Women in management: Essays in Gender and Labor Economics

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> Cras te victurum, cras dicis, Postume, semper.
> Dic mihi, cras istud, Postume, quando venit?
> Quam longe cras istud, ubi est? aut unde petendum?
> Numquid apud Parthos Armeniosque latet?
> Iam cras istud habet Priami vel Nestoris annos.
> Cras istud quanti, dic mihi, possit emi?
> Cras vives? hodie iam vivere, Postume, serum est:
> Ille sapit, quisquis, Postume, vixit heri.
> — Martial 5,58

Berlin, 19 November, 2024
Virginia Sondergeld

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Erklärung zu Co-Autorenschaften

Diese Dissertation besteht aus drei (Arbeits-)Papieren, von denen zwei in Zusammenarbeit mit Co-Autorinnen entstanden sind, sowie einer Datendokumentation, welche in Zusammenarbeit mit einer Co-Autorin enstanden ist:

- Katharina Wrohlich und Virginia Sondergeld: ***"DIW Women Executives Barometer: Method Report and Codebook for the Waves 2015-2024"***
- Virginia Sondergeld: ***"Gender differences and stereotypes in newspaper coverage of company board members"***
- Lavinia Kinne und Virginia Sondergeld: ***"Meet my family: the effect of female CEOs' newspaper coverage on CEO perception and economic decision-making"***
- Virginia Sondergeld und Katharina Wrohlich: ***"Women in management and the gender pay gap"***

Liste der Vorveröffentlichungen

- **Arbeitspapiere**
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- **Beiträge zur Politikberatung**
  - **Teilweise basierend auf Kapitel 2 ist erschienen:**
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    - Sondergeld, V., Wrohlich, K. and Kirsch A. (2023). Erneut mehr Frauen in Vorständen großer Unternehmen: Durch Beteiligungsgebot angestoßene Dynamik lässt aber nach. *DIW Wochenbericht*, 90(3), 22-33.

- ∗ Sondergeld, V., Wrohlich, K. and Kirsch A. (2022). Deutlich mehr Vorständinnen in großen Unternehmen: Beteiligungsgebot scheint bereits zu wirken. *DIW Wochenbericht*, 89(3), 22-33.

– **Basierend auf Kapitel 5 ist erschienen:**

- ∗ Sondergeld, V., and Wrohlich, K. (2024). Gender Pay Gap in einem Betrieb sinkt mit mehr Frauen in Führungspositionen. *DIW Wochenbericht*, 91(3), 38-43.

Rechtliche Erklärung

Erklärung gem. §4 Abs. 2 (Promotionsordnung)

Hiermit erkläre ich, dass ich mich noch keinem Promotionsverfahren unterzogen oder um Zulassung zu einem solchen beworben habe, und die Dissertation in der gleichen oder einer anderen Fassung bzw. Überarbeitung einer anderen Fakultät, einem Prüfungsausschuss oder einem Fachvertreter an einer anderen Hochschule nicht bereits zur Überprüfung vorgelegen hat.

Berlin, 20. Februar 2025
Virginia Sondergeld

Erklärung gem. §10 Abs. 3 (Promotionsordnung)

Hiermit erkläre ich, dass ich für die Dissertation folgende Hilfsmittel und Hilfen verwendet habe. Auf dieser Grundlage und in Zusammenarbeit mit meinen Co-Autor*innen habe ich die Arbeit selbstständig verfasst.

- Software:
  - Stata Versionen 15, 16 und 17
  - Python Versionen 3.8 bis 3.13
  - LaTeX mit Overleaf
- Literatur: siehe Literaturverzeichnis

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Virginia Sondergeld

Abstract

This dissertation consists of four chapters that contribute to the literature on gender and labor economics. More specifically, this dissertation contributes to exploring the role of women as corporate leaders in the labor market and in firms, examining the causes and consequences of women's (under)representation in management, and understanding the interaction of these factors with gender stereotypes.

Chapter 2 documents the underrepresentation of women as leaders of German companies by presenting data from the DIW Women Executives Barometer, the most comprehensive data collection on women's representation on supervisory and executive boards in Germany, which was recently made available for scientific research. The data shows that, despite progress in recent years, women remain underrepresented on both supervisory and executive boards in Germany, with shares ranging from 33 to 38 percent on supervisory boards and 14 to 23 percent on executive boards of the largest publicly listed companies as of the end of 2023. Women's representation is even lower among chairs of executive or supervisory boards of these companies, with values below 10 percent in all groups assessed. The DIW Women Executives Barometer is then used as a data source for further work in **Chapter 3**.

Chapter 3 examines how women and men on German company boards are portrayed in the media and explores the relationship between this coverage and gender stereotypes. By providing initial evidence on gender differences and stereotypes in newspaper coverage of board members through quantitative text analysis of more than 45,000 newspaper articles, this chapter expands our understanding of stereotypes as barriers to women's career advancement and shaping public perception of female leaders through media coverage. In regularized regressions, terms related to family and social interaction predict articles about women, while terms related to power and competition, as well as to failure, scandals, and adversity, predict articles about men. An association of women with family and men with careers is further shown using the term frequency-inverse document frequency (tf-idf) and word embeddings. Additionally, agentic language depicting male stereotypes like success-orientation is more

prevalent for men, while communal language related to female stereotypes like caregiving is more associated with women. Economists' view of gender stereotypes as a form of statistical discrimination suggests that stereotypes in the portrayal of female managers in newspapers should decrease over time as more women attain board positions and information asymmetries about their characteristics diminish. However, I find no clear-cut changes in newspaper coverage in the analyzed articles over the period from 2010 to 2022. Further, in the context of statistical discrimination, gender differences in newspaper coverage would arise if they correctly reflect gender differences in aggregate distributions of managers' characteristics. I assess demographics and previously unanalyzed psychological traits of managers from representative data of the German population, finding that female managers are less likely to be married or have children than male managers. There is no evidence for gender gaps in agency among managers. Thus, the stereotyped representation of board members in newspapers to a large extent does not seem to reflect aggregate distributions of characteristics of women and men in these positions, providing little support for an explanation based on statistical discrimination.

Chapter 4 then asks to what extent gender stereotypes in newspaper coverage of company board members affect perception and economic decision-making of newspaper readers. Taking the result from **Chapter 3** that more family-related language is used in newspaper articles on female than male company leaders as a starting point, we assess this question in a randomized online experiment. We show participants articles consisting of elements from real newspaper coverage on a real company and its CEO, varying whether and how information about their family is presented. We then ask participants incentivized questions on their perception of the CEO's competence (measured by expected 'survival' in the firm and their rating by employees on Glassdoor), the firm's performance on the stock market, and to make a decision on an investment in the firm. We find that expected firm performance substantially differs by CEO gender with participants being less likely to believe in better stock performance in the year after compared to the year before CEO appointment for female CEOs. Although expected stock performance does not differ by CEO coverage, investments in the firm's stock are significantly lower for female CEOs when their family is neutrally mentioned. However, highlighting the successful management of family and career as a trade-off for female CEOs does not result in less favorable investment decisions. The treatment effects are most pronounced for female respondents and parents. Further, we find that women expect female CEOs to be rated worse by their employees, in particular for the treatment highlighting a trade-off between family and career, while male participants perceive an employee bonus for female CEOs in the trade-off treatment compared to

female CEOs without a family mention. There is no effect of stereotypical coverage on CEO 'survival' over a two or five year horizon. Through quantitative analyses of free-text questions, we find that considerations about family and gender play a role in respondents' reasoning.

Finally, **Chapter 5** focuses on spillover effects of female leadership by assessing the causal impact of women's representation in management on labor market outcomes of their direct subordinates on the establishment level. We investigate the influence of women's representation in first- and second-level management on the gender pay gap among employees in German establishments. To this end, we estimate a panel model with establishment fixed effects and industry-specific time dummies based on Linked-Employer-Employee data from the years 2004 to 2018. Our results show that a higher share of women in management significantly reduces the gender pay gap within the establishment. An increase in the share of women in first-level management from zero to above 33 percent decreases the adjusted gender pay gap from a baseline of 15 percent by 1.2 percentage points, i.e. to roughly 14 percent. The effect is stronger for women in second-level compared to first-level management, indicating that female managers with closer interactions with their subordinates have a higher impact on the gender pay gap than women on higher management levels. Notably, the results are very similar for East and West Germany, despite the lower gender pay gap and more gender-egalitarian social norms in East Germany. From a policy perspective, our findings suggest that increasing the presence of women in management positions has the potential to reduce the gender pay gap to some extent. However, further policy measures will be necessary to fully close the gender gap in pay.

Zusammenfassung

Diese Dissertation besteht aus vier Kapiteln, die einen Beitrag zur Literatur im Bereich Geschlechter- und Arbeitsökonomie leisten. Insbesondere trägt diese Arbeit zur Erforschung der Rolle von Frauen in Führungspositionen in Unternehmen und auf dem Arbeitsmarkt bei, indem sie Ursachen und Folgen ihrer (Unter-)Repräsentation sowie deren Interaktion mit Geschlechterstereotypen untersucht.

Kapitel 2 dokumentiert die Unterrepräsentation von Frauen in Führungspositionen in Deutschland anhand von Daten des DIW Managerinnenbarometers, der umfassendsten Datenerhebung zur Repräsentation von Frauen in Aufsichtsräten und Vorständen von Unternehmen in Deutschland. Trotz Fortschritten in den letzten Jahren sind Frauen in Führungspositionen der deutschen Wirtschaft nach wie vor unterrepräsentiert. Die Frauenanteile in den Vorständen der untersuchten Gruppen der größten börsennotierten Unternehmen des deutschen Aktienindex DAX lagen in der letzten Erhebung Ende 2023 zwischen 14 und 23 Prozent. In den Aufsichtsräten waren Frauen stärker vertreten mit Werten zwischen 33 und 38 Prozent. Unter den Vorsitzenden von Vorständen und Aufsichtsräten der DAX Unternehmen lag der Frauenanteil in allen Gruppen unter 10 Prozent. Der Datensatz des DIW Managerinnenbarometers steht seit kurzem für die wissenschaftliche Forschung zur Verfügung und wird als Datenquelle für die weitere Arbeit in **Kapitel 3** herangezogen.

Kapitel 3 untersucht, wie Frauen in Vorständen und Aufsichtsräten deutscher Unternehmen in Zeitungsberichterstattung dargestellt werden, und analysiert den Zusammenhang zwischen dieser Berichterstattung und Geschlechterstereotypen. Dieses Kapitel trägt zu einem umfassenderen Verständnis darüber bei, wie Stereotype zu Barrieren im beruflichen Aufstieg von Frauen beitragen und wie sie durch Medienberichterstattung die öffentliche Wahrnehmung von Frauen in Führungspositionen beeinflussen können. Das Kapitel stellt die erste deskriptive Analyse zu geschlechtsspezifischen Unterschieden und Stereotypen in der Zeitungsberichterstattung über Frauen in Führungspositionen mithilfe quantitativer Textanalysemethoden dar. Lasso-Regressionen zeigen, dass Begriffe aus dem Bereich Familie und soziale Interaktionen spezifisch für

Artikel über weibliche Vorstands- und Aufsichtsratsvorsitzende sind, während Begriffe aus den Bereichen Macht, Wettbewerb und Misserfolg spezifisch für Artikel über männliche Vorstands- und Aufsichtsratsvorsitzende sind. Eine Assoziation von Frauen mit dem Thema Familie und Männern mit dem Thema Karriere wird zudem anhand der tf-idf (Vorkommenshäufigkeit-Inverse Dokumenthäufigkeit) und Wort-Embeddings gezeigt. Weiterhin werden agentische Begriffe, die männliche Stereotype wie Erfolgsorientierung abbilden, stärker mit Männern assoziiert, während kommunale Begriffe, die weibliche Stereotype wie Fürsorglichkeit abbilden, häufiger mit Frauen assoziiert werden. Ökonomische Theorie, in der Geschlechterstereotype als Form statistischer Diskriminierung interpretiert wird, impliziert, dass stereotypische Zeitungsberichterstattung über weibliche Führungskräfte über den untersuchten Zeitraum 2010 bis 2022 abnehmen sollte, da in diesem Zeitraum mehr Frauen in Führungspositionen aufgestiegen sind, wodurch sich Informationsasymmetrien über ihre Eigenschaften verringern sollten. Eine Analyse der Artikel über diese Jahre zeigt jedoch keinen Zeittrend in der Verwendung geschlechterstereotyper Sprache. Darüber hinaus könnten die geschlechtsspezifischen Unterschiede in der Berichterstattung durch statistische Diskriminierung erklärt werden, sofern sie tatsächliche statistische Unterschiede in den Eigenschaften von Führungskräften korrekt widerspiegeln. Um dieser Möglichkeit nachzugehen, analysiere ich demografische Variablen und bisher nicht untersuchte psychologische Eigenschaften von Führungskräften anhand repräsentativer Daten des deutschen Sozioökonomischen Panels (SOEP). Die Daten zeigen, dass weibliche Führungskräfte seltener verheiratet sind oder Kinder haben als ihre männlichen Kollegen. Weiterhin gibt es keine Hinweise auf geschlechtsspezifische Unterschiede in agentischen Persönlichkeitseigenschaften unter Führungskräften. Die stereotype Darstellung von Vorstands- und Aufsichtsratsmitgliedern in Zeitungen scheint in weiten Teilen also nicht reale Unterschiede in den Eigenschaften von Frauen und Männern in diesen Positionen abzubilden, was eine Erklärung durch statistische Diskriminierung nicht unterstützt.

Kapitel 4 geht dann der Frage nach, inwieweit Geschlechterstereotype in der Zeitungsberichterstattung über Frauen in Führungspositionen die Wahrnehmung und das ökonomische Entscheidungsverhalten von Zeitungsleser*innen beeinflussen. Ausgehend von dem Ergebnis aus **Kapitel 3**, dass in Zeitungsartikeln über weibliche Vorstandsvorsitzende (CEOs) häufiger Begriffe aus dem Bereich Familie verwendet werden, untersuchen wir diese Fragestellung in einem randomisierten Online-Experiment. Wir zeigen den Befragten Artikel, die aus Elementen realer Zeitungsberichterstattung über ein reales Unternehmen und dessen weibliche oder männlichen CEO bestehen, und variieren hierbei, ob und wie Informationen über die Familie des oder der CEO dargestellt werden. Anschließend beantworten die Befragten incentivierte Fragen zur wahrgenom-

menen Kompetenz des oder der CEO (gemessen an der erwarteten 'Überlebensrate' im Unternehmen und der Bewertung durch Mitarbeitende auf Glassdoor), zur Aktienperformance des Unternehmens und treffen eine Investitionsentscheidung in die Aktie des Unternehmens. Unsere Ergebnisse zeigen, dass die erwartete Aktienperformance vom Geschlecht des oder der CEO abhängt: die Teilnehmenden geben bei weiblichen CEOs seltener an, dass sich die Aktienperformance im Jahr nach ihrer Ernennung im Vergleich zum Vorjahr verbessert. Obwohl die erwartete Aktienperformance nicht von der Berichterstattung über den oder die CEO beeinflusst wird, sind Investitionen in die Unternehmensaktie signifikant geringer, wenn die Familie einer weiblichen CEO neutral erwähnt wird. Die Investition in das Unternehmen fällt jedoch nicht geringer aus, wenn erwähnt wird, dass die weibliche CEO erfolgreich Familie und Karriere miteinander vereinbart hat. Die Effekte sind unter weiblichen Befragten und Eltern besonders stark. Weiterhin zeigen unsere Ergebnisse, dass Frauen erwarten, dass weibliche CEOs von den Mitarbeitenden schlechter bewertet werden, insbesondere wenn das Thema Vereinbarkeit von Familie und Beruf im Artikel betont wird. Männliche Befragte erwarten in diesem Fall eher eine höhere Zustimmungsrate unter den Mitarbeitenden. Die Ergebnisse zeigen keinen Einfluss der stereotypen Berichterstattung auf die erwartete 'Überlebensrate' der oder des CEOs über einen Zeitraum von zwei oder fünf Jahren. Die Analyse von Freitextfragen, in der die Befragten ihre Antworten begründen können, deutet darauf hin, dass Familie und Geschlecht eine wichtige Rolle bei ihren Überlegungen spielen.

Zuletzt untersucht **Kapitel 5** die Spillover-Effekte weiblicher Führung, indem es den kausalen Zusammenhang des Frauenanteils im Management mit Geschlechterungleichheiten unter Mitarbeitenden auf Betriebsebene analysiert. Wir betrachten den Einfluss des Frauenanteils auf der ersten (höchsten) und zweiten Führungsebene auf die geschlechtsspezifische Lohnlücke (Gender Pay Gap) unter Beschäftigten in deutschen Betrieben. Hierfür schätzen wir ein Panelmodell mit betriebsspezifischen fixen Effekten und industriespezifischen Zeit-Dummies basierend auf den verknüpften Employer-Employee-Daten (LIAB) des Instituts für Arbeitsmarkt- und Berufsforschung für die Jahre 2004 bis 2018. Unsere Ergebnisse zeigen, dass ein höherer Frauenanteil im Management die geschlechtsspezifische Lohnlücke im Betrieb signifikant verringert. Ein Anstieg des Frauenanteils auf der ersten Führungsebene von null auf über 33 Prozent reduziert den bereinigten Gender Pay Gap von einem Ausgangswert von 15 Prozent um 1,2 Prozentpunkte, also auf etwa 14 Prozent. Der Effekt ist stärker für Frauen auf der zweiten Führungsebene, was darauf hinweist, dass weibliche Führungskräfte mit direkteren Interaktionen mit ihren Mitarbeitenden einen größeren Einfluss auf die Lohnlücke haben als Frauen auf höheren Managementebenen. Bemerkenswert ist, dass

die Ergebnisse in Ost- und Westdeutschland ähnlich ausfallen, obwohl der Gender Pay Gap in Ostdeutschland geringer und die sozialen Normen dort gleichstellungsorientierter sind. Unsere Ergebnisse legen nahe, dass eine stärkere Präsenz von Frauen in Führungspositionen das Potenzial hat, das die geschlechtsspezifische Lohnlücke bis zu einem gewissen Grad zu verringern. Dennoch sind zusätzliche politische Maßnahmen notwendig, um den Gender Pay Gap vollständig zu schließen.

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CHAPTER 1

Introduction

Over the past decades, substantial progress has been made in women's integration into labor markets worldwide. Female labor force participation has increased considerably, approaching male participation rates, and in many high-income countries, recent cohorts of women have even surpassed men in educational attainment (Bertrand, 2020). Despite these gains, women remain significantly underrepresented in leadership roles such as in corporate management across countries and industries.[1] For instance, the average women's share among executive board members of blue-chip companies across countries of the European Union stood at 24 percent as of June 2024. The respective EU-average women's share among CEOs of these companies was 8 percent (EIGE, 2024a). In the United States, women accounted for 28 percent of executive team members in Fortune 100 companies in 2022, while only 12 percent of these companies' CEOs were women (Bodine and Reese, 2023).

A large body of economic research has emerged around understanding the reasons behind women's underrepresentation in corporate leadership. Factors identified as contributing to the so-called 'glass ceiling' include career impacts of childbirth (Bertrand et al., 2010; Cortés and Pan, 2023; Kleven et al., 2024), the unequal distribution of non-market labor and the resulting demand for flexibility in working hours (Goldin, 2014; Wiswall and Zafar, 2018), lower investment in certain fields of education, such as STEM (Bertrand, 2018), and unequal access to professional networks (Cullen and Perez-Truglia, 2023; von Essen and Smith, 2023). Drawing on concepts from social

[1] In this dissertation, I primarily use the term 'leadership role' in the context of corporate management. However, women's underrepresentation in leadership extends beyond the corporate sector to areas such as politics (see, for example, EIGE (2024b), which shows that only 14 percent of heads of national governments in the EU are women) and many academic fields (see Schuetz et al. (2024) for a discussion on leadership in the economics profession). Many of the arguments regarding the causes and consequences of women's representation in leadership presented here are also relevant in these contexts.

psychology[2], greater attention has recently been given to the impact of gender stereotypes on decision-making of women and men on the supply and demand sides of the labor market, and how these stereotypes interact with factors that sustain gender gaps in managerial representation. This broadens economists' traditional view of gender stereotypes, which mainly rationalizes them as a form of statistical discrimination, where group membership is used to infer a person's characteristics based on aggregate distributions under imperfect information (Arrow, 1973; Phelps, 1972). Instead, gender stereotypes are increasingly incorporated directly into the formation of preferences and decisions in economic models, and importantly, are not always assumed to be based on accurate beliefs or may overstate between-group in comparison to within-group variation (Bertrand, 2020; Bordalo et al., 2016). Gender stereotypes may influence individual occupational choices and educational investments (Breda et al., 2023; Porter and Serra, 2020), the distribution of work within households (Couprie et al., 2020), or workplace behavior (Coffman, 2014). Additionally, they may contribute to biases and double standards in hiring (Barron et al., 2024; Reuben et al., 2014) or performance evaluation and promotion (Benson et al., 2024).

In many jurisdictions, reducing gender gaps in corporate leadership is considered a policy goal, with active debates about the most effective strategies to achieve it. A central point of discussion is whether policies should focus on reducing the aforementioned barriers that women face in reaching managerial roles — such as implementing family policies that encourage a more gender-equitable distribution of care responsibilities or promoting entry into traditionally male-dominated fields like STEM — or whether they should directly target representation outcomes. An example of the latter approach are gender quotas, which by now have been introduced for corporate board positions in many countries (De Acutis et al., 2024). One rationale for such 'top-down' policies is that they may not only increase gender equality in the targeted positions, but also produce positive effects for other women, helping to decrease barriers to career advancement and gender gaps, such as those in pay, hiring, and promotion rates, within the respective organization and beyond. These spillover effects may, for instance, stem from female leaders being more concerned with gender equality, thus implementing more gender-equal policies and performance schemes (Flabbi et al., 2019; Theodoropoulus et al., 2022), and fostering a more inclusive organizational culture. Additionally, women in management positions can serve as role models and mentors for female employees, thereby enhancing their productivity and career potential (Athey et al., 2000; Kunze and Miller, 2017). Importantly, challenging gender stereotypes may also play a role in creating or mediating spillover effects of women's representation in

[2]See Ellemers (2017) for a review of this literature.

leadership. The presence of a female leader as a stereotype-disconforming experience to employees within the company and to other observers may in the long-run help to decrease implicit biases and prejudices (Adriaans et al., 2023; Beaman et al., 2009). Viewed through the lense of an economic model of statistical discrimination: the observation of a female leader decreases the information asymmetries about female leaders' skills and traits and thus decreases discriminatory behavior towards other women aiming for a leadership position. On the other hand, role congruity theory suggests that women in leadership often face negative backlash, as they violate traditional stereotypes associating men with leadership and women with caretaker roles, leading to perceptions of them as less effective leaders (Eagly and Karau, 2002; Rudman and Phelan, 2008). Consequently, stereotypes may limit the extent to which female managers are seen as role models and can affect their capacity to implement organizational changes.

Taking together the research on factors contributing to women's underrepresentation in corporate leadership and on the impacts or potential spillover effects of their representation suggests that both of these causal mechanisms should not be seen in isolation: women's representation in management is influenced by factors that contribute to the glass ceiling, while, simultaneously, women's presence in managerial roles may help to dismantle these barriers through spillover effects, thus increasing the likelihood of other women achieving leadership positions. Additionally, both of these causal mechanisms may be influenced or mediated by gender stereotypes.

This dissertation contributes to multiple aspects of the causes and consequences of women's (under)representation in management, as well as the role of gender stereotypes in shaping representation, perception, and impact of women as corporate leaders. The empirical analyses focus on Germany, where women's integration into labor markets over recent decades has followed similar trajectories compared to other high-income countries[3], and where women remain similarly underrepresented in leadership roles. First, **Chapter 2** lays the data foundations by presenting data on women's representation on company boards in Germany. **Chapter 3** and **Chapter 4** then examine the role of gender stereotypes —particularly in media portrayals — as barriers to women's career advancement and as factors that shape perceptions of their leadership. Lastly, **Chapter 5** considers spillover effects of women in management, focusing on the gender gap in pay among their subordinates.

Chapter 2 documents the underrepresentation of women as company leaders in Germany by presenting data from the DIW Women Executives Barometer, the most comprehensive data collection on women's representation on supervisory and execu-

[3]See, for example, OECD (2024) for labor force participation rates of women in OECD countries over time.

tive boards in Germany, that was recently made available for scientific research. The data shows that, despite progress in recent years, women remain underrepresented on both supervisory and executive boards in Germany with shares of 33 to 38 percent on supervisory boards and of 14 to 23 percent on executive boards of the largest publicly listed (DAX) companies by the end of 2023. Women's representation is even lower among chairs of executive or supervisory boards of these companies, with shares below 10 percent in all groups. The DIW Women Executives Barometer is then used as a data source for further work in **Chapter 3**.

In **Chapter 3**, I examine media portrayals of women on German company boards and explore their connection to gender stereotypes. I present initial evidence on gender differences and stereotypes in more than 45,000 newspaper articles on company board members using quantitative text analysis. This analysis deepens our understanding of how stereotypes contribute to barriers in women's career advancement and shape public perceptions of female leaders, impacting their capacity to serve as role models to other women or as stereotype-disconfirming examples to a broader audience. In regularized regressions, terms related to family and social interaction predict articles about women. Terms related to power and competition, as well as to failure, scandals, and adversity, predict articles about men. An association of women with family and men with careers is further shown using the term frequency-inverse document frequency (tf-idf) and word embeddings. Additionally, agentic language depicting male stereotypes like success-orientation is more prevalent for men, while communal language related to female stereotypes like caregiving is more associated with women. Economists' view of gender stereotypes as a form of statistical discrimination implies that stereotypes in the portrayal of female managers should decrease over time as more women attain board positions and information asymmetries about their characteristics diminish. I find no clear-cut changes in newspaper coverage in the analyzed articles over the period from 2010 to 2022, though. Further, in the context of statistical discrimination, gender differences in newspaper coverage would arise if they correctly reflect gender differences in aggregate distributions of managers' characteristics. I assess demographics and previously unanalyzed psychological traits of managers from representative data of the German population, finding that female managers are less likely to be married or have children than male managers. There is no evidence for gender gaps in agency among managers. Thus, the stereotyped representation of board members in newspapers likely does not reflect actual distributions in characteristics of women and men in these positions, providing little support for an explanation based on statistical discrimination.

Chapter 4 then asks to what extent gender stereotypes in newspaper coverage of company board members affect perception and economic decision-making of newspaper readers. Taking the result from **Chapter 3** that more family-related language is used in newspaper articles on female than male company leaders as a starting point, we assess this question in a randomized online experiment. We show participants articles consisting of elements from real newspaper coverage on a real company and its CEO, varying whether and how information about their family is presented. We then ask participants incentivized questions on their perception of the CEO's competence (measured by expected 'survival' in the firm and their rating by employees on Glassdoor), the firm's performance on the stock market, and to decide on an investment in the firm. We find that expected firm performance substantially differs by CEO gender with participants being less likely to believe in better stock performance in the year after compared to the year before CEO appointment for female CEOs. Although expected stock performance does not differ by CEO coverage, investments in the firm's stock are significantly lower for female CEOs when their family is neutrally mentioned. However, highlighting the successful management of family and career as a trade-off for female CEOs does not result in less favorable investment decisions. These treatment effects are most pronounced for female respondents and parents. Further, we find that women expect female CEOs to be rated worse by their employees, in particular for the treatment highlighting a trade-off between family and career, while male participants perceive an employee bonus for female CEOs in the trade-off treatment compared to female CEOs without a family mention. There is no effect of stereotypical coverage on CEO 'survival' over a two or five year horizon. Through quantitative analyses of free-text questions, we find that considerations about family and gender play a role in respondents' reasoning.

