					0.000041 (0.825)	
F_directors $\times$ F_executives						0.000049 (1.041)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country, industry, and year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	6137	10,281	10,281	6137	6137	10,281
Adjusted R ²	0.373	0.347	0.347	0.374	0.374	0.347
F-stat.	28.283***	37.312***	37.052***	57.574***	57.268***	92.452***

t statistics are reported in parentheses. Standard errors clustered by firms.
F_employees: female employees; F_executives: female executives; F_directors: female directors.
p < 0.05. *p < 0.01.

Table 12. High-low WGI.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Salary gap	Salary gap	Salary gap	Salary gap	Salary gap	Salary gap
Panel A: High-WGI ($\geq$ median of WGI)						
F_executives	0.0061*** (3.553)					
F_directors		-0.00027 (-0.197)		0.0090*** (8.204)	0.0028* (1.957)	0.0025* (1.665)
F_executives $\times$ F_directors			0.00089 (0.532)	0.0023 (1.292)	-0.0079*** (-4.112)	0.0027** (2.208)
F_executives $\times$ F_directors				-0.00014*** (-3.407)	0.00015*** (3.274)	
F_directors $\times$ F_executives						
Controls	Yes	Yes	Yes	Yes	Yes	-0.00012** (-2.342)
Country, industry, and year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	7569	10,298	10,298	7569	7569	10,298
Adjusted R ²	0.396	0.358	0.358	0.398	0.397	0.358
F-stat.	54.450***	55.635***	55.514***	169.972***	169.271***	196.889***
Panel B: Low-WGI ($<$ median of WGI)						
F_executives	0.0013 (0.608)			0.0039** (2.487)	0.0073*** (4.062)	
F_directors		-0.00089 (-0.565)		0.0036 (1.358)		-0.00091 (-0.536)
F_executives $\times$ F_directors			0.0017 (0.854)		0.0078*** (3.053)	0.0026* (1.739)
F_executives $\times$ F_directors				-0.00014** (-2.301)		
F_directors $\times$ F_executives					-0.00026*** (-4.356)	
Controls	Yes	Yes	Yes	Yes	Yes	-0.000026 (-0.435)
Country, industry, and year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	6239	10,271	10,271	6239	6239	10,271
Adjusted R ²	0.377	0.379	0.379	0.377	0.379	0.379
F-stat.	16.939***	38.246***	38.502***	39.854***	40.815***	89.208***

t statistics are reported in parentheses.
Standard errors clustered by firms.
*p < 0.10. **p < 0.05. ***p < 0.01.

(Kohout and Singh, 2018; Timberlake, 2005) validating that women often exhibit a higher propensity for cooperation and advocacy when collaborating with other women (Bear and Woolley, 2011; Peshkovskaya et al., 2018). Besides, the findings indicate that female leaders (i.e. executives and directors) can reduce wage inequalities in firms with greater women employee ratio (American Psychological Association, 2022; Ely et al., 2011). We extend prior studies showing the benefit of female solidarity on different firm outcomes such as enhancing investment efficiency (Ismail and Wahab, 2024) and improving firm performance (Xing et al., 2021).

Further tests reveal that smaller firms having more female employees are more afflicted by the salary gap than larger firms, and female solidarity is less functional in smaller firms. This could be because female employees might be more suppressed in smaller firms since they are exposed to less scrutiny of stakeholders (e.g. labour unions and regulatory forces). Besides, smaller firms might be weaker in having a structured remuneration and compensation policies. Lastly, firms having more female employees and domiciled in high-WGI countries are more beset by the salary gap than firms domiciled in low-WGI countries. Although female solidarity is functional in both sets of institutional environments, there are some exceptions.

Our findings should also be read against the question of why, and to what degree, a narrower CEO–employee pay gap is desirable. We do not claim that a zero gap is optimal. Tournament theory holds that some vertical dispersion serves as an efficient incentive device (Lazear and Rosen, 1981; Lin et al., 2013), and the evidence indicates that pay dispersion reflecting legitimate differences in inputs and performance can be motivating, whereas excessive or unexplained dispersion depresses employee effort, product quality and firm performance (Cowherd and Levine, 1992; Mueller et al., 2017; Rouen, 2020; Shaw, 2014). The legitimate spread of pay is therefore likely to vary across firms and industries, depending on skill intensity, promotion structures, and the observability of performance (Faleye et al., 2013; Shaw, 2014). What female solidarity appears to discipline in our results is the excessive and unexplained component of the vertical gap, the component that fairness perceptions and efficiency considerations jointly condemn (Adams, 1963; Peters et al., 2024). Framed in this way, our findings carry policy relevance without prescribing a uniform pay ratio: they identify a relational mechanism through which firms can move towards pay structures that employees regard as legitimate, and they invite future research on the sectoral, occupational and institutional contingencies that define legitimate pay dispersion in particular settings.