Finally, **Chapter 5** focuses on spillover effects of female leadership by assessing the causal impact of women's representation in management on labor market outcomes of their direct subordinates on the establishment level, i.e. a lower managerial level compared to executive boards of large companies. We investigate the influence of women's representation in first- and second-level management on the gender pay gap among employees using German Linked-Employer-Employee data from the years 2004 to 2018. To this end, we estimate a panel model with establishment fixed effects and industry-specific time dummies. Our results show that a higher share of women in management significantly reduces the gender pay gap within the firm. An increase in the share of women in first-level management from zero to above 33 percent decreases the adjusted gender pay gap from a baseline of 15 percent by 1.2 percentage points, i.e. to roughly 14 percent. The effect is stronger for women in second-level than

first-level management, indicating that female managers with closer interactions with their subordinates have a higher impact on the gender pay gap than women on higher management levels. Notably, the results are very similar for East and West Germany, despite the lower gender pay gap and more gender-egalitarian social norms in East Germany. From a policy perspective, our findings suggest that increasing the presence of women in high-level management positions has the potential to reduce the gender pay gap to some extent. However, further policy measures will be necessary to fully close the gender gap in pay.

CHAPTER 2

Documenting women's representation on German company boards: The DIW Women Executives Barometer[1]

2.1 Introduction

Women continue to be underrepresented in leadership positions within German companies. For example, in 2023, women made up just under 18 percent of executive board members in the 200 largest companies by revenue. The proportion of women on supervisory boards in this group of firms was higher, at nearly 32 percent. Furthermore, among these top 200 companies, women chaired only nine executive boards and 13 supervisory boards, respectively (Sondergeld et al., 2024).

The gender gap in top leadership positions in the private sector has been the subject of intense political debate in Germany for some time. To increase the representation of women in these positions, several political measures have been introduced in the past years: In 2015, a gender quota of 30 percent for supervisory boards was adopted as part of the First Act for the Equal Participation of Women and Men in Leadership Positions in the Private Sector and in Public Service (*FüPoG I*). Six years later, in 2021, a minimum participation requirement was set for executive board members as part of the Second Act for the Equal Participation of Women and Men in Leadership Positions in the Private Sector and in Public Service (*FüPoG II*). These policies have led to an increase in the proportion of women on the respective boards, although there

[1]This chapter is based on DIW Data Documentation No. 107 (2024), which is co-authored with Katharina Wrohlich (DIW Berlin, University of Potsdam). The documentation has been published together with the release of the data of the DIW Women Executives Barometer in April 2024. We thank Alina Meiner and Lana Lemke for their valuable support in the data collection and preparation.

are still large differences depending on the sector, size, or (public) ownership of the company.

Data on women's representation on company boards is essential for facilitating an informed public debate on gender equality in leadership positions and for supporting evidence-based policymaking. As the largest analysis of its kind, the annual report of the DIW Women Executives Barometer documents the development of the share of women on executive and supervisory boards of different groups of major companies in Germany.[2] As of April 2024, the DIW Women Executives Barometer data of the years 2021 to 2024 (for all surveyed companies) and data of the years 2015 to 2020 (for all companies listed in the German stock index DAX) was made available for scientific research.

In the following sections, we outline the procedure for selecting the various groups of companies assessed (Section 2.2) and for collecting the data (Section 2.3). Section 2.4 describes the structure and variables of the resulting dataset. Section 4.3 presents descriptive results on women's representation on German company boards over time.

2.2 Selection of companies

In the annual DIW Women Executives Barometer, the share of women[3] on the executive and supervisory boards of the largest companies in Germany is calculated separately for different groups of companies. These include the 200 companies with the highest revenue in Germany outside the financial sector (top 200 companies), all companies listed in the German stock index (DAX companies) with four subgroups (DAX-30/40, MDAX, SDAX and TecDAX), all companies with direct federal participation, the 100 largest banks, and the 60 largest insurance companies.

In the first step of data collection, the companies and their membership to a company group must be determined. This is done using various sources:

- The **top 200 companies** are selected based on the publication "Die 100 größten Unternehmen" of the Frankfurter Allgemeine Zeitung, which is published annually in July. Contrary to what the title suggests, the publication includes the country's 200 largest companies by revenue in the fields of industry, trade and

[2] See most recently Sondergeld et al. (2024)

[3] In the context of the DIW Women Executives Barometer, a binary understanding of gender is used. The gender of the persons analyzed is determined using their first name, pronouns, and picture. So far, there were no cases of persons who were identified as non-binary in this way. However, the authors are aware that not every non-binary person makes their gender identity publicly known leading to a potential underrepresentation of non-binary persons in our data.

services, excluding the financial sector.[4] In the annual DIW Women Executives Barometer, both the top 200 and the top 100 companies on the list are analyzed separately.

- The groups of **companies listed in the German stock index DAX** (DAX-40/30[5], MDAX, SDAX, and TecDAX) are taken from the webpage of the Frankfurt stock exchange (`www.boerse.de`). We draw this information at the end of November each year.
- The **companies with direct federal participation** are taken from the most recently published Federal Participation Report (*Beteiligungsbericht des Bundes*).[6]
- The selection of the **100 largest banks** in terms of total assets is based on the annual ranking of the journal "die bank – Zeitschrift für Bankpolitik und Praxis".[7]
- The selection of the **60 largest insurance companies** in terms of premium income is based on a special evaluation by the Cologne Institute for Insurance Information and Business Services (KIVI). In addition, the largest reinsurance companies are integrated into this list from the most recently available reinsurance statistics published by the Federal Financial Supervisory Authority (BaFin).[8]
- The list of **companies subject to the gender quota** on the supervisory board is provided by the initiative Frauen in die Aufsichtsräte (FidAR) e.V. [9]

Using these different sources to identify major German companies, a company can belong to several groups of companies. Volkswagen, for example, was part of the top 100, the top 200, as well as the DAX-40 group in the 2024 edition of the DIW Women Executives Barometer.

[4]See most recently "Die 100 größten Unternehmen", Frankfurter Allgemeine Zeitung, supplement of 4 July 2024.

[5]Since September 20, 2021, the group of the largest listed companies has included 40 instead of 30 companies. Therefore, the index changed its name from DAX-30 to DAX-40. At the same time the MDAX was reduced from 60 to 50 companies.

[6]See website of the Federal Ministry of Finance, `https://www.bundesfinanzministerium.de/Web/DE/Themen/Bundesvermoegen/Privatisierungs_und_Beteiligungspolitik/Beteiligungspolitik/Beteiligungsberichte/beteiligungsberichte.html` (Last accessed: 15 November 2024).

[7]See most recently Kraus and Kuck (2023).

[8]See BaFin website, `https://www.bafin.de/DE/PublikationenDaten/Statistiken/Rueckversicherung/rueckversicherung_artikel.html` (Last accessed: 15 November 2024).

[9]This list also forms the basis for the Women on Board Index published by FidAR e.V., see FidAR website, `https://wob-index.de/` (Last accessed: 15 November 2024).

2.3 Data collection and sources

For each company, we collect the gender composition of the executive board and the supervisory board, i.e. the number of women and men on these boards, as well as the names of the CEOs (chairpersons of the executive board) and chairpersons of the supervisory board. The data is collected annually in the period from October to December for the publication of the Women Executives Barometer in January of the following year. For example, the data of the 2024 Women Executives Barometer was collected from October to December 2023.

Various sources are used to collect the data on a company's board composition in the following order:

- **Self-presentations of companies on the internet:** The preferred data source is the companies' websites, as these usually provide the most up-to-date information on board members. Information from the websites is either retrieved through web scraping or manually collected.
- **Company reports:** If no information on board composition is available on a company's website, the most recent annual reports, financial statements, or other company reports are consulted via the Bundesanzeiger. Companies are then contacted via email or telephone to confirm that the data from this source is up-to-date.
- **Federal Participation Report:** For companies with direct federal participation whose websites do not display the composition of their executive and supervisory boards, information from the most recently published Federal Participation Report is used. These companies are also asked via email or telephone to confirm that the data collected is up-to-date.
- **Direct inquiries to companies:** For companies where board composition data cannot be obtained from the sources above, the information is requested directly from the companies by email or telephone.

Companies whose executive and supervisory board members cannot be identified using these procedures are coded as missing in the dataset and excluded from the calculation of the share of women in the respective positions.

2.4 Structure of the data and variables

The resulting dataset is a panel that is unique at the company-year level. Each year, data is collected for approximately 500 companies. Since firms occasionally change their names or legal forms, an identifier is created to track a company over time. Each company is part of at least one of the groups (top 200 companies, DAX companies, top 100 banks, top 60 insurance companies, and companies with direct federal participation). Table 2.1 describes all variables included in the dataset, their encoding, and the frequencies for wave 2024. The respective tables for the waves 2015 to 2023 can be found in Sondergeld and Wrohlich (2024).

The frequencies of the variable *exec_board_size* (size of the executive board) shows that data on the composition of the executive board is available for most companies (527 out of 532 companies), less than 1 percent of the data on executive boards is missing.[10] For supervisory boards, the share of missing values is slightly higher at 6 percent (34 out of 532 companies, see variable *supervis_board_size*).

[10] Of the five companies, where data is missing, two explicitly informed us that they did not want to disclose any information.

Table 2.1: Description of variables of the DIW Women Executives Barometer 2024

Variable Name	**Description**	**Coding/Distinct Values**	**Frequencies**
company	Name of the analyzed company	String; 532 distinct values	One observation per distinct value: 532
id_company	Identification number of a company in the data over time	Integer; 532 distinct values	One observation per distinct value: 532
year	Year of the Women Executives Barometer publication	Integer; One distinct value (2024)	2024: 532
DAX40	Company is a part of the DAX-40 group as of the cut-off date in Nov 2023	Binary; 1: Listed in the DAX-40; 0: Not listed	1: 40; 0: 492
MDAX	Company is a part of the MDAX group as of the cut-off date in Nov 2023	Binary; 1: Listed in the MDAX; 0: Not listed	1: 50; 0: 482
SDAX	Company is a part of the SDAX group as of the cutoff date in Nov 2023	Binary; 1: Listed in the SDAX; 0: Not listed	1: 70; 0: 462
TecDAX	Company is a part of the TecDAX group as of the cutoff date in Nov 2023	Binary; 1: Listed in the TecDAX; 0: Not listed	1: 30; 0: 502
public	Company is a part of the group of companies with direct federal participation	Binary; 1: Part of group; 0: Not part	1: 69; 0: 463
top200	Company is part of the F.A.Z.-list of the top 200 largest German companies	Binary; 1: Part of the list; 0: Not part	1: 200; 0: 332
ranking_faz	Rank in the F.A.Z.-list of the top-200 largest German companies	Integer; 1-200; Missing: Not on the list	1-200: 200; Missing: 332
bank	Company is part of the group of the 100 largest German banks	Binary; 1: Part of the group; 0: Not part	1: 99; 0: 433
insurance	Company is part of the group of the 60 largest German insurances	Binary; 1: Part of the rgoup; 0: Not part	1: 60; 0: 472
supervis_board_quota	Company is affected by the supervisory board quota adopted in the FüPoG I	Binary; 1: Affected; 0: Not affected	1: 101; 0: 431
exec_board_quota	Company is affected by the minimum participation requirement for the executive board adopted in FüPoG II	Binary; 1: Affected; 0: Not affected	1: 63; 0: 469
exec_board_size	Total number of executive board members	Integer; 1-15: Number of persons; No info: company does not want to disclose any information; Missing: No information found	1-15: 527; No info: 2; Missing: 3
exec_board_men	Number of male executive board members	Integer; 0-12: Number of persons; Missing: For companies for which no information is available	0-12: 527; Missing: 5
exec_board_women	Number of female executive board members	Integer; 0-9: Number of persons; Missing: For companies for which no information is available	0-9: 527; Missing: 5
exec_board_chair_1	Name of the chairperson of the executive board/CEO	String: Name of person; No CEO: Company does not have a CEO; Missing: No info	One observation per name: 487; No CEO: 40; Missing: 5

(continued on next page)

Table 2.1 (continued)

Variable Name	Description	Coding/Distinct Values	Frequencies
woman_exec_board_chair_1	Gender of the CEO	Binary; 1: Woman; 0: Man; Missing: For companies for which no information is available and for companies without a CEO	1: 47; 0: 440; Missing: 45
exec_board_chair_2	In case of co-CEOs with equal status: Name of the second CEO	String: Name of person; Missing: For companies for which no information is available and for companies without a co-CEO	One observation per name: 6; Missing: 526
woman_exec_board_chair_2	Gender of the second CEO	Binary; 1: Woman; 0: Man; Missing: For companies for which no information is available and for companies without a co-CEO	1: 0; 0: 6; Missing: 526
no_ceo	Company does not have a CEO	Binary; 1: No CEO; 0: Has a CEO; Missing: No info	1: 40; 0: 487; Missing: 5
one_ceo	Company has one CEO	Binary; 1: Exactly one CEO; 0: Zero, two, or three CEOs; Missing: No info	1: 481; 0: 46; Missing: 5
two_ceos	Company has two CEOs with equal status	Binary; 1: Exactly two CEOs; 0: Zero, one, or three CEOs; Missing: No info	1: 6; 0: 521; Missing: 5
three_ceos	Company has three CEOs with equal status	Binary; 1: Exactly three CEOs; 0: Zero, one, or two CEOs; Missing: No info	1: 0; 0: 527; Missing: 5
names_exec_board_women	Names of all women on the executive board	String: List of names; Missing: No info or no women on executive board	One observation per distinct value: 287; Missing: 245
supervis_board_size	Total number of supervisory board members	Integer; 2-35: Number of members; No board: company does not have a supervisory board; Missing: For companies for which no information is available	2-35: 475; No board: 23; Missing: 34
supervis_board_men	Number of male supervisory board members	Integer; 0-28: Number of members; Missing: No info or no board	0-28: 475; Missing: 57
supervis_board_women	Number of female supervisory board members	Integer; 0-10: Number of members; Missing: No info or no board	0-10: 475; Missing: 57
supervis_board_chair	Name of the supervisory board chairperson	String: Name of person; Missing: No info or no board	One observation per name: 477; Missing: 55
woman_supervis_board_chair	Gender of the supervisory board chairperson	Binary; 1: Woman; 0: Man; Missing: No info or no board	1: 50; 0: 427; Missing: 55

Notes: Overview of variables, their coding and frequencies of each value for the 2024 wave of the DIW Women Executives Barometer. The respective tables for the waves 2015 to 2023 can be found in Sondergeld and Wrohlich (2024).

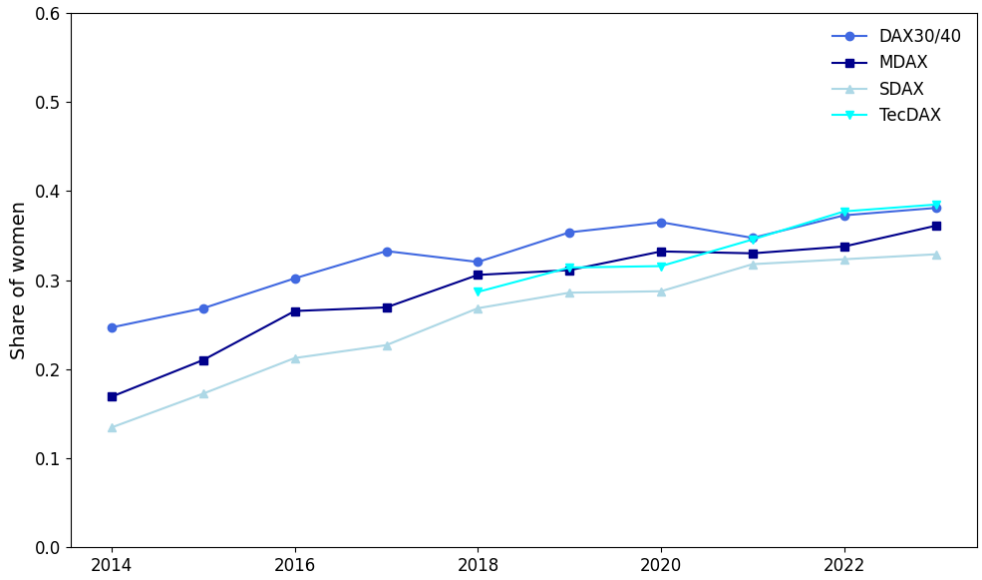
2.5 Women's representation on German company boards

The share of women on company executive and supervisory boards has increased across all groups of major German companies assessed in the DIW Women Executives Barom-

eter over the past years. However, representation remains far from parity in most places. Especially in executive and supervisory chair positions, women are still heavily underrepresented.[11]

Figure 2.1 shows the share of women among supervisory board members in the different groups of companies listed in the German stock index DAX (DAX-40/30, MDAX, SDAX, and TecDAX) from 2014 to 2023 (waves 2015 to 2024 of the Women Executives Barometer). Representation of women has increased across all DAX groups over time. For instance, among DAX-30/40 companies (the 30/40 largest German blue-chip companies), the share of women on supervisory boards rose from 25 percent in 2014 to 38 percent in 2023. Of the DAX groups, the SDAX has had the lowest representation throughout the observation period but has also experienced significant growth, from 13 percent in 2014 to 33 percent in 2023. By contrast, women's representation among supervisory board chairs remains low across the observation period, with values below 10 percent in all DAX groups as of 2023 (Figure 2.2).

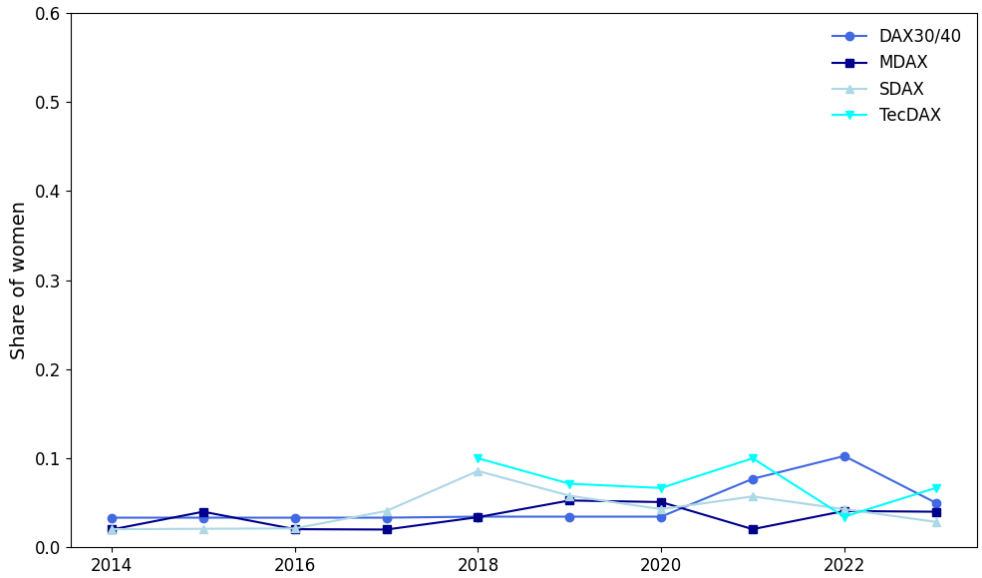
Figure 2.1: Women's shares among supervisory board members of DAX companies



Notes: Shares of women among supervisory board members for different groups of the largest German publicly listed (DAX) companies over time. Calculations based on published data from the DIW Women Executives Barometer 2015-2024. Data shown for each year is collected in November and then published in January of the following year.

[11] I focus on describing women's representation on boards in the DAX groups in this section, as data for these companies is available from 2014 to 2023 in the published dataset, whereas for the other groups, the the published data only starts in 2020. Historical data on women's shares in the other groups of companies can be found in the yearly reports of the Women Executives Barometer and is briefly mentioned for comparison here.

Figure 2.2: Women's shares among supervisory board chairs of DAX companies



Notes: Shares of women among supervisory board chairs for different groups of the largest German publicly listed (DAX) companies over time. Calculations based on published data from the DIW Women Executives Barometer 2015-2024. Data shown for each year is collected in November and then published in January of the following year.

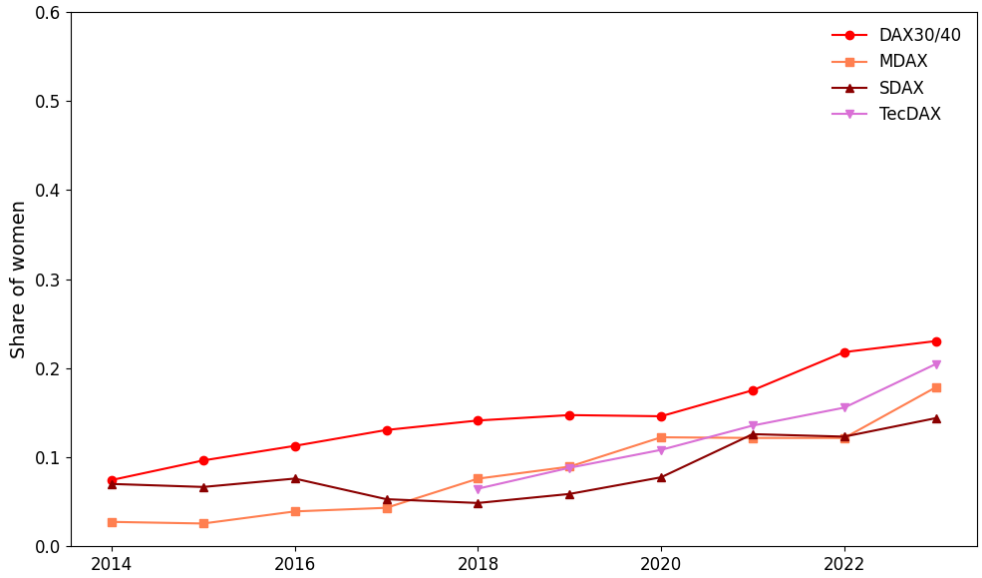
The increase in women's representation on supervisory boards observed in the different DAX groups is also seen in the other groups of companies assessed in the yearly Women Executives Barometer. For example, in the top 200 companies, the share of women on supervisory boards increased from 18 percent in 2014 to 32 percent in 2023. The least gender-equal supervisory boards are found in the finance industry, with women making up 27 percent of supervisory board members in banks and 29 percent in insurance companies in 2023.[12]

The share of women as executive board members has increased similarly over time, though at a lower level than for supervisory boards (Figure 2.3). The share of women on executive boards in DAX-30/40 companies rose from 7 percent in 2014 to 23 percent in 2023, maintaining a higher share than the other DAX groups throughout the observation period. In MDAX, SDAX, and TecDAX companies, the corresponding values are 18, 14, and 21 percent, respectively, in 2023. While the DAX-30/40 group has seen a large increase of more than 7 percentage points between 2020 and 2022 around the time of the introduction of the minimum participation requirement for executive boards, MDAX and TecDAX companies recently caught up in 2023, with increases of over 5 percentage points. A closer look at the distribution of female executive board members over companies (Table 2.A.1) shows that so far increases in women's repre-

[12]See the online appendix of Sondergeld et al. (2024) for the cited values.

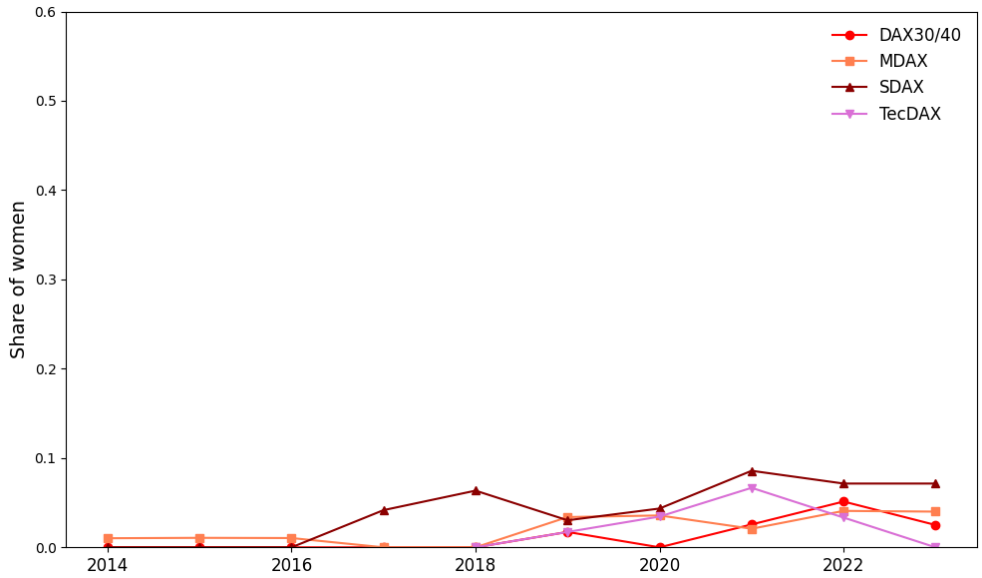
sentation on executive boards were to a large extent driven by companies appointing the first woman to their executive board. By 2023, most companies (46 percent) have exactly one woman on their executive board. Another 38 percent of companies still have no women on their executive board, while a comparably small share of companies (16 percent) have more than one female executive board member. Before 2016, there was exactly one female CEO in the group of MDAX companies, while there were none in the DAX-30/40 and SDAX groups (Figure 2.4). Since then, a small number of women have been appointed as CEOs in DAX companies. However, these increases have not always been stable over time, and in 2023, the share of women among CEOs remains below 10 percent in all DAX groups.

Figure 2.3: Women's shares among executive board members of DAX companies



Notes: Shares of women among executive board members for different groups of the largest German publicly listed (DAX) companies over time. Calculations based on published data from the DIW Women Executives Barometer 2015-2024. Data shown for each year is collected in November and then published in January of the following year.

Figure 2.4: Women's shares among executive board chairs of DAX companies



Notes: Shares of women among executive board chairs for different groups of the largest German publicly listed (DAX) companies over time. Calculations based on published data from the DIW Women Executives Barometer 2015-2024. Data shown for each year is collected in November and then published in January of the following year.

Women's representation on executive boards has developed similarly in the other groups of companies assessed in the yearly Women Executives Barometer reports. For instance, women's representation among executive board members has reached 18 percent in the top 200 companies in 2023, compared to just 5 percent in 2014. The highest share of women can be found in the group of companies with direct federal participation standing at 34 percent in 2023.[13]

2.6 Conclusion

Women remain significantly underrepresented in leadership roles, such as on company boards, and enhancing women's representation in these positions is considered a policy goal in many jurisdictions. In Germany as well, the gender gap in top leadership positions in the private sector has been debated intensely in recent years, leading to the introduction of a quota for supervisory boards and a minimum participation requirement for executive boards.

Reliable data forms the foundation for informed debate and evidence-based policymaking. With this data documentation, we make the data of the DIW Women Executives Barometer, the largest data collection on women's representation on ex-

[13] Again, see the online appendix of Sondergeld et al. (2024) for the cited values.

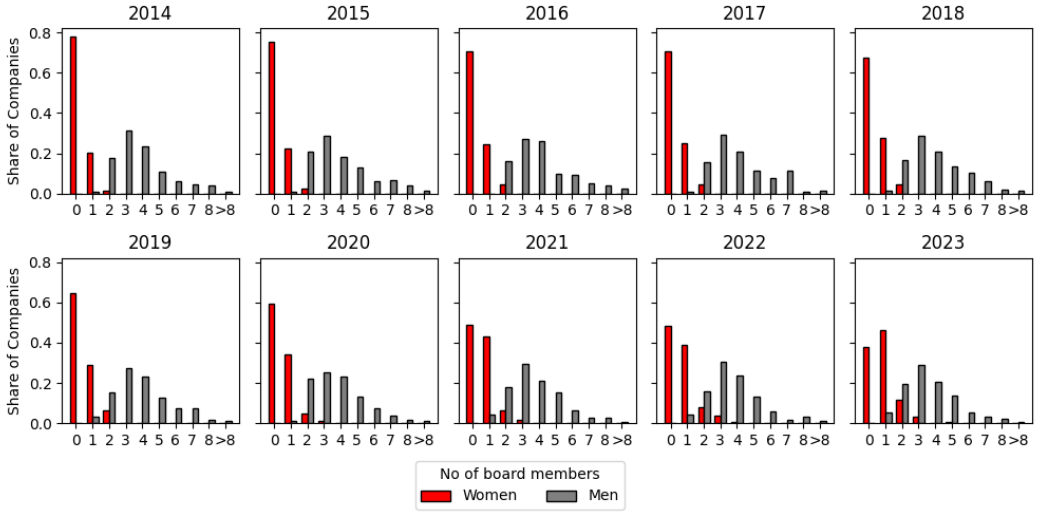
ecutive and supervisory boards in Germany, available for scientific research. We find that imbalances in gender representation on executive and supervisory boards remain across all groups of companies, with women's shares ranging from 33 to 38 percent on supervisory boards and from 14 to 23 percent on executive boards of the largest publicly listed companies as of the end of 2023. Representation is even lower among chairs of executive or supervisory boards, with figures below 10 percent across all groups.