Implications for human resource management

Our findings suggest numerous theoretical, managerial and policy-making implications. Theoretical implications are that gender equity extends beyond representation to include relational support among women, particularly pointing to the need for strategies that enhance female solidarity in firms, such as promoting gender-inclusive policies and homophilous networks for women at all organisational levels. Practical implications we propose invite regulatory bodies to consider policies that facilitate female solidarity as part of broader equity strategies, especially in firms with significant pay disparities. As our findings indicate, firms employing more women are more exposed to a wider salary

gap. This implies that more remuneration policies are needed at employee level ensuring wage equality among women and men. Our further analyses imply that firms may explore internal resolution to this problem by empowering the females inside firms. Recruiting greater number of female executives and appointing more female directors on board enable female solidarity in mitigating salary gap. These findings suggest integration of greater gender equality into recruitment and promotion policies in higher-ranking positions and reducing or elimination discriminative promotion policies. Our findings propose a complementary perspective and resolution to the income inequality issue in firms. This finding implies supportive behaviour of female directors, executives, and employees to overcome men hegemony over remuneration policies.

Our findings underscore the importance of pay transparency as a mechanism to mitigate disparities, aligning with evidence that such practices enhance distributive justice and reduce turnover (Alterman et al., 2021). The introduction of wage transparency by the OECD (2021) and the Dodd-Frank Act in the United States requiring mandatory disclosure of CEO-to-employee pay ratios are examples of such policy interventions. However, the policy effectiveness is contingent upon organisational context and employee perceptions of fairness (Bamberger and Belogolovsky, 2017; Eib et al., 2025).

In the current dynamic environment, compensation systems that cater to diverse workforces and hybrid models must include innovative benefits such as internet fee reimbursements (Teng-Calleja et al., 2024) and algorithmic performance evaluations (Budhwar et al., 2022). Firms need to integrate these practices to enhance resilience and adaptability in increasingly volatile markets. The results suggest policy-making implications too. At the macro policy level, governmental labour policies and stock market regulations may design corporate domain to give equal opportunities to female and male executives and directors. Besides, firms' internal governance mechanisms may also contribute to the solution of the problem, for instance, nomination committees, which are the primary mechanism responsible for recruitment of top executives. The nomination committees can develop policies concerning recruitment and promotion of female executives and also cooperate with them about how to reduce salary gap in firms. Further tests also suggest implications to firms depending on their size and location such as small firms need to empower female directors and executives more by developing their internal policies.

Considering further channel tests, increasing wage gap in smaller firms require the attention of labour unions and regulatory bodies to smaller firms. They might be more easily escaping from the scrutiny of stakeholders. The wage gap observed associated with women employees in high-WGI countries but not low-WGI countries implies that public governance quality does not guarantee the income equality. Considering also that female directors are the channel through which this outcome (i.e. wage gap) appears, there should be other dynamics driving this outcome such as aligning with economic theories (i.e. tournament theory) rather than social theories (i.e. homophily theory). Overall, these differing outcomes highlight the importance of contingencies and deeper further investigations.

Our study's main limitation is associated with availability of data for main variables interest such as salary gap and female employees, executives and directors. In particular, fewer female employee's data are available than female executives and directors' data.

This limitation has led to development of an unbalanced sample. Despite this limitation, our study makes an original contribution to the literature by linking female solidarity to salary gap at a global scale. Future studies may advance our investigation by testing how female solidarity can enrich positive corporate outcomes such as financial and non-financial and reduce negative outcomes such as corporate misconducts. Considering the outcomes of further tests, what might be done to reduce wage gaps in smaller firms is a potential future study. Finally, it is worth further investigating why women employees exacerbate wage gap in high-WGI countries but not low-WGI countries. A further limitation concerns measurement. Our interaction terms capture the joint presence of women across organisational levels, which we treat as a structural precondition of, and proxy for, solidarity; they do not observe solidaristic behaviour directly. Future research could triangulate archival co-presence measures with survey and qualitative evidence of mentoring, sponsorship, advocacy and collective voice among women, thereby testing the relational mechanism we theorise more directly.