The data presented here highlights that, despite gradual improvements over time, additional efforts from both companies and policymakers are needed to achieve equal participation of men and women in corporate leadership.

2.A Appendix

2.A.1 Additional figures

Figure 2.A.1: Distribution of companies over numbers of female and male board members over time



Notes: Shares of DAX companies with a certain number of women and men on their executive board by year. Calculations based on published data from the DIW Women Executives Barometer 2015-2024. Data shown for each year is collected in November and then published in January of the following year.

CHAPTER 3

Gender differences and stereotypes in newspaper coverage of company board members[1]

3.1 Introduction

Despite significant progress in women's integration into the labor market, women continue to be underrepresented in leadership roles such as in top management positions on company boards. For instance, the average women's share among executive board members of blue-chip companies across countries of the European Union stood at 24 percent as of June 2024. The respective EU-average women's share among CEOs was merely 8 percent (EIGE, 2024a). In Germany, where this study's data originates, representation increased over the past years but remains far from parity. As of fall 2023, women held 18 percent of executive board positions in the 200 largest German companies (Sondergeld et al., 2024).

A large body of research seeks to understand and quantify factors contributing to the persistent gender gap in leadership positions, examining obstacles that hinder women's advancement in their careers. These include career interruptions after childbirth (Bertrand et al., 2010; Kleven et al., 2024), the unequal distribution of non-market labor and the resulting demand for flexibility in working hours (Goldin, 2014; Samtleben and Müller, 2022; Wiswall and Zafar, 2018), differential access to networks (Cullen and Perez-Truglia, 2023; Hampole et al., 2024; von Essen and Smith, 2023) or labor market discrimination affecting women's career aspirations (Azmat et al., 2024). Additionally, gender stereotypes on the distribution of skills, social and occupational roles, and personality traits affect labor market decision-making both on the labor

[1]I gratefully acknowledge comments from seminar participants at the Center for Research in Economics and Statistics (CREST) and DIW Berlin. Alina Meiner has provided excellent research assisstance for the analyses in section 3.5.2.2.

supply and the labor demand side, creating barriers for women in attaining leadership positions. On the labor supply side, gender stereotypes affect individual career and occupational choices, investments in education and skills (Breda et al., 2023; Porter and Serra, 2020), the distribution of work within households (Couprie et al., 2020), or behavior in the workplace (Coffman, 2014). On the labor demand side, gender stereotypes may lead to biases and double-standards in hiring (Barron et al., 2024; Reuben et al., 2014), performance evaluation and promotion (Benson et al., 2024) and negative backlash for those who do not conform to them (Rudman and Phelan, 2008).

Newspapers and other media play an important role in transporting gender stereotypes in various contexts. How media consumption shapes attitudes and beliefs of individuals has been extensively researched in social and media sciences (Oppliger, 2007; Sink and Mastro, 2017). Studies have investigated stereotyped representation of women in political leadership positions in the media. More family-related personal coverage and reference to gender as well as physical appearance has been found for female politicians (see Van der Pas and Aaldering (2020) for a meta-analysis). Frequent references to women's families and caregiver roles were also found for female scientists (Eizmendi-Iraola and Peña-Fernández, 2022).

In this paper, I ask whether gender differences or stereotypes are present in newspaper coverage of company board members. I provide initial descriptive evidence on this question using quantitative text analysis, employing several tools from natural language processing (NLP) with a dataset of more than 45,000 articles from three major German newspapers. In a first exploratory analysis of the corpus using regularized regressions, I find that terms related to gender, family, and social interactions predict whether an article is about a woman. Conversely, terms associated with power and competition, with failure, scandals, and adversity are predictive of articles about men. A further analysis, using dictionary-based approaches, more explicitly investigates gender stereotypes related to career and family, as well as to agency and communion—the two most fundamental content dimensions in psychology that are closely related to gender stereotypes (Hsu et al., 2021). I employ both the term frequency-inverse document frequency that captures the quantitative importance of terms in articles as well as word embeddings that capture semantic relationships between terms. Supporting the evidence from the regularized regression and in line with gender stereotypes, I find that women are associated with family and men are associated with careers in the analyzed corpus. Further, I find evidence of agentic language - relating to stereotypically male traits such as success-orientation - being more prevalent for men, while communal language - relating to female stereotypes such as caregiving - is more associated with women.

In economics, gender stereotypes have traditionally been viewed as a form of statistical discrimination (Arrow, 1973; Phelps, 1972), where under asymmetric information an individual's traits are inferred using membership in a social group and beliefs about the aggregate distribution of traits within that group. These group-level beliefs are typically considered accurate in the sense that they are based on the actual aggregate distribution of traits within the social group. Recent work has broadened this view by drawing on concepts from social psychology[2] where stereotypes are seen as cognitive schemas facilitating information processing but do not always reflect true aggregate distributions (Bertrand, 2020). This raises the question whether the gender-stereotyped portrayal of board members in newspaper coverage is based on accurate beliefs about aggregate distributions and thus can be explained as a form of statistical discrimination or whether it reflects a bias. I consider two possible ways that observed gender differences might align with statistical discrimination. First, stereotypes in coverage could stem from an information asymmetry about female manager's characteristics due to their low number. If this were the case, stereotypical coverage would diminish over time as the number of women on boards increases, reducing this asymmetry. However, changes in the gender differences in newspaper coverage of company board members between 2010 and 2022 in the corpus of articles at hand are to a large extent not clearcut. Second, gender differences in coverage might reflect actual differences in characteristics of male and female managers. To assess this, I compare differences in newspaper coverage to distributions of family-related variables and previously unanalyzed data on psychological traits from the representative German Socioeconomic Panel (SOEP). I find that female managers have less children and are married less often than male managers, contradicting the stronger association of female managers with families in newspaper coverage. While I find that managers on average are more agentic than the general population, which is in line with agency being an important characteristic for succeeding in a leadership role, I do not find gender differences in agency in the population and among managers. Gender differences in communion in the general population are smaller or disappear for the subsamples of managers. Thus, the stronger association of agency with men and communion with women in board members' coverage does not align with actual gender differences in these traits among managers. In summary, there is little support that gender stereotypes in newspaper coverage of company board members can be explained by statistical discrimination.

This paper contributes to the growing literature using quantitative text analysis to assess gender biases and stereotypes in economic contexts (Ash et al., 2024; Baltrunaite et al., 2024; Damelang et al., 2024; Eberhardt et al., 2023). It is the first paper to

[2]See Ellemers (2017) for a review of this literature.

provide evidence on gendered language in newspaper coverage of corporate leaders. The paper further contributes to the literature on gender biases and stereotypes as barriers for women's careers progression and leadership (Beaman et al., 2009; Benson et al., 2024; Bertrand, 2020; Coffman, 2014). Analyzing gendered language in newspaper coverage of company board members, this is the first paper to assess in how far biases and stereotypes in media representation may play a role in explaining existing gender gaps in corporate management and how they may mediate the perception and impact of women as corporate leaders.

The remainder of the paper is structured as follows. Section 3.2 introduces the data. Section 3.3 describes the different steps of text preprocessing. Section 3.4 presents the methods and results of the text analysis. Section 3.5 relates the findings on gendered language from section 3.4 to statistical discrimination examining developments over time and comparing them to actual gender differences in characteristics of managers. Section 3.6 concludes.

3.2 Data

I analyze newspaper coverage of company board members using more than 45,000 articles from three prominent German daily newspapers, spanning the years 2010 to 2022. The sample includes articles that mention both the company name and the names of the chairpersons of the executive or supervisory boards, or the names of any female executive board members in the respective companies.

The group of companies assessed comprises all those listed in the three largest German stock market indices (DAX-30/40, MDAX, and SDAX) during the period from 2012 to 2022. The data on companies and board members is sourced from the annual DIW Women Executives Barometer, which is the most comprehensive data collection on women's representation on executive and supervisory boards of companies in Germany (Sondergeld and Wrohlich, 2024). In addition to the number of women and men on these boards in each year, the data includes the names of the chair persons of each board as well as the names of all women on the executive board.

Table 3.1 provides an overview of the numbers of chairpersons of executive and supervisory boards, as well as (non-chair) women on executive boards, and the number of articles related to individuals in each of these roles. Women are significantly underrepresented on boards of German companies, particularly as chairpersons, and this is reflected in the sample. In total, there are 15 (13) women as executive (supervisory) chairs in the sample compared to 373 (260) men. These numbers result in a gender

imbalance in the number of articles with 632 (360) articles mentioning women as executive (supervisory) chairs compared to 35,149 (11,860) for male executive (supervisory) chairs. There are further 2,187 articles on 111 women as executive board members in the data, resulting in a sample of 614 male and 127 female board members and 45,715 articles on men and 2,712 articles on women.[3]

Table 3.1: Numbers of observations of board members and articles

	Executive chairs	Supervisory chairs	Executive members	Total
Men	373	260		614
Women	15	13	111	127
Total - persons	388	273	111	741
Articles men	35,149	11,860		45,715
Articles women	632	360	2,187	2,712
Total - articles	35,781	12,220	2,187	48,427

Notes: Numbers of observations of board members and newspaper articles in the dataset by position and gender. The total numbers of observations (last column) do not match the sum of observations for the separate positions as some persons appear in several groups, e.g. first as executive chair and later as supervisory chair of the same company or as executive board member and later executive chair.

3.3 Data processing

In this section, I explain how I process the raw text of the newspaper articles and transform them into a dataset that can be analyzed using quantitative text analysis methods. All articles used are written in German. I describe all preprocessing steps using English translations of the texts, but provide examples from the original German texts in the appendix wherever useful.

3.3.1 Selecting relevant sentences

The focus of the analysis is on the newspaper coverage of company board members. Therefore, for each article, I restrict the analysis to sentences that either mention a board member's name or refer to their position (executive or supervisory board chair or executive board member) or a pronoun in the grammatical form that corresponds

[3]As heavily imbalanced data can be problematic in particular in estimating regularized regression such as LASSO (section 3.4.1), I further create a dataset taking a 10 percent random sample of articles on men for both executive and supervisory chairmen that I use for this analysis. The numbers of observations of the 10 percent subsample are shown in Table 3.A.1.

to the person's gender. Table 3.2 presents the different search terms used to pick the relevant sentences for the different combinations of board positions and gender.

Table 3.2: Translation of search terms to select relevant sentences from each article

	Man	**Woman**
Executive board chair	first and last names, *he*, *him*, *his*, *chair of the (executive) board* (male), *CEO*, *chief executive officer*, *boss* (male), *speaker of the board* (male), *manager* (male)	first and last names, *she*, *her*, *chair of the (executive) board* (female), *CEO*, *chief executive officer*, *boss* (female), *speaker of the board* (female), *manager* (female)
Supervisory board chair	first and last names, *he*, *him*, *his*, *chair of the supervisory board* (male), *supervisory board chair* (male), *boss* (male), *chief supervisor* (male), *speaker of the supervisory board* (male)	first and last names, *she*, *her*, *chair of the supervisory board* (female), *supervisory board chair* (female), *boss* (female), *chief supervisor* (female), *speaker of the supervisory board* (female)
Executive board member		first and last names, *she*, *her*, *member of the (executive) board*, *board member*, *manager* (female)

Notes: Lists of search terms that are used to select the relevant sentences that refer to a certain board member in an article by position and gender. The lists are translated to English, the original search terms in German can be found in Table 3.A.2 in the appendix. An example of the selection of relevant sentences from an article is provided in Figure 3.A.1.

The selection of relevant sentences using this procedure through search terms is not entirely accurate in picking only sentences that relate to the respective board member. For example, by searching for the pronoun *he*, any sentence referring to a man using that pronoun such as a sentence about a different board member than the one at hand or even some company-external male person may be picked from the text. Further, in German also objects have a grammatical gender: the word *der Löffel* (*spoon*) is grammatically male and is referred to using the pronoun *he*, while *die Gabel* (*fork*) is grammatically female and is referred to as *she*. Thus, a sentence where the pronoun *he* refers to an object with the German grammatical gender male is falsely selected when searching through articles on male board members. Similarly searching for the word *boss* (in German *chef* indicating a male boss or *chefin* indicating a female boss) could relate to a board member of a different company. All of these cases would imply false positive selection, i.e. sentences would be picked that actually should not be included in the dataset. However, excluding the terms *he* or *boss* from the list of search terms would result in a significant number of sentences describing the respective board member being missed, thereby leading to false-negative selection errors. Since

the word *boss* picks sentences only for bosses of the respectively correct gender due to the German gendered forms *chef* vs. *chefin* and the word *he* would pick mainly sentences about male individuals, such falsely positively selected sentences are unlikely to threaten the findings on gender differences in newspaper coverage of company board members as they would still align with the gender of the respective board member.

Through the selection of relevant sentences by person, an article that mentions more than one board member will at this point appear several times in the dataset, however, with a different set of relevant sentences referring to the respective person. The data is thus unique at the article-person level.

3.3.2 Text preprocessing

I follow standard procedures to preprocess the text of each article. For most preprocessing steps, I make use of tools available in the German-language pipeline package of the spaCy library in Python.[4]

First, I remove punctuation, special characters, numbers and capitalization, and divide the text into individual words (tokenization). All inflected words are then reduced to their grammatical root (lemmatization). This includes that nouns are reduced to their singular nominative case and verbs are reduced to their infinitive form.[5] I then remove all German-language stop words, which are sets of very commonly used words that typically carry little meaningful information.[6] Additionally, I remove company and organization names, person names, cities, countries and other geographical locations, as well as dates and times.

In German, most occupations and many words used to refer to a man or woman in a certain position are gendered (such as *Vorstand* for a male and *Vorständin* for a female executive board member). I merge all such words into a common form for all genders. For example, *Vorstand* and *Vorständin* would be merged into the common form *Vorständ_in*. This step is important for the empirical analyses to prevent that

[4] See `https://spacy.io/` (Last accessed: 17 November 2024).

[5] To reduce terms to a common root, lemmatization is relatively more time- and computing power-consuming compared to its alternative stemming, which simply cuts off prefixes and suffixes from a given term. However, the German language has a rich inflectional system with words changing their form based on grammatical features such as case, gender, number, and tense. Therefore, lemmatization leads to substantially more accurate results as it considers the context and grammatical structure of the sentence to determine the grammatical root of a term.

[6] Stop words contain, for example, articles like *a* and *the*, common and auxiliary verbs like *are* and *have*, or common conjuctions such as *and* and *or*. I combine the collections of German stopwords from Python's advertools (see `https://advertools.readthedocs.io/en/master/advertools.stopwords.html`, last accessed: 17 November 2024) and NLTK (see `https://www.nltk.org/search.html?q=stopwords`, last accessed: 17 November 2024) libraries.

these terms are associated with men or women solely because they capture the gender of the person referred to formally but have the same meaning otherwise.

For illustration, Figure 3.A.2 in the appendix shows an example of a raw text from an article and the same text after all preprocessing steps in German and an English translation. The preprocessed text is shorter than the original text due to the removal of stop words and other terms that do not carry any relevance related to gendered language as described above.

The set of articles is then reshaped into its term frequency-inverse document frequency (tf-idf) representation. The tf-idf representation is a numerical vector-form representation of a set of texts that captures how important each word is in a specific text compared to its importance in the entire corpus. Each text is represented as a vector of the size of the total number of words in the corpus. Each element of the vector contains the tf-idf value of a word, which divides how often a word appears in the respective text (the term frequency) by a measure of its frequency in all other texts of the corpus (the document frequency). The tf-idf representation is commonly used in NLP for tasks such as comparing texts through the distance between their tf-idf vectors or extracting topics from texts.

To describe the transformation of the set of articles into its tf-idf representation, I closely follow the notation of Eberhardt et al. (2023) in their analysis of gender differences in reference letters for female and male job market candidates in economics. As is standard practice in NLP, I refer to each article (reduced to the relevant sentences as described in section 3.3.1) as a document d, $d \in \{1, ..., D\}$. D denotes the total number of documents in the corpus. A document d has a length of N_d words. Each word is denoted as $w_i(d)$, $i \in \{1, ..., N_d\}$. Each word $w_i(d)$ is part of the set of terms $\{1, ..., T\}$, which contains all words in the corpus after dropping terms that are very rare or very common.[7] T is the total number of different terms in the corpus. For each term t and document d, the tf-idf is calculated as:

$$tfidf(t, d) = tf(t, d) \times idf(t) \tag{3.1}$$

The tf-idf consists of the product of the term frequency and the inverse document frequency.

[7] As is standard practice, I drop all words that appear in less than 1 percent of documents or in more than 70 percent of documents.

The term frequency $tf(t,d)$ is the number of occurrences of term t in document d:

$$tf(t,d) = \sum_{i}^{N_d} 1(w_i = t) \tag{3.2}$$

Thus, the term frequency $tf(t,d)$ indicates how important a term is in a document.

The inverse document frequency $idf(t)$ is the logarithmically scaled inverse fraction of the document frequency $df(t)$ of term t:

$$idf(t) = \log \frac{1+D}{1+df(t)}, \tag{3.3}$$

where document frequency $df(t)$ is the number of documents that contain the term:

$$df(t) = \sum_{d} 1(tf(t,d) > 0) \tag{3.4}$$

Thus, the inverse document frequency $idf(t)$ is high if a term appears only in a low share of documents in the corpus, i.e. indicates how unique a term is across all documents. In this way the tf-idf as the product of the term frequency and the inverse document frequency reflects the importance of a term in a document relative to the occurence of that term in the entire corpus.

Based on the tf-idf, I reshape the text data into a $D \times T$ matrix. Each row represents a document d, each column a term t and each cell contains the $tfidf(t,d)$ of a term t in the document d. This tf-idf matrix representation of the texts is then merged back to all meta data of the texts such as name, board position, company and gender of the person referred to as well as newspaper, title and date of the respective articles.[8]

3.4 Gender differences and stereotypes in newspaper coverage of company board members

Gender differences and stereotypes in newspaper coverage of company board members are analyzed borrowing different tools from NLP. First, I explore gendered patterns emerging in the data through regularized regression, which allows me to select terms that are the best predictors of the gender of a board member referred to in an article (section 3.4.1). Second, I more explicitly assess gendered language related to gender stereotypes by looking at differences in career- and family-related language (section

[8]Figure 3.A.3 in the appendix shows an excerpt of the tf-idf-transformed data.

3.4.2) as well as in agentic and communal language (section 3.4.3) using respective dictionaries in both tf-idf- and word embeddings-based approaches.

3.4.1 Detecting gender differences in prevalent terms using regularized regression

As an exploratory analysis without any priors on gender differences and stereotypes, I assess which terms in the newspaper coverage of board members are predictive of an article to be about a female versus a male board member using the tf-idf matrix representation of the corpus in regularized regressions.

The tf-idf matrix possesses more columns than rows as the number of terms in the corpus exceeds the number of documents ($T > D$). Further, the matrix is sparse, meaning that most of its elements are zero (see Figure 3.A.3). Given this high-dimensional data setting, applying conventional linear regression to determine which terms most effectively explain a target variable can be problematic. Conventional linear regression attempts to find the best-fitting line by minimizing the sum of squared residuals. However, when the number of predictors (terms) is larger than the number of observations (documents) and the predictors contain many zeros, the model can become overfitted and unreliable. To address this, one can use the absolute shrinkage and selection operator (LASSO) as a regularization technique. The LASSO estimator introduces a penalty term based on the absolute values of the coefficients ('L1' penalty term). In this way, it encourages sparsity in the model by shrinking some coefficients of less important predictors to exactly zero and keeping only those with the highest predictive power in the model. Using the tf-idf representation of the corpus, LASSO solves the problem:

$$\hat{\beta} = argmin_{\beta}\{\frac{1}{2D}\sum_{d=1}^{D}(Woman_d - \mathbf{x_d'}\beta)^2 + \lambda\sum_{j=1}^{p}|\beta_j|\} \tag{3.5}$$

$Woman_d$ is a dummy variable denoting whether the board member referred to in document d is a woman. x_d is the $1 \times T$ row vector of document d in the tf-idf matrix. λ is a tuning parameter that scales the L1 penalty, determining the size of the model, i.e. how many predictors should be kept in the model and how many should be shrunk to zero. The optimal λ is chosen through k-fold cross-validation to maximize predictive power of the model.[9]

[9]For k-fold cross-validation the dataset is divided into k subsets. The LASSO model is then repeatedly trained on $k-1$ subsets and validated on the remaining one, systematically testing different values for λ. The lambda that maximizes predictive power of the model as measured by minimizing the average mean-squared prediction error across all k-folds is then chosen to estimate the final model.

I estimate the LASSO regression separately for articles referring to supervisory or executive board members.[10] Estimating LASSO in a highly imbalanced sample in terms of the variable to be predicted, i.e. having many more articles on men than on women as board members, is problematic as LASSO minimizes the mean squared error over the entire sample. With imbalanced data this will lead to prioritizing terms that are predictive for the majority class, i.e. articles on men, and the model may miss important terms that are predictive of the minority class, i.e. articles on women. For this reason, I use a random sample of 10 percent articles on men to create a more balanced dataset (see Table 3.A.1 for the number of observations).

Figure 3.1 displays the English translations of all terms selected by the LASSO estimator to have predictive power for the gender of the person referred to in the articles separately for male and female supervisory and executive board chairs. The size of the font is scaled by the β-coefficient sizes indicating terms with higher or lower predictive power.

Several observations appear from Figure 3.1. First, terms that relate to gender (such as *woman*, *female*, and *first_ woman*) are more prevalent in articles on women. Further, terms that are related to family (such as *mother*, *child*, *heir/heiress*, and *daughter*) are associated more often with women. The only exception here is the word *patriarch*, a male head of a family, which is more prevalent for men and often used in the context of family businesses. Further, for women more terms capturing social interaction and involvement between individuals or groups are mentioned (*partner*, *to accompany*, *to share*, *support*, *to praise s.o.*, *together*). An exception here is the word *friend* that is more often used for men. Notably, however, for men the word *friend* is often negated (such as *has few friends at ...* or *will not get him new friends*) or used in ways not related to human interactions (such as *friend of China* or *friend of ... technology*).

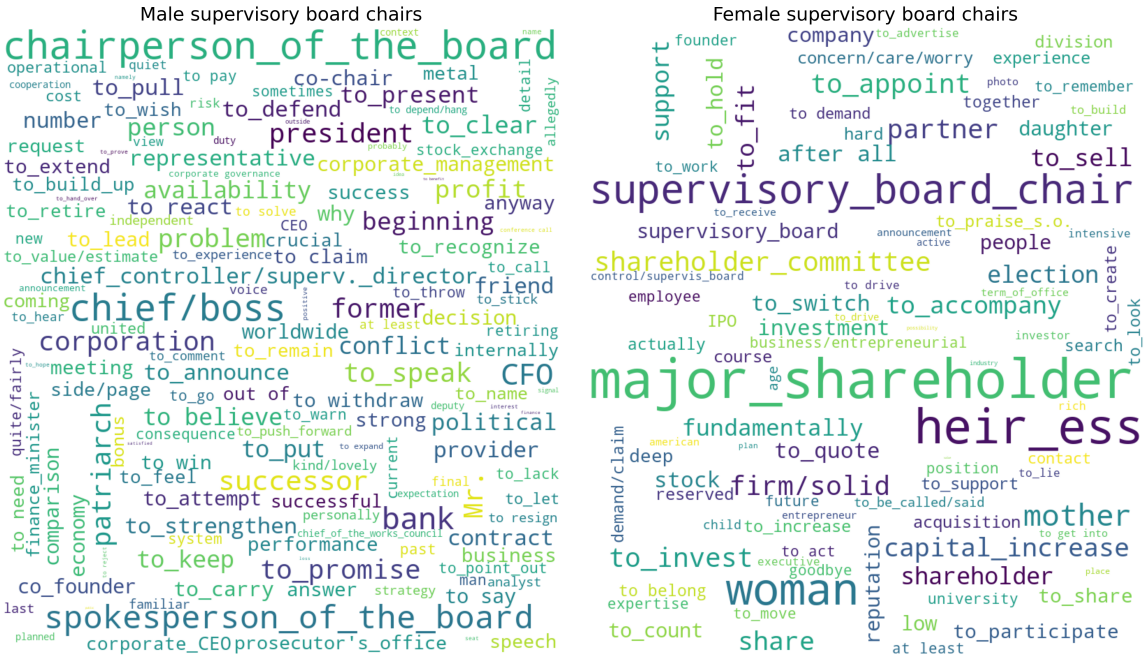
In contrast, terms related to power and competition (such as *boss*[11], *to win*, *profit/victory*, *strategy*, *game*, *to beat*, *to defend*) are predictive of an article being about a male board member. One exception here is the term *to fight*, which is more prevalent in articles on women. This term is however often used in relation to the abovementioned topics gender or and women's careers (such as *fight for equal opportunity*, *has always*

[10] The articles on women executive board members are not included in the LASSO regression since the dataset does not contain articles on male executive board members. If articles on female executives were included, all terms related to their board positions (e.g., chief financial officer or chief of staff) would be listed as predictors of the gender being female. However, this would be a purely mechanical effect, as there would not be any articles on male board members in such positions in the dataset and accordingly such terms would not be mentioned in association with men.

[11] The word referred to here is the German word *boss/bossin*. The German word *chef/chefin* is translated to English as *boss* also. However, *boss/bossin* is more informal than *chef/chefin* and often carries a stronger connotation of personal power and authority.

Figure 3.1: Non-zero coefficients from LASSO regression of gender on tf-idf matrix

(a) Supervisory board chairs



(b) Executive board chairs

Notes: English translation of terms with non-zero coeffiecients from LASSO regression of the gender of a person referred to in an article on the tf-idf matrix using a random sample of 10 percent of articles on men and all articles on women. The font of the terms is scaled by relative size of coefficients.

been fighting for what she wants to achieve). Further terms that are commonly considered negative and associated with failure, adversity and scandals (such as *to cancel*, *conflict*, *to criticize*, *criticism*, *loss*, *to withdraw*, *scandal*, and *pressure*) are mentioned more often for male board members.

The terms picked by LASSO provide an idea of topics and concepts associated with women and men as board members without imposing any priors on differences between male and female board members or stereotypes. Notably, the terms predictive of articles about women already suggest that their gender and gender stereotypes — such as the association of women with family, caregiving, and social orientation and men with power and competition — may be important. In the next sections, I will take a more explicit look at some of these gender stereotypes by examining language related to career and family, as well as the concepts of agency and communion, which are central to gender stereotypes in social psychology.

3.4.2 Gender differences in career vs. family language

Traditional gender roles associate men with careers, expecting them to be the primary breadwinners of a household, and associate women with family, expecting them to be primary caregivers and homemakers. I assess the presence of language related to these gender stereotypes in the newspaper coverage of company board members in two dictionary-based approaches employing the tf-idf representation as well as word embeddings. I employ the Linguistic Inquiry and Word Count (LIWC) dictionaries, which are human-validated and commonly used in linguistics, computer science, and NLP to measure the use of concepts and topics in texts.[12] Following Ash et al. (2024) in their analysis of gender-stereotyped language in judical opinions, I use the dictionaries for *family* and *work* to measure family- and career-related language, respectively.

Using the tf-idf representation, I measure the importance of career and family words in a document as the sum of the tf-idf of terms belonging to each the career and family dimensions. I then compare the average of this sum for documents referring to women compared to men as board members. Table 3.3 shows that career-related terms have a higher average sum of the tf-idf in articles on men (0.981 for women vs. 1.079 for men in the sample of all articles on supervisory, executive chairs, and all women as executive board members, subtable (a) in Table 3.3) while family-related terms have higher tf-idf in articles on women board members (0.121 for women vs. 0.041 for men). Importantly, the relative gender difference for family terms (96 percent) is much larger than for career terms (-10 percent). A reason for this is that overall the investigated

[12]See Meier et al. (2018) for a description of the German version of LIWC.

articles contain many more career-related terms than family terms as the articles are centered around topics in business and management. Exactly for the reason that these articles usually do not deal with family-related topics, the gender difference for these terms is particularly striking. The gender gap in family and career language persist in similar magnitudes also in the separate samples of supervisory or executive board chairs (subtables (b) and (c)).

Table 3.3: Average sum of the $tfidf(t, d)$ of career and family terms in articles by gender

(a) Supervisory and executive board chairs and executive board women

	Men	Women	Difference	Difference in percent
Career	1.079	0.981	-0.0972***	-9.9
Family	0.0411	0.121	0.0803***	95.8
Observations	48,452			

(b) Supervisory board chairs

	Men	Women	Difference	Difference in percent
Career	1.037	0.938	-0.0993***	-10.6
Family	0.0556	0.111	0.0555***	94.1
Observations	12,244			

(c) Executive board chairs

	Men	Women	Difference	Difference in percent
Career	1.081	0.999	-0.0818***	-8.2
Family	0.0377	0.141	0.103***	96.2
Observations	35,773			

Notes: Average sum of the $tfidf(t, d)$ of career and family terms in articles referring to male or female board members in the entire dataset and subsamples of supervisory and executive board chairs.

The advantage of the tf-idf-based approach is that it is easy to implement, computationally efficient, and the results are readily interpretable. However, word-count based approaches like the tf-idf disregard the semantic relationships between terms. This means that the tf-idf treats each word as an independent entity without considering its meaning or the context in which it appears. Consequently, the tf-idf cannot capture the nuanced relationships between words that go beyond simple co-occurrence or frequency patterns. A technique from NLP that preserves semantic relationships between words

are word embeddings. Word embeddings, such as those introduced by Mikolov et al. (2013), represent each term as a vector in a continuous space. These vectors are of a predetermined dimension and are generated based on the context in which words are used within a given corpus. The core idea is that words appearing in similar contexts will have similar vector representations, and the proximity and relative position of these vectors in the vector space capture their semantic similarity. For example, words that are used frequently in similar contexts, like *king* and *queen*, will have vectors that are close together in the vector space. This closeness indicates that these words share a semantic relationship, such as both being royalty terms. Furthermore, the distance and relative position between different word pairs is similar if their semantic relationships to other word pairs are determined by the same underlying concept. For example, the vectors $\overrightarrow{man}$ and $\overrightarrow{woman}$ would hold a similar relative position towards each other as the words $\overrightarrow{king}$ and $\overrightarrow{queen}$ or the words $\overrightarrow{chairman}$ and $\overrightarrow{chairwoman}$ since each of these word pairs' relative position is determined by the underlying concept gender.

I use word embeddings as a second approach to measure the association of women with family and men with career in the newspaper coverage of company board members. I train word embeddings using the Word2vec algorithm separately for articles on supervisory and executive board chairs and for all articles together including those on women executive board members.

I then follow Ash et al. (2024) in measuring the association of men with career and women with family as the cosine similarity of the two vectors defining the gender and the career/family dimension in the corpus of newspaper articles. The gender dimension is identified as the difference between the average vector representation of the ten[13] most common terms in the LIWC male and the female dictionaries:

$$\overrightarrow{mf} = (\overrightarrow{male} - \overrightarrow{female}) = \frac{\sum_n \overrightarrow{maleword}_n}{N_m} - \frac{\sum_n \overrightarrow{femaleword}_n}{N_f} \tag{3.6}$$

Similarly, the career/family dimension is defined as $\overrightarrow{cf} = (\overrightarrow{career} - \overrightarrow{family})$ based on the ten most common terms of the LIWC dictionaries. To measure the association of men with career and women with family, I investigate whether the male and female vectors have a similar relative position to each other as the career and family vectors by calculating the cosine similarity of the vectors $(\overrightarrow{male} - \overrightarrow{female})$ and $(\overrightarrow{career} - \overrightarrow{family})$:

[13] I follow Ash et al. (2024) here, but as a robustness check repeat the exercise also using the five or 15 most common terms (Table 3.A.3). Further, I use the Word2vec default vector size of 100 but also repeat the analysis with a vector size of 300 that is used in this paper as a robustness check (Table 3.A.4).

$$\text{sim}(\overrightarrow{mf}, \overrightarrow{cf}) = \frac{\overrightarrow{mf} \cdot \overrightarrow{cf}}{\|\overrightarrow{mf}\| \cdot \|\overrightarrow{cf}\|} \tag{3.7}$$

$\text{sim}(\overrightarrow{mf}, \overrightarrow{cf})$ varies between -1 and 1, the closer it is to 1 the stronger men are associated with careers and women with family in the corpus of articles. A value of 0 indicates no association and negative values indicate that men are associated with family and women are associated with careers.

Table 3.4 displays the cosine similarities of the gender and career/family dimensions $\text{sim}(\overrightarrow{mf})$ from word embeddings trained on the corpi of articles on supervisory board chairs, executive board chairs and all supervisory and executive board chairs as well as the entire dataset. All of the cosine similarities are positive varying between 0.11 and 0.37 indicating that male terms are associated more with career terms and female terms are associated more with family terms. Compared to the distribution of cosine similarities found in Ash et al. (2024) for different judges, the found association is moderate (in the lower third of the distribution).

Table 3.4: Cosine similarity of gender and career/family dimensions

Supervisory chairs	0.37
Executive chairs	0.12
Executive and supervisory chairs and executive board women	0.11

Notes: Cosine similarities of the vectors capturing the gender dimension ($\overrightarrow{mf}$) and the career/-family dimension ($\overrightarrow{cf}$) using word embeddings trained on articles referring to different groups of board members. A positive cosine similarity indicates that an association of male terms with career terms and of female terms with family terms.

3.4.3 Gender differences in agentic vs. communal language

Psychology has identified agency and communion ('The Big Two') as the two broadest dimensions underlying the content of self and social perception (Abele and Wojciszke, 2018; Martin and Slepian, 2017). While the dimension agency refers to goal-pursuit and achievement orientation, i.e. the existence of a person as an individual striving to be independent, the dimension communion refers to a person's social- and service-orientation, i.e. the strive for building relationships, and emphasizes the existence of an individual as part of a larger organism or community. The two dimensions are also sometimes labelled as 'getting ahead' vs. 'getting along' (Hogan, 1982). The Big Two were originally developed to capture masculine traits and feminine traits and thus are closely related to gender stereotypes, where agency maps onto the stereotypical

male role and communion maps onto the stereotypical female role (Hsu et al., 2021). However, agentic traits are also those that are seen as valuable or even required to succeed in a leadership position. Therefore the stereotypical association of men with agency and women with communion creates gendered expectations on the distribution of skills required for success in managerial roles (Lawson et al., 2022).

I analyze whether gender stereotypes on agency and communion are transported in newspaper coverage of company board members. For this, I employ the dictionary developed by Pietraszkiewicz et al. (2019) measuring the manifestation of agency and communion in language. Agency in the dictionary is captured by terms such as *ambition**, *earn**, *goal**, *importan**, or *independ**, while communal language includes terms such as *accept**, *care**, *contribut**, *human**, or *request**.[14] Analogously as for career and family, I calculate the average sum of the tf-idf for both agentic and communal terms in articles referring to women compared to men as board members.

Table 3.5 shows that in the sample of all articles on supervisory, executive chairs and all women as executive board members on average documents referring to women as board members contain less agentic language than those on men (0.112 for women compared to 0.135 for men), while documents on women contain more communal language (0.133 for women compared to 0.111 for men). This finding also holds for the separate subsamples of supervisory and executive board chairs. Considering the size of the gender difference, the gap in agentic language of -21.3 percent is similar to the one found for job advertisements of male- and female-dominated occupations in Pietraszkiewicz et al. (2019), the difference in communal language of 15.9 percent is comparably smaller.[15]

Analogously to the career/family dimension, I also use the trained word embeddings to compute the cosine similarity of the two vectors defining the gender and the agency/communion dimension. Table 3.6 shows that the cosine similarity is positive varying between 0.12 and 0.26 for all three corpi indicating that male terms are associated with agency while female terms are associated with communion.

[14] Since the newspaper articles in the dataset are in German, I translate all terms in the dictionary to German using ChatGPT.

[15] As Pietraszkiewicz et al. (2019) considers the share of agentic vs. communal terms instead of the tf-idf, I calculate the gender difference also in terms of this normalized word count measure as a robustness check (Table 3.A.5) finding the results to persist but again to be relatively small compared to the job advertisements analyzed in this paper.

Table 3.5: Average sum of the $tfidf(t, d)$ of agentic and communal terms in articles by gender

(a) Supervisory and executive board chairs and executive board women

	Men	Women	Difference	Difference in percent
Agency	0.135	0.112	-0.0238***	-21.3
Communion	0.111	0.133	0.0211***	15.9
Observations	48,452			

(b) Supervisory board chairs

	Men	Women	Difference	Difference in percent
Agency	0.122	0.0883	-0.0340***	-38.6
Communion	0.0971	0.133	0.0358***	27.0
Observations	12,245			

(c) Executive board chairs

	Men	Women	Difference	Difference in percent
Agency	0.136	0.113	-0.0236**	-20.9
Communion	0.0805	0.0974	0.0169**	17.3
Observations	35,880			

Notes: Average sum of the $tfidf(t, d)$ of agentic and communal terms in articles referring to male or female board members in the entire dataset and subsamples of supervisory and executive board chairs.

Table 3.6: Cosine similarity of gender and agency/communion dimensions

Supervisory chairs	0.26
Executive chairs	0.12
Executive and supervisory chairs and executive board women	0.12

Notes: Cosine similarities of the vectors capturing the gender dimension ($\overrightarrow{mf}$) and the agency/communion dimension ($\overrightarrow{ac}$) using word embeddings trained on articles referring to different groups of board members. A positive cosine similarity indicates that an association of male terms with agentic terms and of female terms with communal terms.

3.5 Relation to stereotypes as a form of statistical discrimination

The analysis of newspaper coverage of company board members in section 3.4 revealed gender differences consistent with gender stereotypes. Specifically, women are more associated with family and communion, while men are more associated with careers and agency.

In economics, gender stereotypes have traditionally been viewed as a form of statistical discrimination (Arrow, 1973; Phelps, 1972). In models of statistical discrimination, differential treatment of individuals occurs when, under asymmetric information about an individual's traits, these are inferred using membership in a social group and beliefs about the aggregate distribution of traits within that group (Bertrand, 2020). These group-level beliefs are typically considered accurate in the sense that they are based on the actual aggregate distribution of traits within the social group. Thus, the view of gender stereotypes as a form of statistical discrimination implies that they are rooted in genuine aggregate differences between men and women. For example, the association of women with family and men with careers, while potentially inaccurate for any given individual, could be rationalized within this framework if, on average, women tend to assume more family responsibilities, whereas men more frequently serve as primary earners. In contrast, social psychology[16] emphasizes that stereotypes are cognitive schemas facilitating information processing, but that they may be biased in the sense that they may not accurately reflect true aggregate distributions. Stereotypes could be rooted in history or stem from individuals overgeneralizing their personal experiences with a social group, rather than relying on true aggregate distributions of the group's characteristics. Furthermore, it is stressed that relatively small between-group differences may be exaggerated in cognitive processing, while larger within-group variation is discounted.[17]

This raises the question whether the gender-stereotyped portrayal of board members in newspaper coverage is based on accurate beliefs about aggregate distributions and thus can be explained as a form of statistical discrimination or whether it reflects a bias. I assess two ways the found gender differences could be in line with statistical discrimination: First, due to the low number of women as company board members, there may be an information asymmetry about the characteristics of female managers. Consequently, beliefs about female board members' characteristics and resulting gender differences in newspaper coverage may reflect distributions of characteristics of men and

[16] See Ellemers (2017) for a review of this literature.
[17] See literature on the *gender similarities hypothesis* (Hyde, 2005, 2014; Zell et al., 2015).

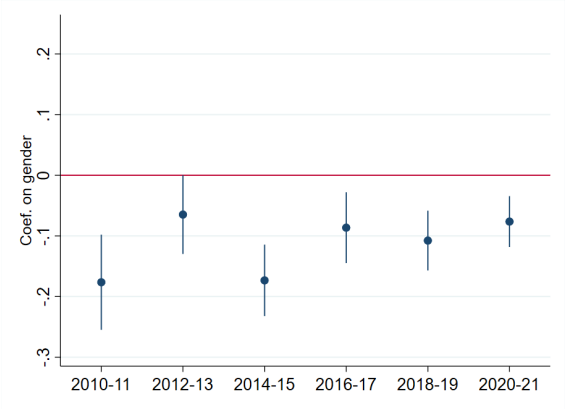
women in the general population, but not necessarily those of the subgroup of managers. If the gender-stereotyped coverage stems from statistical discrimination in this way, one would expect stereotypical coverage to diminish over time as more women attain board roles and the information asymmetry about their characteristics decreases. In section 3.5.1, I analyze changes in language over time to investigate this possibility. Second, gender differences in newspaper coverage may accurately reflect actual distributions of male and female managers' characteristics. To evaluate this, one would like to know: are there differences in family status between men and women on boards that explain the stronger association of family-related language with female board members? And are women on boards genuinely less agentic and more communal than their male colleagues? While such data is not available for German board members specifically, the representative German Socio-Economic Panel (SOEP) provides relevant information on individuals in leadership roles. In section 3.5.2, I compare the differences in newspaper coverage to actual distributions of family-related variables and previously unanalyzed psychological traits from the SOEP.

3.5.1 Changes in language over time

To examine whether gender stereotypes in newspaper coverage might result from statistical discrimination due to information asymmetry about female board members' characteristics, I analyze changes in language over time. The model would predict that gender stereotypes in coverage should diminish as the number of women on company boards has steadily increased over the past decade, reducing information asymmetry about their characteristics. Specifically, I investigate how gender differences in career- and family-related language, as well as in agentic and communal language, have evolved over time.

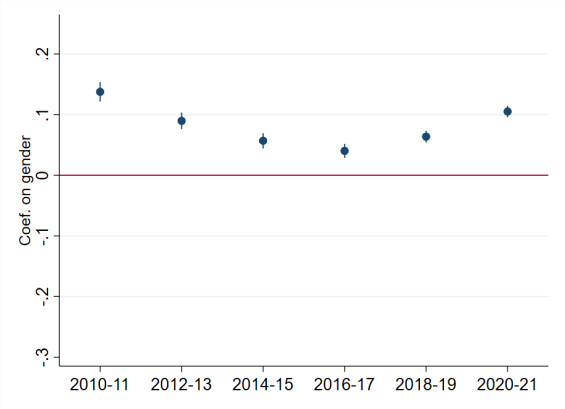
I compute the gender difference in the average sum of the tf-idf of career and family terms as well as agentic and communal terms for six two-year windows from 2010-11 to 2020-21 for the sample of articles on all supervisory and executive board chairs as well as executive board women. Figure 3.2 shows a slight decrease in the gap in career language since 2014-15 but no clear trend when considering the entire observation period, for family terms the positive gender difference (i.e. more family-related terms for women) decreased between 2010-11 and 2016-17 but since then has increased again (Figure 3.3). While for agentic language (Figure 3.4) the gender gap persists but is slightly smaller in the second half of the observed time period, for communion no clear trend is observed. Overall, there is no evident decrease in gender differences in stereotype-related language over time.

Figure 3.2: Gender difference in career terms over time



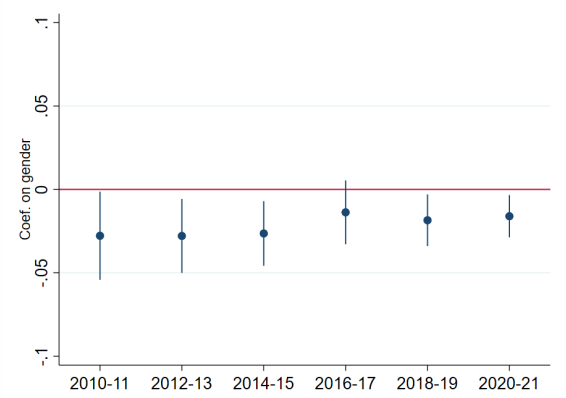
Notes: Difference in the average sum of the $tfidf(d,t)$ of career terms in articles referring to male or female board members over time in two-year windows from 2010 to 2021. A positive coefficient indicates a higher average sum of the $tfidf(d,t)$ for articles on women.

Figure 3.3: Gender difference in family terms over time



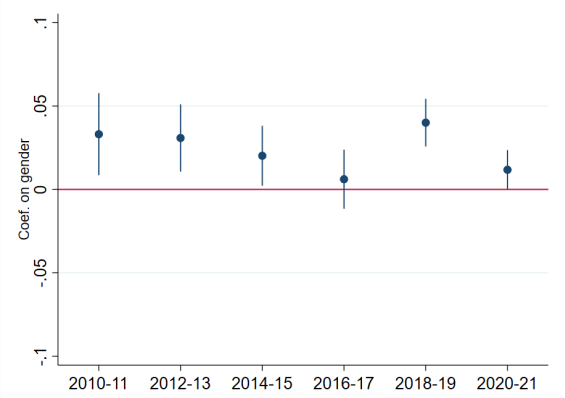
Notes: Difference in the average sum of the $tfidf(d,t)$ of family terms in articles referring to male or female board members over time in two-year windows from 2010 to 2021. I positive coefficient indicates a higher average sum of the $tfidf(d,t)$ for articles on women.

Figure 3.4: Gender difference in agentic terms over time



Notes: Difference in the average sum of the $tfidf(d,t)$ of agentic terms in articles referring to male or female board members over time in two-year windows from 2010 to 2021. A positive coefficient indicates a higher average sum of the $tfidf(d,t)$ for articles on women.

Figure 3.5: Gender difference in communal terms over time



Notes: Difference in the average sum of the $tfidf(d,t)$ of communal terms in articles referring to male or female board members over time in two-year windows from 2010 to 2021. A positive coefficient indicates a higher average sum of the $tfidf(d,t)$ for articles on women.

3.5.2 Comparison to actual distributions

To assess whether the found gender differences in newspaper coverage reflect actual distributions of characteristics of male and female managers correctly, I investigate the distribution of several variables that are related to family status as well as measuring agency and communion among men and women in the general population versus subsample of individuals in leadership positions. For family status, I use the longitudinal

data of the German Socio-Economic Panel (SOEP), which is a representative yearly survey of German households and provides a broad set of demographic and employment variables (Goebel et al., 2019). For agency and communion, I use psychometric data from the SOEP Innovation Sample (SOEP-IS), which so far has not been analyzed.[18]

I calculate the gender differences in the respective variables both for the whole sample of the SOEP as well as for subsamples using different definitions of corporate leadership roles similar to board positions. In this way, I aim to investigate gender differences in the population compared to the (self-)selected group of individuals in managerial roles. As described above, a stereotype may be rooted in a belief about gender differences in a characteristics that may be correct on average for the entire population but may be incorrect on average for gender differences between men and women conditional on them being part of the subgroup of individuals in managerial roles. A first definition of individuals in managerial roles is based on a question from the SOEP questionnaire asking whether the individual in their job is in a leadership position. A second definition is based on the on the classification of the individual's occupation according to the German Classification of Occupations (KldB 2010)[19] or the International Standard Classification of Occupations (ISCO-88)[20].

3.5.2.1 Family status

To assess the family status of men and women in the sample, I consider their marital status as well as the presence of children in the household. Figure 3.6 shows that in the entire SOEP sample, women are slightly less often married than men (49 vs. 52 percent in 2020). This difference, however, is substantially larger for both definitions of managers: a share of 48 to 51 percent of women in leadership positions in the sample are married in 2019/20, while a share of 61 to 69 percent of men in these groups are married. All differences are statistically significant ($p < 0.05$).

Similarly, while on average slightly more women have children living in their household in the general population (23 percent for men and 25 percent for women in 2020, difference not statistically significant), a higher share of male managers (35 percent) has children living in their households than of female managers (24 to 28 percent) in

[18] The SOEP Innovation Sample is a representative dataset used for short-term experiments and innovative survey modules (SOEP Innovation Sample (SOEP-IS), data from 1998-2021. 2023. DOI: `10.5684/soep.is.2021`). The data on the module 'The Big Two - Agency and Communion' was collected once in the year 2012.

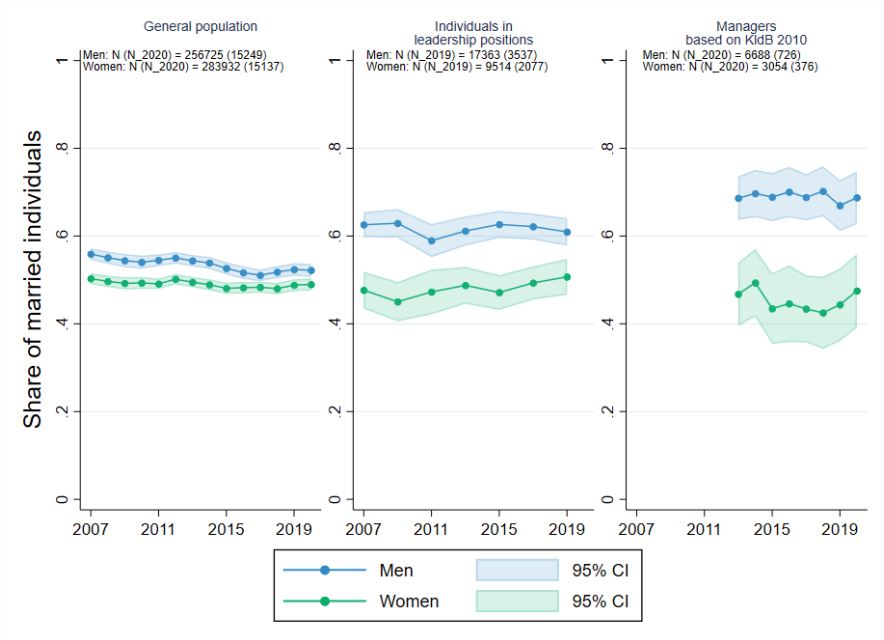
[19] Managers in the KldB 2010 can be identified using the 4th digit of the occupation.

[20] Managers in the ISCO classification can be identified using the 1st digit of the occupation. The newer KldB 2010 is only included in the SOEP data from 2013 onwards. Therefore, I rely on the older ISCO-88 classification for the 2012 SOEP-IS data.

2019/20 (Figure 3.7) Also conditional on having children, male managers on average have slightly more - however not in all years statistically significantly more - children (Figure 3.A.4).

Taken together, these gender differences in marital status and the presence of children in the household suggest that the newspaper coverage of company board members associating women more strongly with family does not accurately reflect average differences in family status among men and women in managerial roles.

Figure 3.6: Share of married men and women in general population and samples of managers



Notes: Share of married men and women by year in the whole sample of the German SOEP and in subsamples of managers identified by the SOEP survey question whether the individual in their job is in a leadership position or using the 4th digit of the KldB 2010 Classification of Occupations.

Figure 3.7: Share of men and women with kids below 18 in the household in general population and samples of managers

Notes: Share of men and women with kids below 18 living in the household by year in the whole sample of the German SOEP and in subsamples of managers identified by the SOEP survey question whether the individual in their job is in a leadership position or using the 4th digit of the KldB 2010 Classification of Occupations.

3.5.2.2 Agency and communion

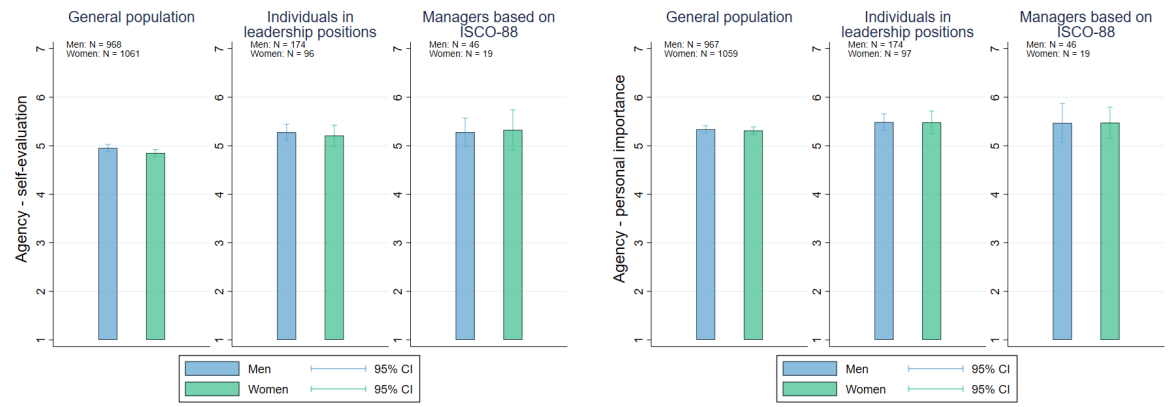
I use the SOEP-IS from 2012 to assess gender differences in agency and communion in the general population and in the subgroup of individuals in managerial roles. The SOEP-IS measures agency and communion through several items such as *competence* and *capability* for agency and *warm-heartedness* and *empathy* for communion. For each item, individuals are asked how they evaluate themselves on a scale from 1 to 7 as well as how important the item is for them personally on a scale from 1 to 7. The items measured have been used in similar compositions in a range of studies in social psychology (see, e.g., Abele et al. (2008); Gebauer et al. (2013); Trapnell and Paulhus (2012)). The items are highly internally consistent with Cronbach's alpha ranging between 0.77 and 0.91 (Table 3.A.6), indicating that the underlying concepts agency and communion are consistently measured. To get an aggregated scale of agency and communion for each individual, I calculate the average over agentic and communal items, again separately for self-evaluation and personal importance.

Men evaluate themselves as slightly but not significantly more agentic in the general population and there are no significant gender differences in agency for individuals in

managerial positions. For personal importance there are also no gender differences in the general sample as well as both samples of managers (Figure 3.8). It can also be seen, though, that both men and women in leadership positions evaluate themselves as more agentic than in the general population and agency is also slightly more personally important to individuals in leadership positions than in the general population. This is in line with the notion that agency is an important characteristic for being successful in a leadership position.

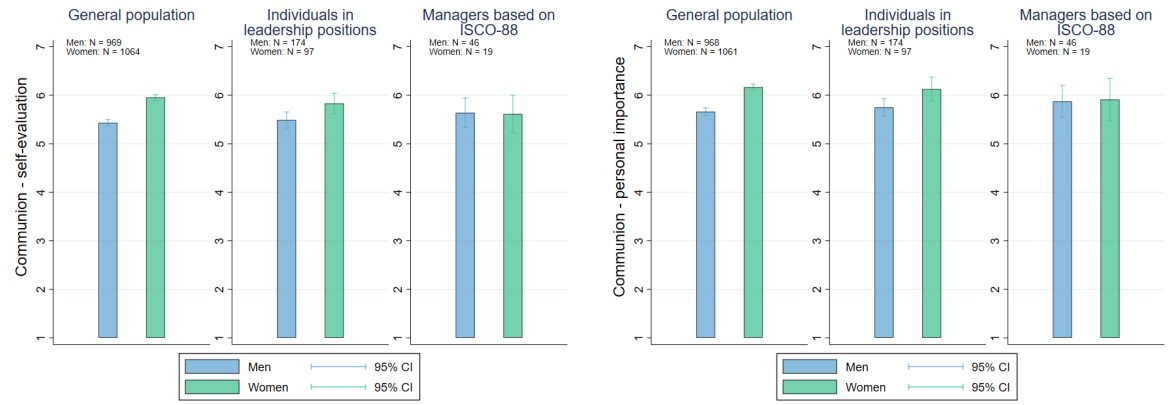
Figure 3.9 shows that women evaluate themselves as more communal than men and that communion is also more important for women than for men in general population. These differences in communion persist but are smaller and only marginally significant ($p < 0.1$) for individuals in leadership positions and completely disappear for managers based on the ISCO classification.

Figure 3.8: Self-evaluation and personal importance of agency of men and women in general population and samples of managers



Notes: Self-evaluation and personal importance of agency of men and women in the whole sample of the German SOEP and in subsamples of managers identified by the SOEP survey question whether the individual in their job is in a leadership position. The 4th digit of the KldB 2010 Classification of Occupations could not be used for the identification of managers as it is only available from 2013 onwards.