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Data availability statement

The data that support the findings of this study are available from LSEG. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from <https://www.lseg.com/en/data-analytics> with the permission of LSEG.

Notes

1. We define the variables in the next section.
2. These values are based on logarithmic transformation of salary gap. Based on raw data without logarithm, salary gap has a mean of 132.65, ranging from 0.89 to 3582.71.
3. Economic significance of the results as follows: $F_{\text{employees}}: 0.0041 * 17.63/3.57 = 2.02\%$, $F_{\text{executives}}: 0.00003 * 14.18/3.57 = 0.01\%$, $F_{\text{directors}}: 0.002 * 14.14/3.57 = 0.79\%$.
4. Please see the definitions of these variables in Table 2.

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Appendix

Table A1. Country-level sampling distributions.

	Country	Unique firms	Percent	Data points	Percent
1	Argentina	2	0.05	6	0.03
2	Australia	238	5.45	1458	7.09
3	Austria	31	0.71	152	0.74
4	Azerbaijan	1	0.02	2	0.01
5	Bahamas	1	0.02	1	0.00
6	Belgium	36	0.82	188	0.91
7	Bermuda	1	0.02	4	0.02
8	Cambodia	1	0.02	3	0.01
9	Canada	259	5.93	1365	6.63
10	Cayman Islands	1	0.02	9	0.04
11	Chile	27	0.62	118	0.57
12	China	824	18.86	2707	13.16
13	Colombia	1	0.02	1	0.00
14	Cyprus	2	0.05	11	0.05
15	Denmark	45	1.03	219	1.06
16	Finland	72	1.65	405	1.97
17	France	155	3.55	987	4.80
18	Germany	200	4.58	1047	5.09
19	Greece	3	0.07	5	0.02
20	Hong Kong	127	2.91	973	4.73
21	Hungary	1	0.02	1	0.00
22	Iceland	7	0.16	10	0.05
23	India	133	3.04	899	4.37
24	Indonesia	6	0.14	12	0.06
25	Ireland; Republic of	31	0.71	225	1.09
26	Israel	8	0.18	27	0.13
27	Italy	77	1.76	266	1.29
28	Japan	1	0.02	1	0.00
29	Jersey	6	0.14	28	0.14
30	Jordan	1	0.02	1	0.00
31	Kenya	1	0.02	5	0.02
32	Korea; Republic (S. Korea)	10	0.23	13	0.06
33	Luxembourg	23	0.53	78	0.38
34	Macau	3	0.07	29	0.14
35	Malaysia	54	1.24	201	0.98
36	Malta	5	0.11	14	0.07
37	Mexico	1	0.02	12	0.06
38	Netherlands	55	1.26	370	1.80
39	New Zealand	36	0.82	164	0.80

(continued)

Table A1. (continued)

	Country	Unique firms	Percent	Data points	Percent
40	Nigeria	1	0.02	1	0.00
41	Norway	63	1.44	284	1.38
42	Pakistan	1	0.02	4	0.02
43	Peru	1	0.02	1	0.00
44	Philippines	8	0.18	23	0.11
45	Poland	28	0.64	172	0.84
46	Portugal	12	0.27	62	0.30
47	Russia	9	0.21	33	0.16
48	Saudi Arabia	8	0.18	13	0.06
49	Singapore	36	0.82	169	0.82
50	Slovenia	1	0.02	4	0.02
51	South Africa	94	2.15	758	3.68
52	Spain	50	1.14	204	0.99
53	Sweden	234	5.35	793	3.85
54	Switzerland	134	3.07	717	3.48
55	Taiwan	24	0.55	46	0.22
56	Thailand	107	2.45	243	1.18
57	Turkey	1	0.02	2	0.01
58	United Arab Emirates	8	0.18	24	0.12
59	United Kingdom	450	10.30	2719	13.21
60	United States	606	13.87	2279	11.08
61	Vietnam	8	0.18	8	0.04
	Total	4370	100.00	20,576	100.00