Figure 3.9: Self-evaluation and personal importance of communion of men and women in general population and samples of managers



Notes: Self-evaluation and personal importance of communion of men and women in the whole sample of the German SOEP and in subsamples of managers identified by the SOEP survey question whether the individual in their job is in a leadership position. The 4th digit of the KldB 2010 Classification of Occupations could not be used for the identification of managers as it is only available from 2013 onwards.

Based on the analysis of the SOEP-IS data on agency and communion, I conclude that the use of language related to agency and communion in board members's newspaper coverage to a large extent is not in line with average gender differences in agency and communion among individuals in managerial positions. In summary, the findings from this and the previous sections do not support the idea that gender differences and stereotypes in newspaper coverage of company board members can be explained by statistical discrimination. Instead, they suggest that female board members are portrayed in ways that do not align with the actual distribution of their characteristics and that exposure to more women attaining board positions over time did not lead to a decrease in this bias.

3.6 Conclusion

This paper presents initial evidence on gender differences and stereotypes in the newspaper coverage of company board members using quantitative text analysis. Regularized regressions show that terms related to gender, family, and social interactions are predictive of an article being about a woman, while terms associated with power and competition as well as failure, scandals, and adversity are more prevalent for men. Assessing gender stereotypes more explicitly in dictionary-based analyses employing both the tf-idf-representation capturing the quantitative importance of terms as well as word embeddings measuring semantic relationships between terms, I find evidence for stereotypes of associating men with careers and women with families in the articles

at hand. Further, stronger use of agentic language is found for men and stronger use of communal language for women. No clear-cut trends in these gender differences in newspaper coverage are found over the past decade. Using data from the German Socio-Economic Panel, I find that women in managerial roles are less often married and less often have children compared to male managers and compared to the general population. There is no strong evidence for either men or women in managerial roles to be more agentic, and while women in the general population are more communal than men, these differences are smaller or disappear in the subgroup of managers. Thus, the gender differences in newspaper coverage of company board members to a large extent do not seem to be founded on actual differences in characteristics of women and men in these positions and do not diminish with increased exposure to female board members, providing little support for an explanation based on statistical discrimination.

Increasing women's representation on corporate boards is a policy goal in many jurisdictions.[21] In this light, the findings of this study raise the question how the stereotypical representation of female board members in newspapers affects readers' beliefs about the competences of the respective persons and their success as leaders. Further, is has not yet been investigated if such potentially gendered beliefs on competence induced by gendered newspaper coverage affect economic decision-making, such as investment in a firm or hiring decisions, in ways that constitute barriers for women to attain managerial roles and perpetuate existing gender gaps. On the one hand, for example, a representation as less agentic could send a signal to individuals that women are less suited for leadership roles than men as agency is considered to be a required skill to succeed in leadership roles. On the other hand, role congruity theory (Eagly and Karau, 2002) would suggest that a more counter-stereotypical representation of women as more agentic or more career-driven could create negative backlash and make them appear less likable as a leader. These questions could be addressed, for instance, in incentivized experimental settings and provide avenues for future research.

[21] In the European Union, for example, a directive was passed that stipulates a gender quota for company boards. See Directive (EU) 2022/2381 of the European Parliament and of the Council of 23 November 2022 on improving the gender balance among directors of listed companies and related measures.

3.A Appendix

3.A.1 Additional figures and tables

Table 3.A.1: Numbers of observations of board members and articles - whole dataset vs. random 10 percent sample of articles on men

	Executive chairs		Supervisory chairs		Executive members	Combined
	Total	10% articles on men	Total	10% articles on men	Total	Using 10% articles on men
Men	373	264	260	146		399
Women	15	15	13	13	111	127
Total - persons	388	279	273	159	111	526
Articles men	35,149	3,488	11,860	1,137		4,608
Articles women	632	632	360	360	2,187	2,712
Total - articles	35,781	4,120	12,220	1,497	2,187	7,320

Notes: Numbers of observations of board members and newspaper articles in the dataset by position and gender for the total sample of articles as well as taking a random sample of 10 percent of articles on men.

Table 3.A.2: German list of search terms to select relevant sentences from each article

	Man	**Woman**
Executive board chair	first and last names, *er*, *ihm*, *ihn*, *der/den/dem vorstandsvorsitzende/n*, *CEO*, *geschäftsführer/s*, *chef/s* , *boss*, *spitze*, *manager/s*	first and last names, *sie*, *ihr*, *die/der vorstandsvorsitzende/n*, *CEO*, *geschäftsführerin*, *chefin*, *sprecherin*, *spitze*, *managerin*
Supervisory board chair	first and last names, *er*, *ihm*, *ihn*, *der/den aufsichtsratsvorsitzende/n*, *der vorsitzende*, *chefkontrolleur*, *chefaufseher*, *sprecher*, *aufsichtsratschef/s*, *chef des aufsichtsrats*, *boss des aufsichtsrats*, *aufsichtsratsboss*	first and last names, *sie*, *ihr*, *die/der aufsichtsratsvorsitzende/n*, *die vorsitzende*, *bossin*, *chefkontrolleurin*, *chefaufseherin*, *aufsichtsratschefin*, *sprecherin*, *chefin des aufsichtsrats*
Executive board member		first and last names, *sie*, *ihr*, *vorständin*, *chefin*, *managerin*

Notes: Lists of search terms that are used to select the relevant sentences that refer to a certain board member in an article by position and gender.

Figure 3.A.1: Example of selection of relevant sentences on board members using search terms

Das Wachstumswunder aus dem Westerwald

Ralph Dommermuth ist ein Mann für kurze Sätze. Das erfährt jeder, der mit dem Vorstandsvorsitzenden der United Internet AG spricht. Zum Thema Internetempfang über das Mobiltelefon sagte Dommermuth dieser Zeitung zum Beispiel lediglich: "Das wird kommen. Wenn der Markt entsteht, wollen wir dabei sein." In welcher Form Dommermuths Internetunternehmen aus Montabaur im Westerwald an diesem Geschäft teilhaben könnte, umriss der Manager ebenso prägnant. "Ein Ansatzpunkt für uns wäre der ‚Blackberry für jedermann'. Wir sind aber noch in der Evaluierungsphase." Zehn Jahre ist es nun her, dass der inzwischen 52 Jahre alte Dommermuth die Chancen für einen Erfolg im mobilen Internet auslotete und dabei auch Bezug auf das Gerät nahm, das den Siegeszug des Internetempfangs per Handy damals wie kein anderes verkörperte. Denn "der Blackberry" stand 2005 noch synonym für den Netzzugriff von unterwegs. Vor allem Führungskräfte und solche, die es glaubten zu sein, nutzten das Handy mit der eingebauten Druckknopftastatur und riefen darüber E-Mails ab oder Internetseiten auf. Heute ist das als süchtig machendes "Crackberry" verballhornte Gerät fast schon vergessen, und den Smartphone-Markt dominieren der amerikanische Elektronikkonzern Apple und der koreanische Konkurrent Samsung. Im dritten Quartal 2015 kam nach Angaben des Marktforschungsunternehmens Gartner jedes dritte neu verkaufte Gerät von diesen beiden Unternehmen. Blackberry ist also so gut wie weg. Doch United Internet und sein Vorstandschef Dommermuth sind noch da - und zwar stärker als je zuvor. [. . .]

The Growth Miracle from the Westerwald

Ralph Dommermuth is a man of few words. This becomes evident to anyone who speaks with the CEO of United Internet AG. When discussing internet reception via mobile phone, Dommermuth told this newspaper, "It will come. When the market emerges, we want to be part of it." Dommermuth similarly outlined how his internet company from Montabaur in the Westerwald could participate in this business. "One approach for us would be 'Blackberry for everyone.' But we are still in the evaluation phase." It has now been ten years since the now 52-year-old Dommermuth explored the potential for success in mobile internet, referencing the device that embodied internet reception via mobile phone like no other at the time. In 2005, "the Blackberry" was still synonymous with internet access on the go. Primarily executives and those aspiring to be used the phone with the built-in push-button keyboard to retrieve emails or browse the web. Today, the device, mockingly referred to as the addictive "Crackberry," is almost forgotten, and the smartphone market is dominated by American electronics giant Apple and Korean competitor Samsung. In the third quarter of 2015, according to market research firm Gartner, every third newly sold device came from these two companies. Blackberry is virtually gone. Yet, United Internet and its CEO Dommermuth are still here—and stronger than ever. [. . .]

Notes: Example of the selection of relevant sentences on board members from articles using the search terms listed in Figure 3.A.2. The board member searched for is Ralph Dommermuth. The selected sentences are highlighted in blue. The German text in the left column is the original article, the text in the right column is the English translation using ChatGPT.

Figure 3.A.2: Example of text preprocessing (original and English translation by ChatGPT)

Raw text:

Carla Kriwet übernimmt die Führung der Medizinfirma Fresenius Medical Care. Sie ist damit künftig eine von nur zwei Dax-Chefinnen Es war eine ziemliche Überraschung, als Carla Kriwet, 51, in der vergangenen Woche mitteilte, dass sie Europas größtem Hausgerätehersteller BSH verlassen werde, und zwar sehr plötzlich, schon zu Ende April. Kriwet war erst im Sommer 2020 – mitten in der Pandemie – Chefin des Unternehmens geworden, das mit Waschmaschinen, Kühlschränken, Herden und Küchenmaschinen der Marken Bosch, Siemens, Gaggenau und Neff einen Weltumsatz von fast 16 Milliarden Euro macht.

Preprocessed text:

übernehmen führung medizinfirma chef_in überraschung mitteilen hausgerätehersteller verlassen plötzlich pandemie chef_in unternehmen waschmaschine kühlschrank herd küchenmaschine marke weltumsatz

Raw text:

Carla Kriwet takes over the leadership of the medical company Fresenius Medical Care. She will thus become one of only two female CEOs in the DAX. It was quite a surprise when Carla Kriwet, 51, announced last week that she would be leaving Europe's largest home appliance manufacturer, BSH, very suddenly, at the end of April. Kriwet had only become the head of the company in the summer of 2020 – in the midst of the pandemic. The company, which manufactures washing machines, refrigerators, stoves, and kitchen appliances under the brands Bosch, Siemens, Gaggenau, and Neff, has a global turnover of almost 16 billion euros.

Preprocessed text:

take over leadership medical company boss surprise announce home appliance manufacturer leave suddenly pandemic boss company washing machine refrigerator stove kitchen appliance brand global turnover

Notes: Example of a raw article text (relevant sentences as selected using the search terms) and the resulting text after all preprocessing steps such as tokenization, removal of stop words, names, places, dates and organization names, and lemmatization.

Figure 3.A.3: Snippet of the tf-idf-transformed data

name	company	position	gender	relevant_sentences_preprocessed	abbau _tfidf	abgang _tfidf	abgeben _tfidf	ablösen _tfidf	abschie d_tfidf	abschließ en_tfidf	aktie_ tfidf	aktienkurs _tfidf	aktionär_ in_tfidf
michael diekmar	allianz	VST-Vors	0	vorstandsvorsitz legen öffentlich k	0	0	0	0	0	0	0	0	0
michael diekmar	allianz	VST-Vors	0	vorstandsvorsitz beginn ungewohr	0	0	0	0	0	0	0	0	0
michael diekmar	allianz	VST-Vors	0	börsenchef nennen niedrig steuers	0	0	0	0	0	0	0	0	0
michael diekmar	allianz	VST-Vors	0	investments infrastruktur vorstelle	0	0	0	0	0	0	0	0	0
michael diekmar	allianz	VST-Vors	0	amtszeit beschreiben erfolgreich u	0	0	0	0	0	0	0	0	0,42601
michael diekmar	allianz	VST-Vors	0	fazit spitzenmanagment konzern sp	0	0	0	0	0	0	0	0	0
michael diekmar	allianz	VST-Vors	0	chef_in fluchtartig unternehmen ve	0	0	0,1664	0	0	0,17274	0	0	0
michael diekmar	allianz	VST-Vors	0	langjährig vorstandsvorsitz amtier	0	0	0	0	0	0	0	0	0
michael diekmar	allianz	VST-Vors	0	vorstandsvorsitz übergeben legen	0	0	0	0	0	0	0	0	0
michael diekmar	allianz	VST-Vors	0	chef_in helga jung frau konzernvor	0	0	0	0	0	0	0	0	0
oliver bäte	allianz	VST-Vors	0	wagen vorständ_in ausblick gesch	0	0	0	0	0	0	0	0	0
oliver bäte	allianz	VST-Vors	0	vorstandschef_in bank branche dü	0	0	0	0	0	0	0	0	0
oliver bäte	allianz	VST-Vors	0	selten ereignis wechsel vorstandss	0	0	0	0	0	0	0	0	0
oliver bäte	allianz	VST-Vors	0	schnell denken schnell sprechen s	0	0	0	0	0	0	0	0	0
oliver bäte	allianz	VST-Vors	0	spüren manager_in assekuranz ver	0	0	0	0	0	0	0	0	0
oliver bäte	allianz	VST-Vors	0	amt sprechen hochmotiviert mitar	0	0,2105	0	0	0	0	0	0	0
oliver bäte	allianz	VST-Vors	0	halten versprechen messlatte divid	0	0	0	0	0	0	0	0	0,20176
oliver bäte	allianz	VST-Vors	0	langjährig vorstandsvorsitz amtier	0	0	0	0	0	0,16568	0	0	0

Notes: Screenshot of a snippet of the articles data after preprocessing and the tf-idf transformation. The columns *name*, *company*, *gender* and *position* contain the name, company name, gender and board position of the person refereed to in the article. The column *relevant_ sentences_ preprocessed* contains the preprocessed text of each article. All columns with a *tfidf*-suffix are the $T \times D$ tf-idf matrix and each column contain the tf-idf of the respective term.

Table 3.A.3: Cosine similarity of gender and career/family dimensions using the five and 15 most common terms

	Five Terms	15 Terms
Supervisory chairs	0.28	0.31
Executive chairs	0.22	0.10
Executive and supervisory chairs and executive board women	0.27	0.11

Notes: Cosine similarities of the vectors capturing the gender dimension ($\overrightarrow{mf}$) and the career/-family dimension ($\overrightarrow{cf}$) based on the five and 15 most common terms using word embeddings trained on articles referring to different groups of board members. A positive cosine similarity indicates that an association of male terms with career terms and of female terms with family terms.

Table 3.A.4: Cosine similarity of gender and career/family dimensions using a vector size of 300

Supervisory chairs	0.29
Executive chairs	0.10
Executive and supervisory chairs and executive board women	0.12

Notes: Cosine similarities of the vectors capturing the gender dimension ($\overrightarrow{mf}$) and the career/-family dimension ($\overrightarrow{cf}$) using word embeddings trained on articles referring to different groups of board members using a vector size of 300. A positive cosine similarity indicates that an association of male terms with career terms and of female terms with family terms.

Table 3.A.5: Average normalized word counts of agency and communion terms in articles by gender

(a) Supervisory and executive board chairs and executive board women

	Men	Women	Difference	Difference in percent
Agency	3.530	3.073	-0.457***	-14.9
Communion	5.654	6.385	0.730***	11.4
Observations	48,452			

(b) Supervisory board chairs

	Men	Women	Difference	Difference in percent
Agency	3.553	3.041	-0.512*	-16.9
Communion	5.969	7.619	1.650***	21.7
Observations	12,216			

(c) Executive board chairs

	Men	Women	Difference	Difference in percent
Agency	3.533	3.221	-0.312	-9.7
Communion	5.527	5.918	0.391*	6.6
Observations	35,773			

Notes: Average sum of agency and communion terms per 100 words in articles referring to male or female board members in the entire dataset and subsamples of supervisory and executive board chairs.

Figure 3.A.4: Average number of children in the household conditional on having children in general population and samples of managers

Notes: Average number of children in the household among individuals that have at least one child in the household by year in the whole sample of the German SOEP and in subsamples of managers identified by the SOEP survey question whether the individual in their job is in a leadership position or using the 4th digit of the KldB 2010 Classification of Occupations.

Table 3.A.6: Cronbach's alpha of agency and communion scales

	Cronbach's Alpha
Agency - self-evaluation	0.77
Agency - personal importance	0.81
Communion - self-evaluation	0.84
Communion - personal importance	0.91

Notes: Cronbach's alpha of agency and communion scales measured in the SOEP-IS data. Items considered for agency are *cleverness*, *competence*, *ability*, and *influence*. Items considered for communion are *warmth*, *helpfulness*, *empathy*, and *caringness*. Separate scales for self-evaluation and personal importance are considered.

CHAPTER 4

Meet my family: the effect of female CEOs' newspaper coverage on CEO perception and economic decision-making[1]

4.1 Introduction

The way newspapers and news-providing web pages frame objective facts is an important factor for readers' perception of news content (see Bursztyn et al. (2023); DellaVigna and La Ferrara (2015); Tetlock (2015)). This is, for instance, true for narratives around health crises (Berger et al., 2023), green technology (Chen et al., 2022), as well as more personal topics such as fertility (Ferrara et al., 2012). Recent studies have shown differences in portrayal of women and men in public positions in the media (Eizmendi-Iraola and Peña-Fernández, 2022; Sondergeld, 2024; Van der Pas and Aaldering, 2020). In particular, Sondergeld (2024) highlights that more family-related language is used in newspaper articles on female CEOs compared to male CEOs of publicly listed companies in Germany. This is in line with gender stereotypes around the care responsibilities of men and women. It remains an open question, though, whether this gendered newspaper coverage has an impact on readers' perception of the portrayed public figures as well as resulting financial decisions.

We run a randomized online experiment to answer the question whether the stereotypical representation of company leaders in newspapers affects readers' economic

[1]This chapter is joint work with Lavinia Kinne (DIW Berlin, University of Potsdam). We gratefully acknowledge generous funding by the Joachim Herz Foundation and the German Science Foundation project CRC TRR 190. We also thank numerous workshop participants for their valuable comments. IRB approval was obtained from the German Association for Experimental Economic Research (Project number: gawVyUPi); the experiment was pre-registered in the AEA RCT Registry (AEARCTR-0013611).

decision-making. We show respondents articles based on real newspaper coverage on a company and its CEO, hereby varying if and how the family of a male or female CEO is mentioned. The families of female and male CEOs are either not brought up, mentioned only neutrally, or a family-career trade-off is highlighted for the female CEO only. Regarding outcomes, we are interested in readers' perception of CEO competence (measured by their expected 'survival' in the firm and assumptions about employee ratings), and the assessment of firm performance on the stock market. Additionally, we ask respondents to invest an endowment of 100€ into either the firm's stock or a financial product following the evolution of the largest German stock index overall. Outcomes are incentivized following the development of the real firm and CEOs that the articles are based on, the investment is paid out for some of the participants. Free-text questions ask respondents to provide a reasoning for their answers, allowing for deeper analysis of potential mechanisms through quantitative text analysis.

We find that female and male CEOs are perceived differently which has consequences for real investment decisions. Firms with female CEOs are generally associated with a worse stock performance in the year following their appointment compared to the year prior. While this difference seems to be driven by all treatment groups with a female CEO, regardless of newspaper coverage, investment decisions depend very much on the way the family is mentioned for female CEOs. More precisely, respondents invest around 6.5 percent less into the stock of the firm if the family of a female CEO is mentioned neutrally, a result that is significantly different to all other treatment groups. Strikingly, highlighting the trade-off between family and career that the female CEO went through does not follow the same investment penalty.

The smaller investments into female CEOs are driven by female respondents and parents. Female respondents invest more in the baseline treatment of a male CEO without a family than male respondents. While both men and women invest less in case of the family of the female CEO being mentioned neutrally, this difference is more pronounced for female respondents. Instead, male respondents assign an investment bonus to male CEOs with a family and, to some extent, to female CEOs where the successful management of a family-career trade-off is highlighted. Female respondents, on the other hand, are also more skeptical towards male CEOs with a family mention. These effects seem to be partially driven by differences in gender norms between women and men in our sample. Parents invest up to 14 percent less into the firm with a female CEO and any representation as well as a male CEO with a family mention, with the strongest difference again observed for the treatment where the family of a female CEO is neutrally mentioned. Instead, childless participants assign a slight investment bonus

to male CEOs with a family as well as female CEOs in the family-career trade-off treatment.

A more or less gender-stereotypical representation of CEOs has little impact on the perception of CEO competence as measured by beliefs about employee ratings and expected 'survival' in the firm. No statistically significant differences are observed for expected employee approval of the CEO on the platform Glassdoor. This result masks heterogeneities by gender but not by parental status. Female respondents expect significantly lower approval for a female CEO in all scenarios, in particular when the family is mentioned with a trade-off between family and career. Instead, male participants assume a more positive employee rating for male CEOs with a family and female CEOs who successfully managed a family-career trade-off. No treatment patterns are observed for expected CEO 'survival' in the firm after two and five years.

Using two free-text questions, we show that participants assign an important role to considerations around gender and family when answering the questions on incentivized outcomes. Concepts related to gender are almost exclusively mentioned in treatment groups with a female CEO, indicating that the gender of a female CEO is much more salient than in the case of a male CEO. The sentiment of these gender-related arguments is mostly balanced between positive and/or negative, whereas the gender has a larger share of positive connotations for the treatment highlighting a family-career trade-off for female CEOs. The share of respondents mentioning family-related words is associated with the family information on the CEOs and is clearly highest for the trade-off treatment of female CEOs. Surprisingly, these family-related arguments almost exclusively have a positive connotation, in particular for the trade-off treatment.

Our results speak in favor of both care stereotypes and perceived positive ability selection as mechanisms for our treatment effects. In the treatment where a family is only neutrally mentioned, respondents may rely particularly on stereotypes to make assumptions about the division of labor within a CEO's household. The more pessimistic assessment of female CEOs in this group together with the smaller likelihood to mention the family with a positive connotation may hence reflect the expected involvement in their family life. Instead, highlighting that a female CEO has successfully managed the trade-off between career and family appears to create a narrative of a positively selected leader who may be particularly able to generate positive impact on the firm and its employees. This suggests that stereotypes on care responsibilities may be especially strong in the absence of explicit mentions of success in managing them, potentially further slowing women's already limited advancement into leadership roles.

We mainly contribute to the literature on the impact of stereotypes and narratives in the media on economic decisions. While this has been studied in other contexts, we are the first to show that stereotypical representation of women in leadership positions has important consequences on real financial decision-making. Ferrara et al. (2012) show that more progressive gender norms in television shows can lead to a change in viewers' own fertility decisions. DellaVigna and La Ferrara (2015) and Tetlock (2015) summarize the literature regarding the impact of media on economic, social, and financial decisions, Zhuravskaya et al. (2020) review the findings around social media and political outcomes. More recently, Bursztyn et al. (2023) turn to opinion programs, especially during the COVID-19 pandemic, as a particularly polarizing type of media coverage. Berger et al. (2023) use a similar experimental setting to ours to show that narratives around the COVID-19 pandemic have a substantial impact on expected stock market development.

Relatedly, we add to the literature on gender stereotypes in large texts, and their impact on economic outcomes. Baltrunaite et al. (2024) and Eberhardt et al. (2023) analyze reference letters from the economics academic job market and show that female and male applicants are associated with different characteristics leading to consequences for their job placement. Ash et al. (2024) use gender stereotypes in judges' authored opinions to classify the gender attitudes of judges in US courts. Through random assignment of judges, they are also able to show the impact of such 'gender slant' on judicial decision-making. We contribute to this literature by focusing on gender stereotypes in ubiquitous daily documents, i.e. newspapers. Additionally, we provide evidence on financial decisions such as stock investments which may have a broader impact on stock markets overall as well as perceived leader competence that in turn may hinder the progression of women into leadership positions.

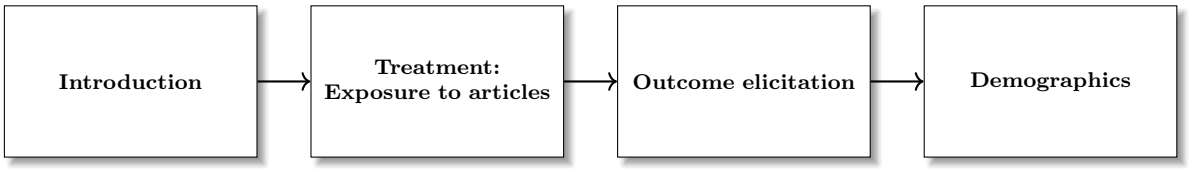
Lastly, we speak to the evidence on stereotypes as barriers for women reaching leadership positions. Barron et al. (2024) and Reuben et al. (2014) document how stereotypes lead to biases and double-standards in hiring decisions of employers. Benson et al. (2024) additionally shed light on stereotypes in employee evaluations and their impact on job promotions. Furthermore, women who do progress into leadership positions may face backlash from violating gender stereotypes according to role congruity theory (Eagly and Karau, 2002; Rudman, 1998; Rudman and Phelan, 2008). Our paper investigates a particular channel that may hinder women from reaching top management positions: differential expectations about their competence in the firm and resulting gendered investment patterns into the firm's stock. We show that this channel is particularly shaped by media and their representation of female leaders, in particular regarding family and care stereotypes.

The remainder of the paper is structured as follows. Section 4.2 explains the experimental design. Section 4.3 gives an overview of the sample and its descriptive statistics. Section 4.4 presents the results of the experiment. Section 5.8 concludes.

4.2 Experimental design

The experiment is conducted as an online experiment with a sample of German participants ($n = 3000$, of which 500 in the pilot and 2500 in the main study). Participants are recruited through a survey company with the sample being representative of the German population in terms of gender, age (between 18 and 69 years old), and education. All sample instructions, texts and questionnaires are given in German. Figure 4.1 shows the overall flow of the experiment. Screenshots of all instructions in German can be found in appendix 4.A.2.

Figure 4.1: Flow of the experiment



Notes: Overview of the flow of the experiment. Participants that do not agree to the conditions of the experiment or meet the quota limit are directed out of the survey after the introduction.

4.2.1 Introduction

Participants are welcomed to the experiment and informed about the usage and protection of their survey data. They are also told that in addition to the show-up fee, they will be able to earn money depending on their responses to the questions given throughout the study. Participants are asked to agree to these conditions before reporting their gender, age, and level of education for quota sampling. If any of the quota limits are met, they are directed out of the survey.

4.2.2 Treatment: exposure to articles

Participants are informed that they will see an article about the appointment of a real CEO in a real German company. They are told that the article is based on real German newspaper coverage of the company and the CEO, but that the company name, the CEO's name, any other personal names, and the city of the company's headquarters will be pseudonymized. They are asked to read the article carefully, as they will have

the opportunity to earn additional money by correctly answering questions about the company and the CEO later on.

Participants are then randomly assigned to one of five treatment groups, and are shown the respective article that varies in the nature of information about the CEO's family status. Table 4.1 gives an overview of the different treatment groups.

Table 4.1: Overview of treatment groups

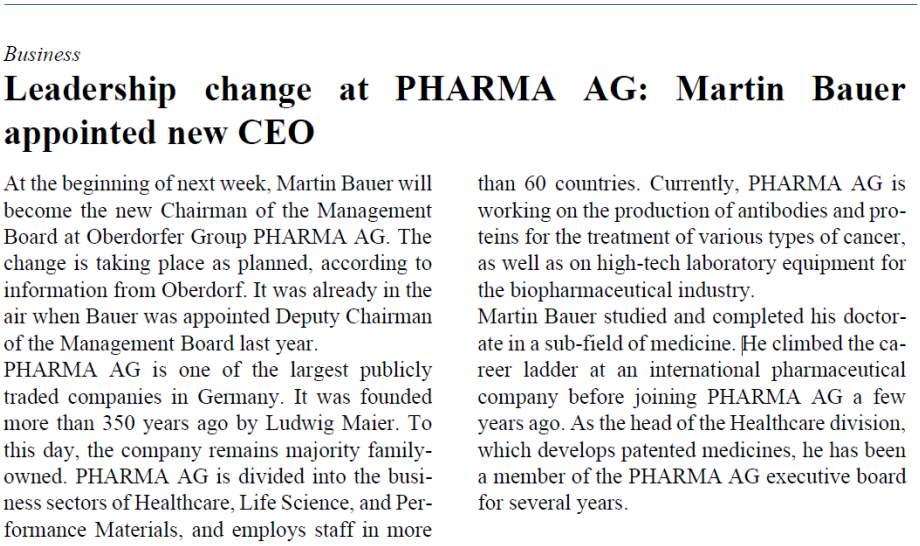
gender CEO	no family info (1)	family mentioned (2)	family-career trade-off (3)
female (F)	x	x	x
male (M)	x	x	

Notes: Overview of information about the CEO's family status in the article shown to each treatment group. We refer to the different groups according to the gender of the CEO and the variation in family information as 1M, 1F, 2M, 2F, and 3F.

Each article consists of three paragraphs. The first paragraph is an announcement that a new person is taking over the position of the chair of the board (CEO) of the company PHARMA AG which corresponds to the real German pharmaceutical company Merck KGaA. In two groups, the new CEO is a man named Martin Bauer (based on their CEO from 2016-2021, Stefan Oschmann), in the other three groups, the new CEO is a woman named Martina Bauer (based on Belén Garijo, Merck's current CEO). The second paragraph provides some general description of the company and its business activities. This paragraph is identical in all groups. The third paragraph provides biographical information about the new CEO, which is identical for the male and the female CEO given the almost identical biography of the two real CEOs the article is based on. However, at the end of this paragraph we vary the degree of gender-stereotypical representation by including information about the CEO's family in different ways.

For groups 1M (Figure 4.2) and 1F (Figure 4.A.1), no information about the family is given. In groups 2M (Figure 4.A.2) and 2F (Figure 4.3), the marriage and parental status of the CEO is briefly mentioned at the end of the paragraph by adding the sentence *"Bauer is married and father/mother of two children"*. In group 3F (Figure 4.4), the marriage and parental status of the female CEO is given and in addition, a trade-off between family and career is highlighted by adding the sentence: *"Bauer is married and a mother. She raised two children and still managed to have a successful career"*. There is no such treatment group for the case of the male CEO since in the actual newspaper articles the sentences are taken from, a family-career trade-off is in no case mentioned for a male CEO.

Figure 4.2: Translation of article text group 1M - male CEO and no information on family



Business

Leadership change at PHARMA AG: Martin Bauer appointed new CEO

At the beginning of next week, Martin Bauer will become the new Chairman of the Management Board at Oberdorfer Group PHARMA AG. The change is taking place as planned, according to information from Oberdorf. It was already in the air when Bauer was appointed Deputy Chairman of the Management Board last year.
PHARMA AG is one of the largest publicly traded companies in Germany. It was founded more than 350 years ago by Ludwig Maier. To this day, the company remains majority family-owned. PHARMA AG is divided into the business sectors of Healthcare, Life Science, and Performance Materials, and employs staff in more than 60 countries. Currently, PHARMA AG is working on the production of antibodies and proteins for the treatment of various types of cancer, as well as on high-tech laboratory equipment for the biopharmaceutical industry.
Martin Bauer studied and completed his doctorate in a sub-field of medicine. He climbed the career ladder at an international pharmaceutical company before joining PHARMA AG a few years ago. As the head of the Healthcare division, which develops patented medicines, he has been a member of the PHARMA AG executive board for several years.

Notes: English translation (using ChatGPT) of article shown to participants in treatment group with a male CEO and no family mention (1M). The original German text can be found in Figure 4.A.10.

4.2.3 Outcome elicitation: incentivized questions on firm and CEO performance

After being presented with the articles on the CEO according to their treatment group, participants are asked four incentivized questions. These questions only vary by treatment arms based on the gender of the CEO since the name of the CEO is mentioned in the questions, but they do not mention any of the family-related information. Some of the questions are accompanied by unincentivized questions where participants are asked how sure they are about their answers or to explain their reasoning in free-text questions. At each question on an incentivized outcome, participants have the chance to re-read their respective article if they wish to do so.

Outcome 1: Beliefs about stock performance in the year after CEO appointment

Participants are asked whether the stock of PHARMA AG performed better or worse in the year after the appointment of the CEO compared to the year prior to their appointment. Participants receive €0.50 for answering this question correctly. Figure

Figure 4.3: Translation of article text group 2F - female CEO and information on family

Business

Leadership change at PHARMA AG: Martina Bauer appointed new CEO

At the beginning of next week, Martina Bauer will become the new Chairwoman of the Management Board at Oberdorfer Group PHARMA AG. The change is taking place as planned, according to information from Oberdorf. It was already in the air when Bauer was appointed Deputy Chairwoman of the Management Board last year.

PHARMA AG is one of the largest publicly traded companies in Germany. It was founded more than 350 years ago by Ludwig Maier. To this day, the company remains majority family-owned. PHARMA AG is divided into the business sectors of Healthcare, Life Science, and Performance Materials, and employs staff in more than 60 countries. Currently, PHARMA AG is working on the production of antibodies and proteins for the treatment of various types of cancer, as well as on high-tech laboratory equipment for the biopharmaceutical industry.

Martina Bauer studied and completed her doctorate in a sub-field of medicine. She climbed the career ladder at an international pharmaceutical company before joining PHARMA AG a few years ago. As the head of the Healthcare division, which develops patented medicines, she has been a member of the PHARMA AG executive board for several years. Bauer is married and mother of two children.

Notes: English translation (using ChatGPT) of article shown to participants in treatment group with a female CEO and neutral family mention (2F). The original German text can be found in Figure 4.A.13.

4.A.15 shows the original German text used to elicit this outcome. The correct answers are *worse* for Martina Bauer and *better* for Martin Bauer.[2]

As a follow-up, participants are asked by how much the stock out-/underperformed itself in the year after the appointment compared to the year before the appointment, depending on which answer they gave to the previous question. The ranges are 0-5, 5-10, 10-15 or more than 15 percentage points, respectively. This question is not incentivized since participants who answer the first question incorrectly are not able to answer the follow-up correctly anymore. Figure 4.A.16 shows the original texts for this elicitation.

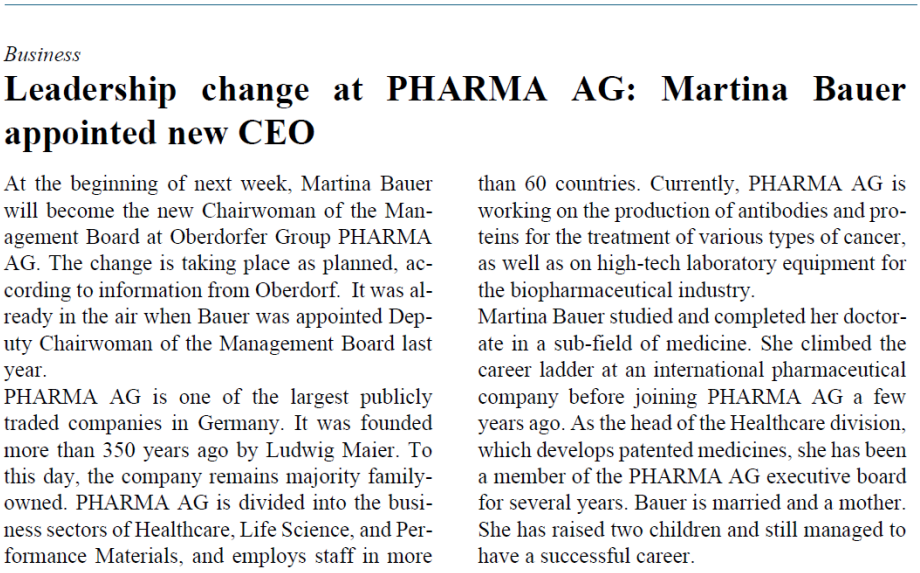
Outcome 2: Investment in the firm's stock at the date of CEO appointment

Participants are asked to split a total of €100 into an investment in the stock of PHARMA AG on the day of the CEO's appointment and a financial product that tracks the price performance of the German stock index (DAX).[3] Participants are in-

[2]Participants are also asked to assess how sure they are of their answer, ranging from *not sure at all* to *very sure*, including a neutral option.

[3]In the pilot version of this experiment, we tested two versions of this question with differing alternative investments: first, a secure savings account that will guarantee a 2 percent return for the year, and second, an investment in the DAX equivalent as described above. We decided to move forward with the latter option to prevent confounding this decision with a respondent's general willingness to invest in the stock market.

Figure 4.4: Translation of article text group 3F - female CEO and information on family-career trade-off



Business

Leadership change at PHARMA AG: Martina Bauer appointed new CEO

At the beginning of next week, Martina Bauer will become the new Chairwoman of the Management Board at Oberdorfer Group PHARMA AG. The change is taking place as planned, according to information from Oberdorf. It was already in the air when Bauer was appointed Deputy Chairwoman of the Management Board last year.

PHARMA AG is one of the largest publicly traded companies in Germany. It was founded more than 350 years ago by Ludwig Maier. To this day, the company remains majority family-owned. PHARMA AG is divided into the business sectors of Healthcare, Life Science, and Performance Materials, and employs staff in more than 60 countries. Currently, PHARMA AG is working on the production of antibodies and proteins for the treatment of various types of cancer, as well as on high-tech laboratory equipment for the biopharmaceutical industry.

Martina Bauer studied and completed her doctorate in a sub-field of medicine. She climbed the career ladder at an international pharmaceutical company before joining PHARMA AG a few years ago. As the head of the Healthcare division, which develops patented medicines, she has been a member of the PHARMA AG executive board for several years. Bauer is married and a mother. She has raised two children and still managed to have a successful career.

Notes: English translation (using ChatGPT) of article shown to participants in treatment group with a female CEO and mentioning of family and career trade-off (3F). The original German text can be found in Figure 4.A.14.

formed that after the end of the study, five[4] participants will be randomly selected to receive a payout equal to the value of their investment one year after the appointment of Martin(a) Bauer. Figure 4.A.17 displays the original German text that participants saw for this investment question. The returns of PHARMA AG in the year after their appointment were 18 percent for Martina Bauer and 32 percent for Martin Bauer. The DAX returns in the same respective year amounted to -7 percent for Martina Bauer and 25 percent for Martin Bauer.

Outcome 3: Beliefs about CEO approval by employees on Glassdoor

Participants are asked about their beliefs regarding the approval of the CEO by their employees on the employer rating platform Glassdoor[5] approximately 1.5 years after the CEO appointment. The participants could choose a value on a scale from 0 (i.e. no employee that rated the CEO on Glassdoor approved them) to 100 percent (i.e. all employees that rated the CEO on Glassdoor approved them). As an anchor, the participants receive the information that in Glassdoor's latest report (from 2021) the average global CEO approval rate is 73 percent (see Figure 4.A.18). Participants receive €1 if they chose a value within a 5 percentage point range around the true CEO approval

[4]To keep the information given to the particpants constant, we select five participants in the pilot and five in the main study.

[5]See www.glassdoor.com (Last accessed: 07 November 2024).

(93 percent for Martina Bauer and 89 percent for Martin Bauer). Additionally, we provide an unincentivized free-text question about what participants think that employees perceive as either positive or negative about their CEO when providing the rating on Glassdoor (see Figure 4.A.19).

Outcome 4: Beliefs about CEO 'survival'

In this question, participants are asked whether they believe the CEO is still in their position two years after appointment (Figure 4.A.20). The correct answer in both cases is *yes*, and the participants receive €0.50 for answering this question correctly.[6] Participants are then asked to explain their reasoning in an unincentivized follow-up question (see Figure 4.A.21). Given that most participants answered *yes* to the two-year 'survival' question in the pilot study, we added the same question with a five-year time horizon in the main study, for those participants that chose 'survival' in the two-year question. Given that for one of the real CEOs the study is based on less than five years have passed since their appointment, this additional question could not be incentivized.

4.2.4 Attention check, demographics and additional questions

After assessing the last incentivized outcome measure, we provide an attention check to the participants to make sure they have been reading the questions carefully up until that point. Participants are asked to respond both *do not agree* and *fully agree* to a question about how easy it is to find reliable information in the media nowadays (Figure 4.A.22).

After being thanked for their responses to the questions on PHARMA AG and its CEO, participants are asked about the following demographics: employment status (*full-time employed*, *part-time employed*, *self-employed*, *not employed/looking for work*, *minor or irregular employment*, *retired*, *student/apprentice*, and *other*/free-text), number (integer) of adults and children, and their gender in the household (*male*, *female*, and *non-binary/diverse*), total available monthly household income (*less than €1000*, *€1000 to €2000*, *€2000 to €3000*, *€3000 to €4000*, and *more than €4000*), newspaper reading frequency (*daily*, *at least once/week*, *several times/month*, *approx. once/month*, and *less than once/month*), and their preferred newspapers (ten largest newspapers in online and print in Germany and *other*/free-text).

[6] Again, participants can rate how sure they are about this answer as explained for outcome 1.

Participants are also asked about their risk attitudes (*not at all willing to take risks*, *rather not willing to take risks*, *riskneutral*, *rather willing to take risks*, and *very willing to take risks*) and their experience in investing in the stock market, both whether they have ever invested in the stock market (*yes*, *no*, and *don't know*) and if yes, the frequency (*daily, weekly, 1-2 times/month, 1-2 times/quarter, 1-2 times/year, less than once/year*). They are further asked whether they have tried to look up information to answer the incentivized questions (*yes*, *no*, and *yes, but could not find anything*) and what they think the topic of the study was (free-text).

To understand mechanisms related to potential treatment effects, we also ask participants in which newspaper they could imagine an article like the one shown to be published (the options are again the 10 largest newspapers in online and print in Germany). To get an idea of individuals' descriptive and injunctive gender norms, we ask participants about their beliefs regarding the share of women as CEOs in DAX companies (in percent) and if they think that women's representation in upper management should change (*should increase significantly*, *should increase slightly*, *should remain the same*, *should decrease slightly*, and *should decrease significantly*). Similarly, we elicit the gender of the CEO/managing director of their employer (*male*, *female*, *non-binary/diverse*, *I don't know*, and free-text to explain if, for instance, employer has no or several CEOs). These last questions are only asked after the question on the topic of the study to avoid pointing participants in the direction of the actual topic. Lastly, participants get the chance to voice any feedback on the study.

4.3 Sample and descriptive statistics

Our sample consists of 3,011 respondents and is representative for the German population according to gender, age, and education. Table 4.A.1 additionally gives an overview of the respondents' employment status, household size, and household income for the full sample of pilot and main study. Most participants are full-time employed (45 percent), part-time employed (16 percent) or retired (16 percent), and earn between 1000€ and 4000€ per month in the household. The median household in our sample has one female and one male household member above age 18, around 30 percent of respondents report to have at least one household member below the age of 18 living with them.

In addition to demographic information, we also ask participants about some study-specific characteristics, in particular their newspaper reading behavior, risk aversion, and investment behavior. Table 4.2 summarizes these characteristics. Around 65 percent of respondents report to read newspapers offline or online at least once per week

or daily, 19 percent have a newspaper reading frequency of less than once per month.[7] Similarly, 65 percent of the sample consider themselves risk-neutral or slightly risk-averse. 43 percent of participants have ever invested on the stock market, of which around 40 percent do this weekly or bi-weekly. Another 24 percent of respondents are active on the stock market less than once per year.[8]

Given the randomized nature of our experiment together with the quotas for age, gender, and education, we do not expect any major imbalances by background characteristics in our sample. Table 4.A.2 shows the balance of all individual characteristics described above. The respondents are close to evenly distributed among the five treatment arms and are balanced along the main dimensions used for quota sampling, namely age, gender, and education. Small imbalances are observed for very rare groups like non-binary respondents and other educational degrees than the ones presented for the quotation.[9] Similarly, there is selected imbalances for specific categories of some background variables such that we always show empirical specifications with and without controls for these demographics.

After completion of the treatment, we furthermore ask respondents for their beliefs or opinions on study-related topics. Given the incentivization scheme related to the real company the articles are based on, we ask respondents whether they tried to find any information on the real firm while answering the survey. Most respondents report that they either did not look up the firm (91 percent) of that they did but could not find any useful information (around 3 percent, see Table 4.3).[10] Relatedly, we ask for a guess regarding the topic of the study, in free-text format. We classify

[7] We additionally ask about the newspapers that individuals prefer to read. We propose the ten most popular newspapers on- and offline using data from the German Federal Statistical Office *Statistisches Bundesamt* and respondents can choose as many of the newspapers as they like. While the shares are relatively evenly distributed among the ten newspapers (between 6 and 28 percent), almost 40 percent of participants state that they (additionally) consume news from other sources which mostly appear to be regional newspapers or more general news websites such as "t-online" or "msn". Interestingly, the tabloid "BILD-Zeitung" is by far the most-read newspaper in Germany which is not reflected in our sample.

[8] In the overall German population, 17.6 percent of Germans stated to currently own stocks or portfolios of stocks in the last data collection in 2023 (DAI, 2023).

[9] While we cannot check for this, there is a chance that respondents strategically choose these answering options assuming that there is no quota on them. This might be especially true for respondents who are very familiar with such surveys and hence understand that the longer a survey has been posted on the platform, the more likely it is that some quotas are already full.

[10] We furthermore ask respondents in which of the most popular 10 German online and offline newspapers they could imagine the treatment article to appear in (non mutually exclusive). A large share of participants (around 25-30 percent respectively) expects such an article to appear in the popular general-interest newspapers Süddeutsche Zeitung, FOCUS, Spiegel, ZEIT, and WELT or their respective online counterparts. Almost half of the participants (49 percent) additionally flag the business newspaper Handelsblatt (including online) as a source for the article.

Table 4.2: Study-related characteristics of survey sample

	(1) Obs.	(2) Mean	(3) Median	(4) Std. Dev.	(5) Min.	(6) Max.
Frequency newspaper reading:						
<once/month	3,011	0.19	0	0.39	0	1
approx. once/month	3,011	0.05	0	0.22	0	1
several times/month	3,011	0.12	0	0.32	0	1
at least once/week	3,011	0.27	0	0.44	0	1
daily	3,011	0.37	0	0.48	0	1
Risk aversion:						
very willing to take risks	3,011	0.03	0	0.16	0	1
rather willing to take risks	3,011	0.20	0	0.40	0	1
risk-neutral	3,011	0.35	0	0.48	0	1
rather not willing to take risks	3,011	0.29	0	0.45	0	1
not willing to take risks at all	3,011	0.13	0	0.34	0	1
Experience investing:						
No	3,011	0.55	1	0.50	0	1
Yes	3,011	0.43	0	0.50	0	1
Don't know	3,011	0.02	0	0.15	0	1
Frequency investing:						
less than once/year	1,298	0.24	0	0.43	0	1
1-2 times/year	1,298	0.12	0	0.32	0	1
1-2 times/quarter	1,298	0.14	0	0.35	0	1
1-2 times/month	1,298	0.24	0	0.43	0	1
weekly	1,298	0.17	0	0.38	0	1
daily	1,298	0.07	0	0.26	0	1

Notes: Descriptive statistics of study-related characteristics on newspaper reading behavior, risk aversion, and investment behavior of study participants. Balancing checks by treatment group on these variables can be found in Table 4.A.2.

answers based on whether they mention terms related to a certain topic.[11] The largest category we can identify relates to *management and business* (around 35 percent of respondents) whereas around 20 percent of respondents state they don't know what the study was about. 10 to 15 percent mention topics related to *media*, *pharma and medicine*, or *financial markets*. Slightly less than 10 percent mention topics related to *women/gender* (see Figure 4.A.6).

Finally, we attempt to assess the norms and perceptions of respondents around women in leadership positions, before giving them the chance to provide more general free-text feedback on the study. First, participants are asked to estimate the share of

[11] The list of terms capturing topics are generated using ChatGPT with the following request separately for each topic (in German): "I would like to measure whether a text mentions the topic xyz. Can you create a list of terms that I can search for?"

female CEOs among the 40 companies in the German stock index (DAX). The correct share at the time of the experiment was 1/41[12], i.e. 2.4 percent, and respondents vastly overestimate this figure (mean 29 percent, median 25 percent, see Table 4.3). Nonetheless, a majority of participants thinks that the share should be slightly or significantly higher (almost 75 percent). Only two percent would like the share of women as CEOs to be lower. Lastly, two fifths (19 percent) of our sample have a male (female) CEO in their own firm. Almost 15 percent don't know the gender of their employer's CEO or provide other answers, e.g. that they don't work or that their company has multiple CEOs.[13]

Table 4.3: Look-up behavior and study-related opinions of survey sample

	(1) Obs.	(2) Mean	(3) Median	(4) Std. Dev.	(5) Min.	(6) Max.
Tried to look up firm:						
No	3,011	0.91	1	0.29	0	1
Yes	3,011	0.07	0	0.25	0	1
Yes, but could not find anything useful	3,011	0.03	0	0.16	0	1
Belief share of women as CEOs	3,011	29.00	25.00	19.62	0	100
Desired change in female CEO share:						
Should be significantly lower	3,011	0.01	0	0.10	0	1
Should be slightly lower	3,011	0.01	0	0.10	0	1
Should stay same	3,011	0.25	0	0.43	0	1
Should be slightly higher	3,011	0.39	0	0.49	0	1
Should be significantly higher	3,011	0.34	0	0.47	0	1
Own CEO gender:						
Male	3,011	0.66	1	0.47	0	1
Female	3,011	0.19	0	0.40	0	1
Diverse	3,011	0.01	0	0.09	0	1
Don't know	3,011	0.09	0	0.29	0	1
Other	3,011	0.05	0	0.21	0	1

Notes: Descriptive statistics on look-up behavior and opinions related to women in leadership positions. Balancing checks by treatment group on these variables can be found in Table 4.A.3.

[12]We ran the experiment in September 2024 where only Belén Garijo was leading a DAX-40 company as CEO, namely Merck KGaA. Zalando had two CEOs at the time, Robert Gentz and David Schröder, such that the total number of CEOs is 41.

[13]Table 4.A.3 shows a balancing check for these study-related attitudes. We only observe one minor imbalance related to the *other* category of own CEO gender. Nonetheless, we again provide estimates for our treatment effects in section 4.4 including these characteristics as control variables (so-called *further study controls*).

4.4 Results

In this section, we present the estimation results on our main incentivized outcomes (section 4.4.1) as well as the unincentivized free-text questions that aim to uncover the mechanisms behind respondents' reasoning (section 4.4.2). Lastly, section 4.4.3 presents heterogeneities in treatment effects by gender and parental status.

4.4.1 Main incentivized outcomes

Outcome 1: Beliefs about stock performance in the year after CEO appointment

We first ask whether respondents assess the performance of PHARMA AG differently depending on the gender of the presented CEO and their stereotypical representation in the newspaper article. Overall, 88.4 percent of respondents believe that the company performed better in the year after CEO appointment compared to the year before, the rest thinks the firm performed worse, there is no neutral option. Table 4.4 shows the treatment effects compared to the male treatment without family information (1M) as a baseline (columns 1-3) as well as a comparison for all treatments with a male CEO (1M, 2M; baseline) and those with a female CEO (1F, 2F, 3F; columns 4-6) with varying sets of controls.

There is a strong and persistent difference in expected performance between a female-led company compared to one with a male CEO. We first compare all treatment groups to the baseline treatment of a male CEO without mentioning his family as this is the most common and neutral coverage we observe in real newspaper articles (Sondergeld, 2024). There is no significant difference in the share of respondents who expect the firm to perform better between the neutral male baseline treatment and all other treatments (columns 1-3, Table 4.4). The coefficient is positive for the 2M treatment mentioning the family neutrally for men which would indicate a reward for family information of men, potentially due to more identification with the CEO if personal information is provided. All coefficients for the female treatments are negative suggesting a penalty for female CEOs in the expected stock performance being better or worse than in the year before CEO appointment. This is confirmed by the results in columns 4-6 that compare all treatments with a male CEO to all female CEO treatments. Mentioning a female CEO in our treatment article leads to a reduction in the share of respondents expecting a better stock performance of around two percentage points compared to a baseline of almost 90 percent.

Table 4.4: Treatment effects on beliefs about stock performance in the year after CEO appointment

Outcome: share of respondents expecting better stock performance						
	(1)	(2)	(3)	(4)	(5)	(6)
Baseline mean:	88.74% (1M)			89.57% (Male CEO)		
2M - family neutral	0.017	0.015	0.018			
	(0.018)	(0.018)	(0.017)			
1F - no family	-0.008	-0.013	-0.015			
	(0.018)	(0.018)	(0.018)			
p-value 1F-2M:	[0.114]	[0.163]	[0.066*]			
2F - family neutral	-0.014	-0.013	-0.014			
	(0.019)	(0.018)	(0.018)			
p-value 2F-2M:	[0.092*]	[0.115]	[0.073*]			
3F - family trade-off	-0.012	-0.019	-0.020			
	(0.019)	(0.018)	(0.018)			
p-value 3F-2M:	[0.111]	[0.06*]	[0.038**]			
CEO female				-0.020*	-0.022*	-0.025**
				(0.012)	(0.012)	(0.012)
Control for individual demographics	No	Yes	Yes	No	Yes	Yes
Further study controls	No	No	Yes	No	No	Yes
R-squared	0.001	0.035	0.049	0.001	0.035	0.048
N	3,011	3,011	3,011	3,011	3,011	3,011

Notes: Results of regression of incentivized outcome 1 (beliefs about stock performance in the year after CEO appointment) on treatment group dummies and control variables, and p-values of treatment effects for different treatment group comparisons (columns 1-3). Results of regression of incentivized outcome 1 on CEO gender dummy and control variables (columns 4-6). Standard errors in parenthesis, *p <0.10, **p<0.05, ***p<0.01.

The differential assessment of stock performance based on CEO gender is driven by coverage that neutrally mentions the male CEO's family. Table 4.4 additionally shows the p-values of tests on coefficient differences between all female treatment groups and the male treatment group mentioning the family neutrally (2M). Focusing on column 3 that includes all demographic and study controls, we see that all coefficients on female treatment groups are significantly different from 2M coefficients, at least at the 10 percent level. This suggests that neutrally mentioning families of CEOs may particularly activate gendered care stereotypes in respondents' reasoning that lead to an assessment difference of their quality as CEOs. Although the coefficients are not significantly different between the female treatments, the effect size is largest for the 3F treatment group that highlights the (successfully navigated) trade-off between family and career for the female CEO.[14] The coefficient sizes imply a 1.4-2 percentage point

[14]This seems to be partially driven by respondents' confidence about their answers within the female CEO treatments as reported in Table 4.A.4. In particular, respondents are significantly less confident about their answers in the treatment that neutrally mentions the female CEO's family compared to a female CEO without family mention.

decrease in the share of respondents expecting a better stock performance after CEO appointment, relative to a baseline share of 90.43 percent in the 2M treatment.[15]

Outcome 2: Investment in the firm's stock at the date of CEO appointment

While expected firm performance on the stock market gives a first indication of respondents' assessment of perceived CEO impact on firm outcomes, we are also interested in real investment decisions of participants. To this end, we let participants choose how to invest a total of €100 into either the stock of PHARMA AG or a financial portfolio following the trend of the German stock index (DAX). The money would be invested for one year after CEO appointment and respondents are aware that five of them will randomly be picked to receive the realized values of these investments after the experiment. Hence, investment decisions in this question may reflect actual investment behavior on the stock market. Table 4.5 shows treatment effects of differential coverage of female and male CEOs compared to the baseline treatment of a male CEO without mentioning his family (1M).[16]

Consistent with the results on firm performance, we again observe that most of the differences are observed for treatments that neutrally mention the CEO's family. In particular, respondents invest around €3.45 less into the stock of the firm if the existence of a family is neutrally mentioned for a female CEO. This corresponds to 6.5 percent of the baseline mean of group 1M, and coefficients are stable under different empirical specifications with varying sets of control variables. Investment amounts into the PHARMA AG stock are not distinguishable from the baseline group for all other treatments, but all investment sums differ significantly from the ones in treatment 2F. This implies that the penalty in perceived firm performance for the family-career trade-off treatment 3F compared to 2M does not translate into lower investments.

To understand whether these treatment effect stems from shifts around the mean of the distribution or movements to extreme investments, Figure 4.5 shows the distribution of investment sums across respondents, separately by treatment group. The average investment into the PHARMA AG stock is around €53, i.e. slightly more than half of the assigned budget. Overall, the investment distribution looks very similar for all treatment groups, but group 2F shows a few interesting patterns. There is a notable

[15] We do not find any differences in the expected range of better or worse stock performance in five-percentage-point categories (not shown).

[16] In the pilot to this study, we had tried a version of this question where respondents could invest into a savings account with a guaranteed return of 2 percent on their investment instead of the DAX ETF. The 247 participants who were presented with this alternative investment are hence not part of the estimation sample for Table 4.5.

Table 4.5: Treatment effects on investment in stock of PHARMA AG compared to DAX ETF out of €100

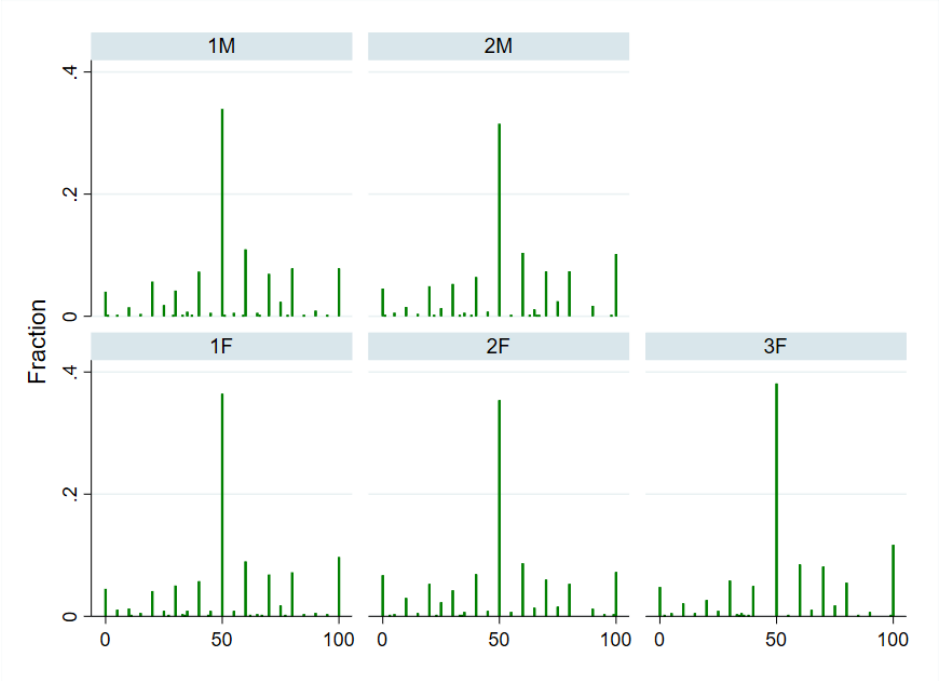
Outcome: investment into stock of PHARMA AG (in EUR)			
	(1)	(2)	(3)
Baseline mean:	53.23 EUR (1M)		
2M - family neutral	1.155	0.679	0.591
	(1.491)	(1.483)	(1.481)
1F - no family	0.332	0.099	-0.063
	(1.451)	(1.457)	(1.451)
2F - family neutral	-3.421**	-3.455**	-3.459**
	(1.466)	(1.459)	(1.455)
p-value 2F-2M:	[0.003***]	[0.006***]	[0.007***]
p-value 2F-1F:	[0.012**]	[0.016**]	[0.021**]
p-value 2F-3F:	[0.002***]	[0.005***]	[0.005***]
3F - family trade-off	1.142	0.746	0.730
	(1.465)	(1.461)	(1.460)
Control for individual demographics	No	Yes	Yes
Further study controls	No	No	Yes
R-squared	0.005	0.046	0.055
N	2,764	2,764	2,764

Notes: Results of regression of incentivized outcome 2 (investment in stock of PHARMA AG compared to DAX ETF out of €100 at date of CEO appointment) on treatment group dummies and control variables, and p-values of treatment effects for different group comparisons. Standard errors in parenthesis, *p <0.10, **p<0.05, ***p<0.01.

increase in zero investments compared to the other groups, and a sizable reduction in the fraction of respondents who invest all of their €100 into the firm stock.

Both Table 4.5 and Figure 4.5 suggest that there is no penalty for women if the family is mentioned in a context that highlights the trade-off between family and career. One potential explanation for this is that the additional information given to respondents about this particular female CEO having managed to combine both successfully resolves the uncertainty around care obligations of this CEO and sends a signal of high ability. Instead, the 2F treatment that neutrally mentions the family could cater to a more stereotypical mindset for the participants if it creates uncertainty about the involvement in family life of the female CEO and how much this affects the dedication to their role in the firm. Interestingly, such mechanisms do not seem to be at play for men where the 2M group actually seems to see a bonus in terms of investment compared to 1M, although not statistically significant. We will explore this further in

Figure 4.5: Distribution of investment in stock of PHARMA AG compared to DAX ETF



Notes: Distribution of investment in stock of PHARMA AG compared to DAX ETF out of €100 by treatment group. The y-axis denotes the fraction of respondents within each treatment group investing a particular amount.

the free-text answers in section 4.4.2.

Outcome 3: Beliefs about CEO approval by employees on Glassdoor

Thinking about employees' assessment of CEOs could lead to very different hypotheses compared to firm performance. While caring for a family seems potentially detrimental to firm success due to increased obligations on other dimensions than work, family involvement might come with increased ability to also care for employees and may foster identification with the CEO among employees who have children. While we don't observe any statistically significant differences in respondents' beliefs about employee satisfaction with the CEO 1.5 years after their appointment on the platform Glassdoor, there is weak evidence that male CEOs are associated with higher employee ratings if they have a family (see Table 4.6). Figure 4.6 shows that this seems to be driven by a general shift of the distribution in 2M to the right, but also by more participants assuming that the male CEO has a perfect score among employees. No striking patterns can be observed for the female CEO treatment groups: although all coefficients are negative in our preferred specification in column 3 of Table 4.6, the overall difference

between male and female CEOs is not statistically distinguishable from zero.

Table 4.6: Treatment effects on beliefs about CEO approval by employees on Glassdoor

Outcome: expected share of employees approving of CEO						
	(1)	(2)	(3)	(4)	(5)	(6)
Baseline mean:	63.48% (1M)			64.05% (Male CEO)		
2M - family neutral	1.162	0.826	0.817			
	(1.124)	(1.115)	(1.107)			
1F - no family	-0.520	-1.085	-1.272			
	(1.139)	(1.116)	(1.102)			
p-value 1F-2M:	[0.157]	[0.103]	[0.069*]			
2F - family neutral	-0.283	-0.329	-0.387			
	(1.093)	(1.069)	(1.056)			
3F - family trade-off	0.354	-0.448	-0.448			
	(1.111)	(1.085)	(1.067)			
CEO gender				-0.715	-1.022	-1.099
				(0.733)	(0.719)	(0.709)
Control for individual demographics	No	Yes	Yes	No	Yes	Yes
Further study controls	No	No	Yes	No	No	Yes
R-squared	0.001	0.068	0.113	0.000	0.068	0.113
N	3,011	3,011	3,011	3,011	3,011	3,011

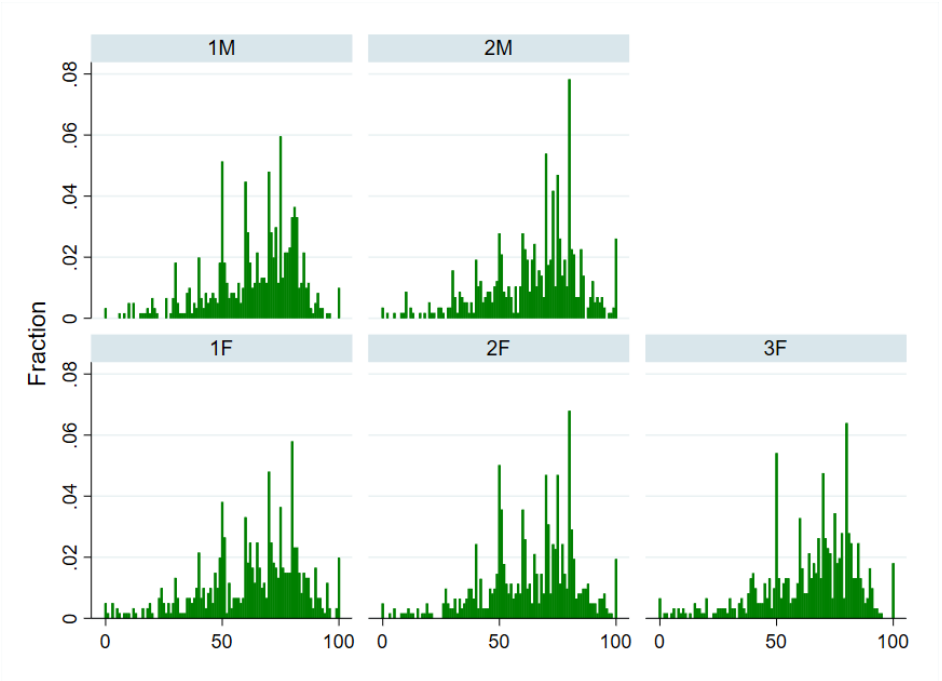
Notes: Results of regression of incentivized outcome 3 (beliefs about CEO approval by employees on Glassdoor) on treatment group dummies and control variables (columns 1-3). Results of regression of incentivized outcome 3 on CEO gender dummy and control variables (columns 4-6). Standard errors in parenthesis, *p <0.10, **p<0.05, ***p<0.01.

Outcome 4: Beliefs about CEO 'survival'

As a last outcome, we elicit respondents' beliefs about the persistence of the female and male CEOs in their leading position. This question aims at isolating the perceptions about CEO competence as well as potential consequences of the expected firm performance and employee ratings as assessed in the previous outcomes. For example, participants could be thinking about the firm going very well in the year after CEO appointment, employees being very satisfied with the CEO around 1.5 years after appointment and hence assume that this person is still CEO after two years, and vice versa. With this medium-term persistence, we are hence most likely going to measure direct consequences of performance and employee rating while asking about 5-year 'survival' captures competence in a longer time horizon.

As for firm performance, expected 'survival' after two years is overall very high at 88.4 percent. Again, there is no significant difference between treatment groups (see columns 1-3 of Table 4.7). Beliefs about 5-year CEO 'survival' are considerable

Figure 4.6: Distribution of believed CEO approval of employees



Notes: Distribution of beliefs about CEO approval of employees on Glassdoor by treatment group. The y-axis denotes the fraction of respondents within each treatment group believing in a particular approval score.

more pessimistic (69.8 percent), but again there is no differences by CEO gender or stereotypical representation (columns 4-6).[17]

4.4.2 Mechanisms from text analysis

Two free-text questions allow us to explore some of the mechanisms we eluded to in section 4.4.1. We allow respondents twice to explain the reasoning behind their answers. First, we ask them to elaborate on positive and negative characteristics of a CEO that employees might consider when ranking them on Glassdoor. Second, we elicit why individuals expect a CEO to (not) be in their position two years after their appointment, hereby highlighting that they should keep in mind their reasoning for all presented outcome questions. In both cases, participants have to provide at least 25 characters before being allowed to move on to the next question, and the button to proceed to the next question only appears after ten seconds.

A first step to analyze the answers to these questions is to assess their quality. To this end, we define nonsense-answers as those who only contain special characters or numbers, that are composed of only one letter, or that do not contain any word from

[17]There is also no pattern in confidence about respondents' answer to this question (not shown).

Table 4.7: Treatment effects on beliefs about CEO 'survival'

	Outcome: share of respondents believing in 'survival' of CEO					
	two years			five years		
	(1)	(2)	(3)	(4)	(5)	(6)
Baseline mean:	87.91% (1M)			68.69% (1M)		
2M - family neutral	0.008	0.005	0.008	0.026	0.018	0.020
	(0.019)	(0.019)	(0.019)	(0.031)	(0.031)	(0.031)
1F - no family	-0.010	-0.015	-0.017	0.019	0.011	0.011
	(0.019)	(0.019)	(0.019)	(0.031)	(0.031)	(0.031)
2F - family neutral	0.019	0.019	0.016	0.016	0.008	0.009
	(0.018)	(0.018)	(0.018)	(0.031)	(0.031)	(0.031)
3F - family trade-off	0.008	0.001	-0.002	-0.004	-0.013	-0.011
	(0.018)	(0.018)	(0.018)	(0.031)	(0.031)	(0.031)
Control for individual demographics	No	Yes	Yes	No	Yes	Yes
Further study controls	No	No	Yes	No	No	Yes
R-squared	0.001	0.034	0.052	0.001	0.016	0.034
N	3,011	3,011	3,011	2,236	2,236	2,236

Notes: Results of regression of beliefs about CEO 'survival' of two years in office (incentivized outcome 4) and five years in office on treatment group dummies and control variables. Standard errors in parenthesis, *p <0.10, **p<0.05, ***p<0.01.

the German vocabulary of the spaCy library[18]. Overall, the share of nonsense-answers is between two and seven percent in the two free-text answering options (see Table 4.8). Furthermore, the correlation between providing a nonsense-answer in either of the questions is around 0.6, i.e. positive and relatively high (not shown).[19]

Interestingly, there is some variation in the share of nonsense-answers, both by question type and treatment group. The share of nonsense-answers is significantly lower (higher) for those who indicated that the CEO would (not) 'survive' in their position for two years. This seems to be driven by treatment groups 1M and 2F for 'survival' compared to 1F, 1M, and 3F for no survival. Additionally, there seems to be a treatment effect on the share of nonsense-answers for the question on employee approval. In particular, respondents in group 3F provide significantly fewer nonsense-answers compared to the baseline treatment 1M (see Table 4.A.5). One potential explanation may be that they feel more of an urge to explain their answer when being assigned the female treatment article with a family-career trade-off.

[18]See `https://spacy.io/` (Last accessed: 04 November 2024).

[19]Running a simple regression of an indicator on ever providing a nonsense-answer on all control variables we use in our regressions shows that nonsense-answers are less common among females, the oldest respondents, those who have ever invested in the stock market, those who did not look up information on the real firm, those who want more females as CEOs in German DAX firms, and those who themselves have a female CEO (not shown). Hence, simply excluding these respondents would lead to a selected subsample of participants.

Table 4.8: Distribution of nonsense-answers

	Whole sample	1M	2M	1F	2F	3F
Nonsense Q3 Approval reason	0.03	0.04	0.04	0.03	0.05	0.02
Nonsense Q4 Survival reason	0.02	0.02	0.03	0.03	0.03	0.01
Nonsense Q4 No-Survival reason	0.07	0.11	0.05	0.06	0.06	0.07
Diff. Q3 Approval vs Q4 Survival Reason	.01***	.02**	.01	0	.02*	.01
	(2.96)	(2.38)	(.8)	(.15)	(1.85)	(1.59)
Diff. Q3 Approval vs Q4 No-Survival Reason	-.04***	-.07***	-.01	-.04*	-.02	-.05***
	(-3.55)	(-2.77)	(-.31)	(-1.66)	(-.65)	(-2.84)
N(Q3)	3011	604	575	604	618	610
N(Q4 Survival)	2662	531	510	525	555	541
N(Q4 No-Survival)	349	73	65	79	63	69

Notes: Share of answers identified as nonsense for question on reasons for Glassdoor approval and reasons for beliefs about why CEO is still in place after two years (for participants believing in 'survival') or not (those believing in 'no-survival') as well as differences in shares of nonsense-answers between questions overall and within each treatment group. T-statistics in parenthesis, *p <0.10, **p<0.05, ***p<0.01.

An additional dimension of interest is the share of respondents who seem to be answering out of intuition rather than for specific reasons.[20] To detect them, we search for answers containing variations of the phrase *"I don't know"* (e.g. *I have no idea*, *no clue*, ...). Overall, between 6 and 20 percent of respondents provide such an answer for the questions about employee approval and CEO 'survival' in the firm (Table 4.9). Again these shares are significantly different between the questions: compared to the share of don't know-answers in the reasoning on outcome 3, the share of don't know-answers in the reasoning on outcome 4 is significantly lower (higher) for those participants believing in CEO 'survival' ('no-survival'). These differences remain stable across treatments groups for participants believing in 'survival', and are mostly driven by 1M and 2F for 'no survival'. Additionally, there is evidence for a difference in the share of non-substantiated answers between the two treatments without family mention for the question on 'survival' (1M and 1F, see Table 4.A.6).

For the further analysis of the text answers, we preprocess all texts following standard techniques from natural language processing. All texts are converted to lower case, and numbers, punctuation, and special characters are removed. We take out all common German stopwords combining the collections from Python's advertools[21] and NLTK[22] libraries as well as prepositions, conjunctions, and some colloquial fillers (e.g., *blabla*). Using the spaCy library, all words are reduced to their grammatical roots (lemmatization). Furthermore, we combine some words that appear frequently to n-grams (*e.g., fresh_ wind*) and group some words that refer to positions in a grammatically gendered

[20] Potentially, not giving any reasoning reflects a lack of interest in the survey which is equally interesting to our analysis.

[21] See `https://advertools.readthedocs.io/en/master/advertools.stopwords.html` (Last accessed: 04 November 2024).

[22] See `https://www.nltk.org/search.html?q=stopwords` (Last accessed: 04 November 2024).

Table 4.9: Distribution of don't know-answers

	Whole sample	1M	2M	1F	2F	3F
Don't know Q3 Approval reason	0.13	0.13	0.12	0.13	0.13	0.13
Don't know Q4 Survival reason	0.06	0.08	0.05	0.05	0.06	0.05
Don't know Q4 No-Survival reason	0.20	0.23	0.18	0.16	0.24	0.19
Diff. Q3 Approval vs Q4 Survival Reason	.07***	.05***	.07***	.08***	.07***	.07***
	(8.67)	2.78	3.77	4.77	3.88	4.28
Diff. Q3 Approval vs Q4 No-Survival Reason	-.08***	-.11**	-.06	-.04	-.11**	-.06
	(-3.91)	(-2.47)	(-1.49)	(-.96)	(-2.42)	(-1.44)
N(Q3)	3011	604	575	604	618	610
N(Q4 Survival)	2662	531	510	525	555	541
N(Q4 No-Survival)	349	73	65	79	63	69

Notes: Shares of don't know-answers for question on reasons for Glassdoor approval and reasons for beliefs about why CEO is still in place after two years (for participants believing in "survival") or not (those believing in "no survival") as well as differences in shares of don't know-answers between questions overall and within each treatment group. T-statistics in parenthesis, *p <0.10, **p<0.05, ***p<0.01.

way[23]. Finally, we remove CEO names and words that directly refer to the question text.

Given the focus of our study on gender and family of the CEOs, we assess the importance that participants assign to these concepts in their reasoning. For this purpose, we calculate the share of answers that mention terms related to the topics gender and family. The list of terms capturing gender and family are generated using ChatGPT.[24] To deal with the fact that sometimes respondents mention the term *family* in relation to PHARMA AG being a family-owned company, we separately search for terms capturing this aspect (e.g., *family business*) and exclude these from capturing the topic family more generally. Figure 4.7 shows that the topic gender is predominantly mentioned in treatments with a female CEO (in 14 to 20 percent of responses). The topic family is generally brought up more often in the treatments where the family is mentioned, both for the male and female CEO. Additionally, this share increases in treatment 3F that mentions the family-career trade-off (17 percent of all answers).[25]

In addition to mentioning terms related to family and gender, the sentiment attached to these concepts can give further indication of mechanisms driving participants' decision-making. To assess this, we manually tag whether a family- or gender-related word has a more positive or negative connotation (or both).[26] Figure 4.8 shows the

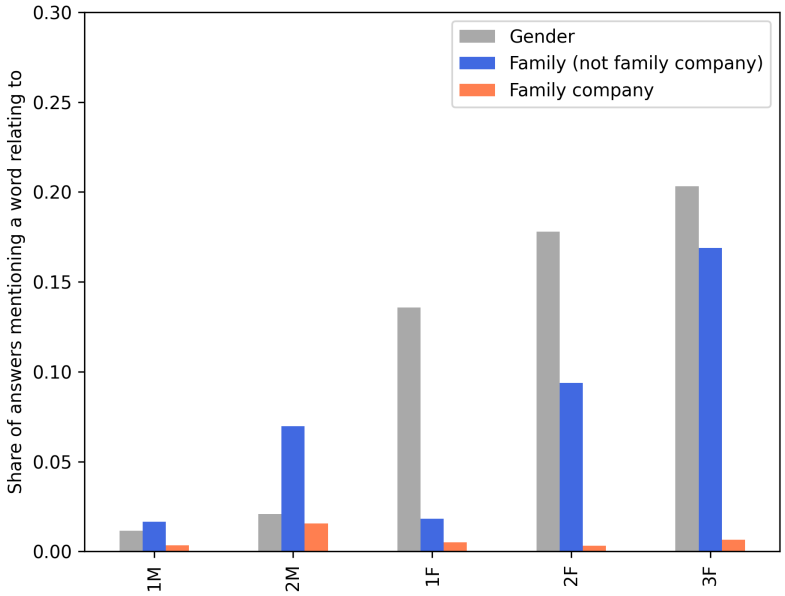
[23]In German, most occupations and many words used to refer to a man or woman in a certain position are gendered. E.g the term *chefin* refers to a female boss while *chef* refers to a male boss. We group these terms as *chef_in*.

[24]We use the following request separately for gender and family in ChatGPT (in German): "I would like to measure whether a text mentions the topic family (gender). Can you create a list of terms that I can search for?"

[25]Figure 4.A.3 shows the same bar graphs for the reasoning regarding CEO 'survival'. The shares of respondents mentioning gender and family are lower, but the general patterns from Figure 4.7 hold.

[26]Some words, like *gender quota* without any further context, cannot be categorized as positive or negative and will hence be missing from the count.

Figure 4.7: Mentioning of gender and family words in reasoning on Glassdoor approval



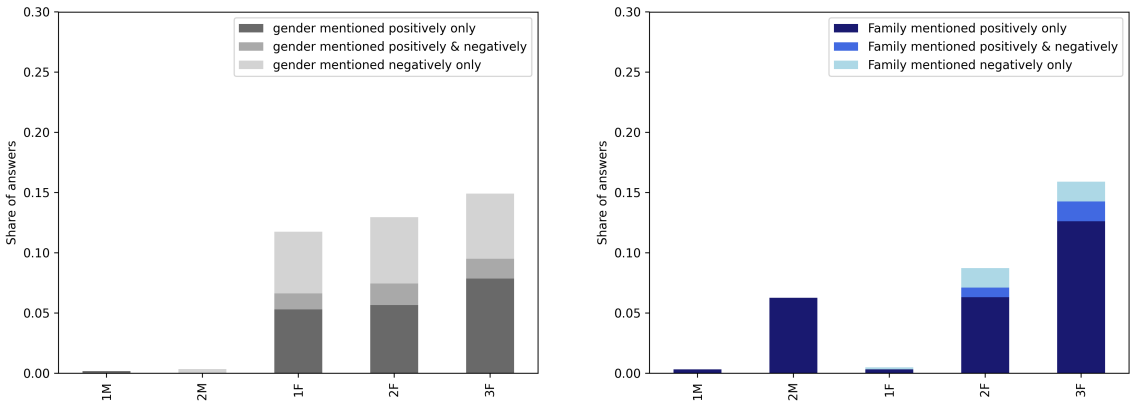
Notes: Shares of answers mentioning at least one term related to gender, family or PHARMA AG as family-owned business for question on reasons for Glassdoor approval by treatment group.

share of sentiments across treatment groups for the question about employee approval on Glassdoor. While the few answers relating to gender in the treatment groups with a male CEO are rarely associated with a specific sentiment, the gender-related parts within the female CEO treatments are mostly balanced in their positive and negative connotation. For the trade-off treatment 3F there is a larger portion of positive mentions.

Family-related words (not related to family businesses) are mostly mentioned in a positive way which may be related to the assumption that CEOs with a family are particularly able to take care of their employees. For female CEOs, there is also a small share of family-related answers with negative connotation, but the vast majority remains positively associated. This is again particularly true for the trade-off treatment 3F: 14 percent of answers mention family-related words with a positive connotation compared to 6 and 7 percent in groups 2M and 2F respectively. This is in line with a positive view of a female CEO having successfully combined a career and care responsibilities and her being perceived as particularly positively selected. [27]

[27] The sentiment in answers to the question about CEO 'survival' are very much aligned with the expected 'survival' of the CEO in the firm (Figures 4.A.4 and 4.A.5). Overall, answers tend to be harder to categorize into positive and negative connotations, but those who are mention gender and family positively for expected 'survival' (panel a) and negatively for expected 'no-survival' (panel b).

Figure 4.8: Sentiment of gender and family words in reasoning on Glassdoor Approval



(a) gender (b) family

Notes: Shares of answers mentioning gender and family in positive or negative or both positive and negative ways for question on reasons for Glassdoor approval by treatment group.

4.4.3 Heterogeneous treatment effects

Heterogeneity by respondent gender

Given the focus of our study on gender and family, we assess whether female and male participants respond differently to the stereotypical coverage of CEOs in newspapers. This may be the case if female and male respondents differ in their gender norms, or in their exposure to women in leadership positions. In fact, both of this is true in our sample: female respondents are significantly more likely to have a female CEO (29.7 percent, vs 9.8 percent of men, Table 4.A.7) and they are more strongly in favor of more women in leadership positions than men (although they already believe more CEOs of German DAX-40 companies to be female compared to men, Table 4.A.7). Hence, female respondents in our sample are both more exposed to female leadership and they hold more progressive gender norms in this regard.

Different gender norms across female and male respondents also translate into gender differences in their investment behavior. Table 4.10 shows the main results from Table 4.5 separately by participant gender. Even though women in our sample are significantly more risk-averse than men, they invest significantly more into the stock of PHARMA AG compared to the theoretically less volatile DAX ETF in the baseline (1M). Both genders invest less into the stock when the family is mentioned neutrally for a female CEO (2F) with the effect being more pronounced for female respondents. Men to some extent assign an investment bonus to female CEOs with the successful management of a family-career trade-off highlighted (3F). For both genders, there is

Table 4.10: Treatment effects on investment in stock of PHARMA AG compared to DAX ETF, by gender

	(1)	(2)	(3)	(4)	(5)	(6)
		Men			Women	
Baseline mean (1M):	50.80EUR			55.80EUR		
2M - family neutral	2.665	3.050	2.967	-0.426	-1.063	-1.097
	(2.179)	(2.195)	(2.205)	(2.024)	(2.029)	(2.021)
1F - no family	0.409	0.073	-0.352	0.097	0.218	0.131
	(2.122)	(2.113)	(2.094)	(1.959)	(2.024)	(2.021)
2F - family neutral	-2.904	-2.717	-2.544	-3.926**	-4.154**	-4.374**
	(2.184)	(2.189)	(2.183)	(1.946)	(1.960)	(1.958)
p-value 2F-2M:	[0.013**]	[0.01**]	[0.014**]	[0.091*]	[0.127]	[0.104]
p-value 2F-1F:	[0.128]	[0.197]	[0.308]	[0.045**]	[0.029**]	[0.025**]
p-value 2F-3F:	[0.033**]	[0.043**]	[0.072*]	[0.019**]	[0.034**]	[0.022**]
3F - family trade-off	1.756	1.746	1.424	0.859	0.173	0.272
	(2.127)	(2.144)	(2.148)	(2.002)	(2.028)	(2.038)
Control for individual demographics	No	Yes	Yes	No	Yes	Yes
Further study controls	No	No	Yes	No	No	Yes
R-squared	0.005	0.055	0.066	0.005	0.042	0.053
N	1,417	1,417	1,417	1,336	1,336	1,336

Notes: Results of regression of incentivized outcome 2 (investment in stock of PHARMA AG compared to DAX ETF out of €100) on treatment group dummies and control variables, by gender. Standard errors in parenthesis, *p <0.10, **p<0.05, ***p<0.01.

statistically significantly less investment in the female CEO with neutral family mention compared to a highlighted successful family-career trade-off (3F vs 2F), though.

Gender differences further appear in respondents' investment in female CEOs with neutral versus without mention of family (2F vs 1F) and versus male CEOs with neutral family mention (2F vs 2M). Female respondents invest significantly less in female CEOs with neutral family mention compared to no mention, which may stem from their own experience with female CEOs. For male respondents, there is no significant effect here. Instead, for male respondents the important differences seem to come from the comparison of male and female CEOs with a family. There is suggestive evidence that male participants invest a premium in 2M also in comparison to the baseline (1M), while female respondents actually invest slightly less in this case. This results in men's investment in 2F being significantly lower than in 2M, while for women this difference is not statistically significant.

Female and male participants also have different expectations around a CEO's employee approval on Glassdoor. This is especially striking for the treatment that highlights the trade-off between family and career (3F, see Table 4.11). Male participants positively value a successful management of career and family when considering employee satisfaction, compared to both female (1F) and male CEOs (1M, baseline) with-

Table 4.11: Treatment effects on beliefs about CEO approval of employees, by gender

	(1)	(2)	(3)	(4)	(5)	(6)
		Men			Women	
Baseline mean (1M):	64.04%			62.89%		
2M - family neutral	1.506	1.527	1.527	0.798	0.329	0.271
	(1.567)	(1.549)	(1.546)	(1.623)	(1.633)	(1.592)
1F - no family	-0.011	-0.283	-0.373	-1.168	-2.040	-2.418
	(1.591)	(1.564)	(1.552)	(1.640)	(1.591)	(1.558)
2F - family neutral	0.980	1.192	1.230	-1.499	-2.152	-2.445
	(1.539)	(1.538)	(1.513)	(1.564)	(1.501)	(1.489)
p-value 2M-2F:	[0.743]	[0.834]	[0.849]	[0.160]	[0.112]	[0.086*]
3F - family trade-off	2.802*	2.346	2.266	-2.218	-3.581**	-3.550**
	(1.442)	(1.437)	(1.427)	(1.706)	(1.663)	(1.614)
p-value 1F-3F:	[0.068*]	[0.084*]	[0.075*]	[0.556]	[0.371]	[0.494]
p-value 2M-3F:	[0.393]	[0.583]	[0.613]	[0.088*]	[0.026**]	[0.024**]
Control for individual demographics	No	Yes	Yes	No	Yes	Yes
Further study controls	No	No	Yes	No	No	Yes
R-squared	0.003	0.060	0.107	0.003	0.092	0.147
N	1,529	1,529	1,529	1,470	1,470	1,470

Notes: Results of regression of incentivized outcome 3 (beliefs about CEO approval by employees on Glassdoor) on treatment group dummies and control variables, by gender. Standard errors in parenthesis, *p <0.10, **p<0.05, ***p<0.01.

out the family being mentioned. Female respondents are generally more pessimistic about employees' rating of female CEOs, in particular compared to male CEOs with a family that is only mentioned (2M).

Heterogeneity by respondent parental status

Equivalently to respondent gender, the focus of the articles on family also suggests a potentially different reaction of parents and non-parents to the treatments. We identify the parental status of participants through a question asking them about the composition of their household. More precisely, we ask them to give us the number of all female, male, or non-binary members currently living in their household, both below the age of 18 and above. A respondent is considered a parent if there is at least one person below the age of 18 in the household. Although this may include non-biological children and may exclude children that do not live with their parents (anymore), we are mostly after the exposure to care responsibilities which should be concentrated in the presence of children living in the household. Around 30 percent of respondents ($n = 891$) are classified as parents following this definition.[28]

[28]The median number of children reported among parents is 1 while the average is 1.62, and this comes similarly from female and male children.

Table 4.12: Treatment effects on investment in stock of PHARMA AG compared to DAX ETF, by parental status

	(1)	(2)	(3)	(4)	(5)	(6)
		Childless			Parents	
Baseline mean (1M):	52.07EUR			55.75EUR		
2M	2.221	1.583	1.498	-1.138	-1.231	-1.645
	(1.815)	(1.813)	(1.806)	(2.599)	(2.622)	(2.642)
1F	1.086	0.856	0.671	-1.257	-0.998	-1.086
	(1.753)	(1.758)	(1.744)	(2.582)	(2.625)	(2.623)
2F	-1.361	-1.635	-1.695	-7.892***	-7.643***	-7.524***
	(1.801)	(1.784)	(1.783)	(2.506)	(2.579)	(2.567)
p-value 2F-2M:	[0.057*]	[0.085*]	[0.086*]	[0.009***]	[0.015**]	[0.025**]
p-value 2F-1F:	[0.179]	[0.167]	[0.189]	[0.010**]	[0.010**]	[0.013**]
p-value 2F-3F:	[0.039**]	[0.046**]	[0.045**]	[0.019**]	[0.025**]	[0.026**]
3F	2.396	1.942	1.917	-1.659	-1.673	-1.611
	(1.750)	(1.737)	(1.739)	(2.660)	(2.702)	(2.695)
Control for individual demographics	No	Yes	Yes	No	Yes	Yes
Further study controls	No	No	Yes	No	No	Yes
R-squared	0.003	0.003	0.003	0.015	0.015	0.015
N	1,947	1,947	1,947	817	817	817

Notes: Results of regression of incentivized outcome 2 (investment in stock of PHARMA AG compared to DAX ETF out of €100) on treatment group dummies and control variables, by parental status of respondents. Standard errors in parenthesis, *p <0.10, **p<0.05, ***p<0.01.

As for gender, respondents take very different decisions depending on their parental status. Parents and childless respondents already invest differently in the baseline treatment (1M) with parents allocating a larger share of their endowment to the stock of PHARMA AG. This is again in contrast to parents being significantly more risk-averse in the overall sample. Parents tend to evaluate both a male CEO with family mention and all female CEOs worse than the baseline male CEO without family mention (1M), although only significantly so for a female CEO with neutral family coverage (2F, Table 4.12). The latter group is also punished most compared to all other treatment groups with parents investing almost 8€ less into the stock of PHARMA AG when presented with the corresponding treatment article. This implies that parents anticipate the care responsibilites for CEOs that are parents, both for male CEOs when the family is mentioned, and, in particular, for female CEOs across both family groups. For childless participants, the comparison to the baseline group (1M) seems to be less important, although they seem to invest slightly more when there is a male CEOs whose family is neutrally mentioned (2M). In particular, this is true compared to a female CEO with neutral family mention (2F). Most strikingly, childless individuals assign a premium to female CEOs with a family when it is highlighted that they successfully managed the trade-off between career and family (3F). Hence, childless individuals seem to particularly believe in positive selection of the female CEO in treatment 3F.

Table 4.13: Treatment effects on beliefs about CEO approval by employees on Glassdoor, by parental status

	(1)	(2)	(3)	(4)	(5)	(6)
		Childless			Parents	
Baseline mean (1M):	64.37%			61.53%		
2M	0.504	-0.212	-0.137	2.555	3.314	3.300
	(1.328)	(1.331)	(1.320)	(2.100)	(2.082)	(2.063)
1F	-1.772	-2.415*	-2.650**	2.269	2.161	2.009
	(1.363)	(1.348)	(1.324)	(2.068)	(1.995)	(1.990)
2F	-0.300	-0.333	-0.402	-0.194	-0.329	-0.080
	(1.309)	(1.299)	(1.291)	(1.978)	(1.920)	(1.879)
p-value 2M-2F:	[0.557]	[0.930]	[0.843]	[0.192]	[0.079*]	[0.095*]
3F	-0.263	-0.874	-0.811	1.505	0.756	0.998
	(1.283)	(1.266)	(1.242)	(2.226)	(2.169)	(2.151)
p-value 1F-3F:	[0.273]	[0.254]	[0.156]	[0.741]	[0.523]	[0.645]
p-value 2M-3F:	[0.568]	[0.618]	[0.599]	[0.654]	[0.271]	[0.314]
Control for individual demographics	No	Yes	Yes	No	Yes	Yes
Further study controls	No	No	Yes	No	No	Yes
R-squared	0.001	0.059	0.112	0.003	0.127	0.165
N	2,120	2,120	2,120	891	891	891

Notes: Results of regression of incentivized outcome 3 (beliefs about CEO approval by employees on Glassdoor) on treatment group dummies and control variables, by parental status of respondents. Standard errors in parenthesis, *p <0.10, **p<0.05, ***p<0.01.

Parents also assess employee satisfaction differently from non-parents. In particular, parents expect higher employee ratings for male CEOs with a family (2M) and for female CEOs without family mention (1F) or with successful management of a family-career trade-off (3F) compared to the baseline (1M). Instead, for female CEOs with neutral mention of their family (2F), parents expect lower employee ratings, especially compared to a male CEO with neutral family mention (2M). Instead, childless respondents generally assume that employees rate female CEOs worse, in particular if no family is mentioned (1F). These findings suggest that parents value the empathy aspect of having a family or being female for employee satisfaction while childless individuals may perceive female CEOs as less competent in maintaining a satisfied workforce in the firm.

4.5 Conclusion

This paper investigates how stereotypical newspaper coverage of male and female CEOs affects readers' economic decision-making and their assessment of CEO competence. We conduct an online experiment in which we vary whether and how the family of

a CEO is mentioned in a newspaper article, either not at all, neutrally, or in the framework of a trade-off between career and family. Respondents are then incentivized to answer questions on expected firm performance one year after CEO appointment, expected employee satisfaction with the CEO 1.5 years after appointment, and CEO 'survival' in the firm after two and five years. Additionally, participants can invest an endowment of €100 in the firm's stock or a DAX ETF for one year following the CEO's appointment; a subset of participants receives their investment payout upon completion of the study.

We find that expected firm performance differs substantially by CEO gender with participants being less likely to believe in better stock performance in the year after compared to the year before CEO appointment for female CEOs. Further, investment amounts are significantly lower for female CEOs whose family is neutrally mentioned. Instead, highlighting the successful management of family and career as a trade-off for female CEOs, does not lead to less favorable investment decisions. Considerations about family and gender play a role in respondents' reasoning, and treatment effects are most pronounced for female respondents and parents. There is no effect of stereotypical coverage on CEO 'survival'. Women expect female CEOs to be rated worse by their employees, in particular for the treatment highlighting a trade-off between family and career, while male participants perceive an employee bonus for female CEOs in the trade-off treatment compared to female CEOs without a family mention. Heterogeneities by gender may be driven by differences in exposure to and gender norms regarding women in leadership positions.

Our results highlight the importance of media coverage in shaping readers' perceptions and economic decisions. Gendered and stereotypical portrayal of CEOs is wide-spread in German media (Sondergeld, 2024). Given that nearly 65 percent of our participants report reading online or offline newspapers at least once per week, and 43 percent state they have stock market investment experience, the stereotypical representation of CEOs could potentially have a significant impact on stock investments and, consequently, stock market equilibria. Furthermore, the more pessimistic expectations towards firms led by female CEOs may present an additional barrier to women's representation in leadership positions. Policies should take these media-driven effects into account when aiming to create a level playing field for women and men to reach leadership positions. Further, policies can incentivize counter-stereotypical behavior, such as a more gender-equal distribution of caregiving responsibilities, ultimately helping to reduce gender stereotypes over time.

4.A Appendix

4.A.1 Additional figures and tables

Figure 4.A.1: Translation of article text group 1F - female CEO and no information on family

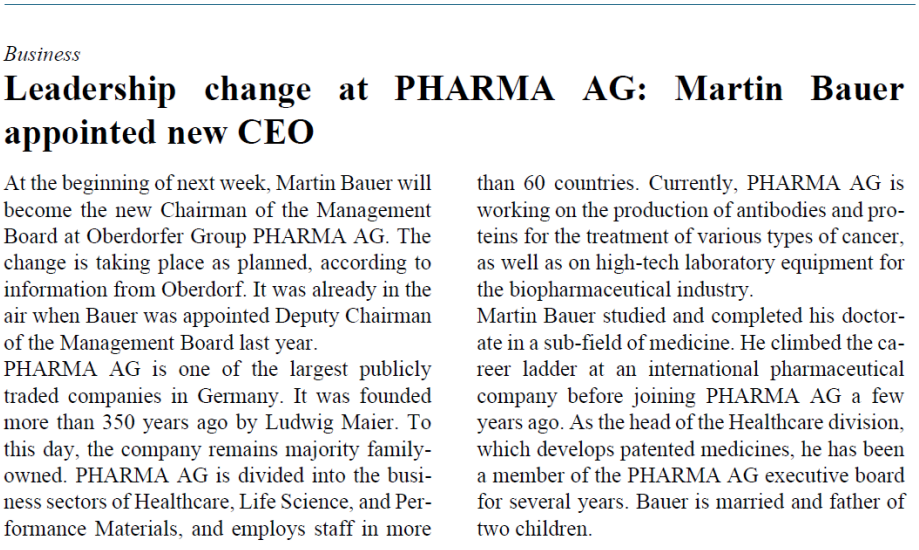
Business

Leadership change at PHARMA AG: Martina Bauer appointed new CEO

At the beginning of next week, Martina Bauer will become the new Chairwoman of the Management Board at Oberdorfer Group PHARMA AG. The change is taking place as planned, according to information from Oberdorf. It was already in the air when Bauer was appointed Deputy Chairwoman of the Management Board last year.
PHARMA AG is one of the largest publicly traded companies in Germany. It was founded more than 350 years ago by Ludwig Maier. To this day, the company remains majority family-owned. PHARMA AG is divided into the business sectors of Healthcare, Life Science, and Performance Materials, and employs staff in more than 60 countries. Currently, PHARMA AG is working on the production of antibodies and proteins for the treatment of various types of cancer, as well as on high-tech laboratory equipment for the biopharmaceutical industry.
Martina Bauer studied and completed her doctorate in a sub-field of medicine. She climbed the career ladder at an international pharmaceutical company before joining PHARMA AG a few years ago. As the head of the Healthcare division, which develops patented medicines, she has been a member of the PHARMA AG executive board for several years.

Notes: English translation (using ChatGPT) of article shown to participants in treatment group with a female CEO and no family mention (1F). The original German text can be found in Figure 4.A.11.

Figure 4.A.2: Translation of article text group 2M - male CEO and information on family



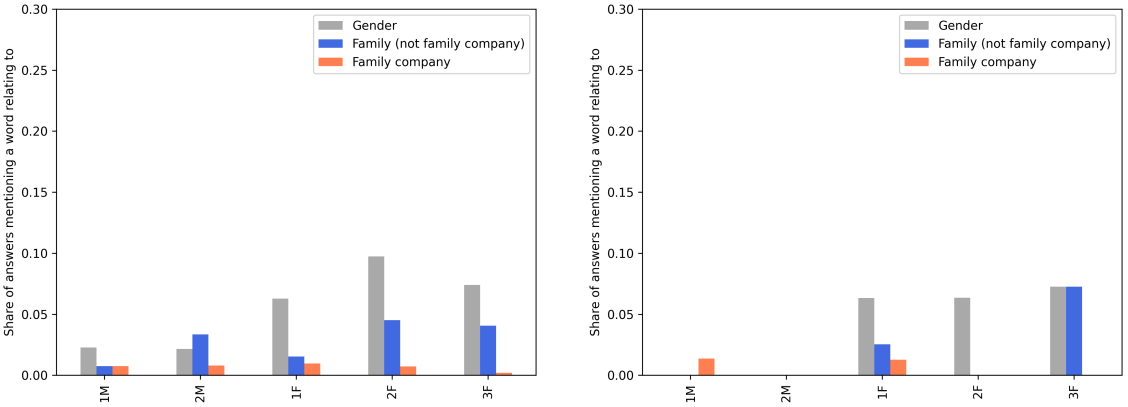
Business

Leadership change at PHARMA AG: Martin Bauer appointed new CEO

At the beginning of next week, Martin Bauer will become the new Chairman of the Management Board at Oberdorfer Group PHARMA AG. The change is taking place as planned, according to information from Oberdorf. It was already in the air when Bauer was appointed Deputy Chairman of the Management Board last year.
PHARMA AG is one of the largest publicly traded companies in Germany. It was founded more than 350 years ago by Ludwig Maier. To this day, the company remains majority family-owned. PHARMA AG is divided into the business sectors of Healthcare, Life Science, and Performance Materials, and employs staff in more than 60 countries. Currently, PHARMA AG is working on the production of antibodies and proteins for the treatment of various types of cancer, as well as on high-tech laboratory equipment for the biopharmaceutical industry.
Martin Bauer studied and completed his doctorate in a sub-field of medicine. He climbed the career ladder at an international pharmaceutical company before joining PHARMA AG a few years ago. As the head of the Healthcare division, which develops patented medicines, he has been a member of the PHARMA AG executive board for several years. Bauer is married and father of two children.

Notes: English translation (using ChatGPT) of article shown to participants in treatment group 2M. The original German text can be found in Figure 4.A.12.

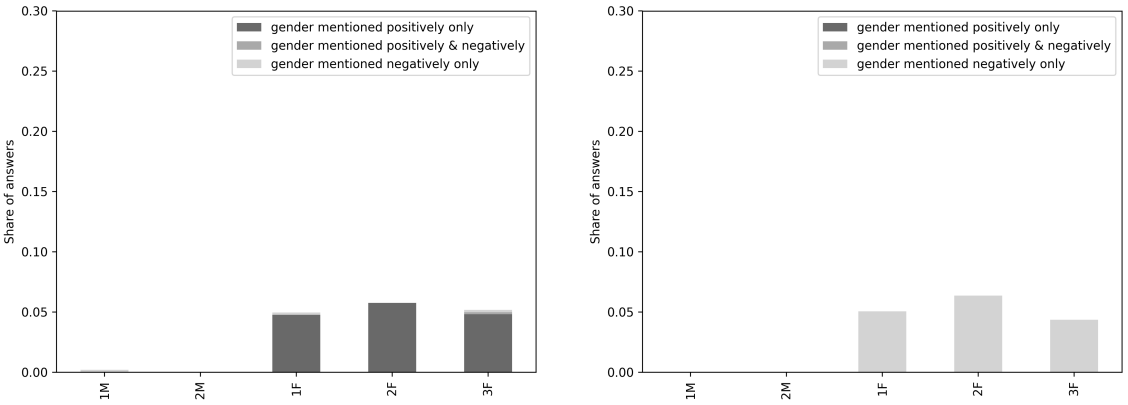
Figure 4.A.3: Mentioning of gender and family words in reasoning on CEO 'survival'



(a) CEO still in place after two years (b) CEO not in place anymore after two years

Notes: Shares of answers mentioning at least one term related to gender, family or PHARMA AG as family-owned business for questions on reasons for believed CEO 'survival' or 'no-survival' by treatment group.

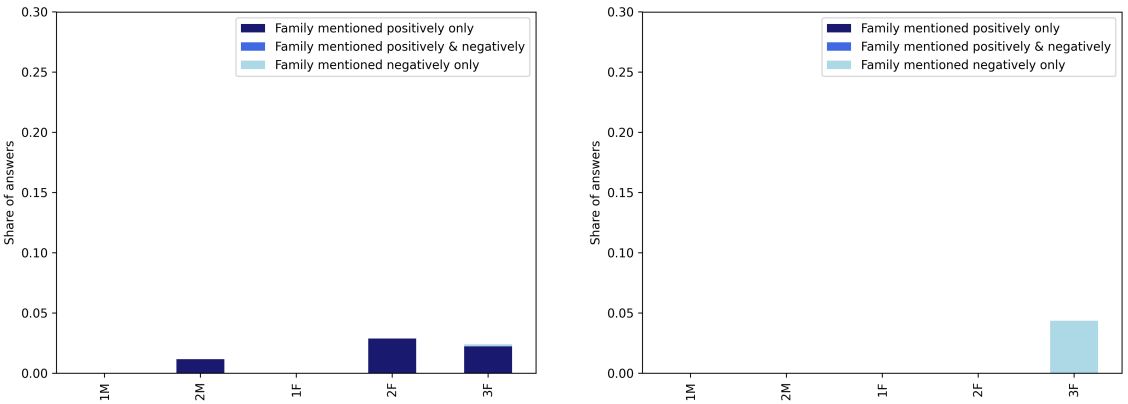
Figure 4.A.4: Sentiment of gender words in reasoning on CEO 'survival'



(a) CEO still in place after two years (b) CEO not in place anymore after two years

Notes: Shares of answers mentioning gender in positive or negative or both positive and negative ways for questions on reasons about expected CEO 'survival' or 'no-survival' by treatment group.

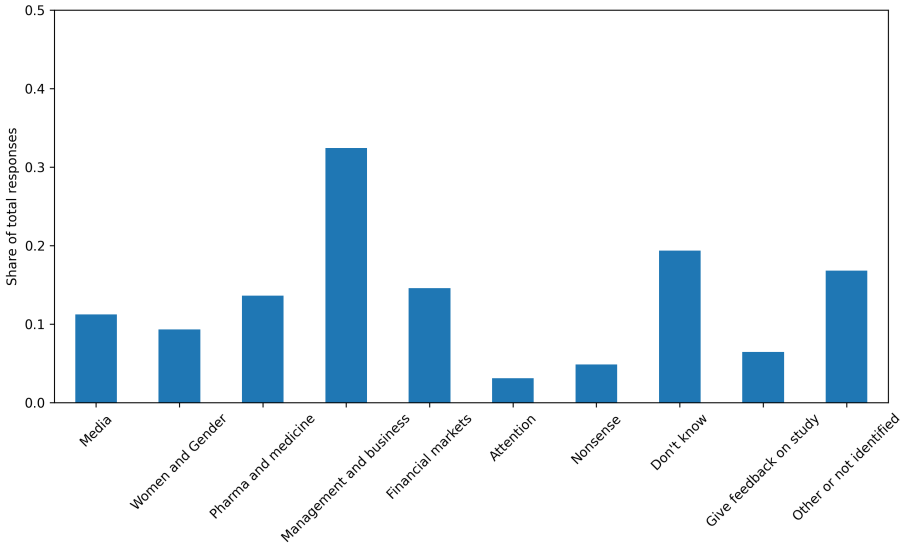
Figure 4.A.5: Sentiment of family words in reasoning on CEO 'survival'



(a) CEO still in place after two years (b) CEO not in place anymore after two years

Notes: Shares of answers mentioning family in positive or negative or both positive and negative ways for questions on reasons about expected CEO 'survival' or 'no-survival' by treatment group.

Figure 4.A.6: Guesses for topic of the study



Notes: Shares of answers mentioning terms related to different topics in question on beliefs about study topic. An answer can mention terms related to several of these topics, therefore shares do not add up to one.

Table 4.A.1: Demographics of survey sample

	(1) Obs.	(2) Mean	(3) Median	(4) Std. Dev.	(5) Min.	(6) Max.
Employment status:						
Full-time employed	3,011	0.45	0	0.50	0	1
Part-time employed	3,011	0.16	0	0.37	0	1
Self-employed	3,011	0.04	0	0.19	0	1
Unemployed	3,011	0.06	0	0.23	0	1
Irregularly employed	3,011	0.01	0	0.10	0	1
Retired	3,011	0.16	0	0.36	0	1
Student/apprentice	3,011	0.07	0	0.26	0	1
Other	3,011	0.05	0	0.22	0	1
Household members <18:						
Male	3,011	0.23	0	0.52	0	4
Female	3,011	0.25	0	0.60	0	10
Diverse	3,011	0.00	0	0.16	0	8
Household members >=18:						
Male	3,011	0.92	1	0.91	0	33
Female	3,011	0.96	1	1.56	0	77
Diverse	3,011	0.01	0	0.16	0	6
Household income:						
<1000 EUR	3,011	0.08	0	0.28	0	1
1000-2000 EUR	3,011	0.23	0	0.42	0	1
2000-3000 EUR	3,011	0.27	0	0.44	0	1
3000-4000 EUR	3,011	0.20	0	0.40	0	1
>4000 EUR	3,011	0.21	0	0.41	0	1

Notes: Descriptive statistics on demographic variables. Balancing checks by treatment group on these variables can be found in Table 4.A.2.

Table 4.A.2: Balancing checks for demographics and study-related characteristics used as control variables

Variable	(1) 1M	(2) 2M	(3) 1F	(4) 2F	(5) 3F	(6) 2M vs 1M	(7) 1F vs 1M	(8) 2F vs 1M	(9) 3F vs 1M
Gender:									
Male	0.503	0.513	0.513	0.494	0.516	0.010	0.010	-0.010	0.013
Female	0.488	0.487	0.485	0.503	0.477	-0.001	-0.003	0.015	-0.011
Diverse/Non-binary	0.007	0.000	0.002	0.003	0.007	-0.007*	-0.005	-0.003	-0.000
Prefer not to answer	0.002	0.000	0.000	0.000	0.000	-0.002	-0.002	-0.002	-0.002
Age:									
18-29	0.227	0.184	0.205	0.212	0.170	-0.042*	-0.022	-0.015	-0.056**
30-39	0.184	0.186	0.192	0.202	0.189	0.002	0.008	0.018	0.005
40-49	0.162	0.193	0.192	0.188	0.166	0.031	0.030	0.025	0.003
50-59	0.242	0.231	0.215	0.207	0.251	-0.010	-0.026	-0.035	0.009
60-69	0.185	0.205	0.195	0.191	0.225	0.020	0.010	0.006	0.039*
Education:									
No school leaving certificate	0.007	0.005	0.002	0.006	0.005	-0.001	-0.005	-0.000	-0.002
Hauptschule without vocational education	0.086	0.096	0.075	0.087	0.085	0.010	-0.012	0.001	-0.001
Hauptschule with vocational education	0.137	0.167	0.169	0.168	0.157	0.030	0.031	0.031	0.020
Realschule without Abitur	0.348	0.329	0.329	0.317	0.328	-0.019	-0.018	-0.031	-0.020
Abitur without tertiary degree	0.374	0.351	0.356	0.364	0.377	-0.023	-0.018	-0.010	0.003
Tertiary (e.g. university) degree	0.048	0.052	0.066	0.053	0.043	0.004	0.018	0.005	-0.005
Other	0.000	0.000	0.003	0.003	0.005	0.000	0.003	0.003	0.005*
Employment status:									
Full-time employed	0.449	0.431	0.462	0.447	0.485	-0.017	0.013	-0.002	0.037
Part-time employed	0.141	0.172	0.172	0.178	0.131	0.031	0.031	0.037*	-0.010
Self-employed	0.036	0.042	0.041	0.042	0.033	0.005	0.005	0.006	-0.004
Unemployed	0.058	0.066	0.046	0.066	0.052	0.008	-0.012	0.008	-0.005
Irregularly employed	0.013	0.009	0.005	0.016	0.011	-0.005	-0.008	0.003	-0.002
Retired	0.171	0.174	0.149	0.129	0.166	0.003	-0.022	-0.041**	-0.005
Student/apprentice	0.075	0.061	0.084	0.071	0.062	-0.014	0.010	-0.003	-0.012
Other	0.058	0.045	0.040	0.050	0.059	-0.013	-0.018	-0.008	0.001
Household members <18:									
Male	0.225	0.219	0.268	0.228	0.202	-0.006	0.043	0.003	-0.024
Female	0.263	0.242	0.253	0.278	0.195	-0.022	-0.010	0.015	-0.068**
Diverse	0.015	0.000	0.005	0.002	0.003	-0.015	-0.010	-0.013	-0.012
Household members >=18:									
Male	0.954	0.960	0.904	0.867	0.898	0.006	-0.050	-0.086**	-0.055
Female	0.902	1.071	0.950	0.911	0.949	0.169	0.048	0.009	0.047
Diverse	0.025	0.009	0.008	0.011	0.011	-0.016	-0.017	-0.014	-0.013
Household income:									
<1000 EUR	0.078	0.083	0.088	0.099	0.072	0.006	0.010	0.021	-0.006
1000-2000 EUR	0.257	0.226	0.212	0.218	0.241	-0.031	-0.045*	-0.038	-0.016
2000-3000 EUR	0.270	0.282	0.258	0.275	0.269	0.012	-0.012	0.005	-0.001
3000-4000 EUR	0.167	0.200	0.222	0.218	0.207	0.033	0.055**	0.051**	0.039*
>4000 EUR	0.228	0.209	0.220	0.189	0.211	-0.020	-0.008	-0.039*	-0.017
Frequency newspaper reading:									
<once/month	0.204	0.170	0.162	0.223	0.169	-0.033	-0.041*	0.020	-0.035
approx. once/month	0.053	0.038	0.060	0.049	0.049	-0.015	0.007	-0.004	-0.004
several times/month	0.124	0.118	0.121	0.134	0.102	-0.006	-0.003	0.010	-0.023
at least once/week	0.263	0.290	0.248	0.273	0.274	0.027	-0.015	0.010	0.011
daily	0.356	0.383	0.409	0.320	0.407	0.027	0.053*	-0.036	0.051*
Risk aversion:									
very willing to take risks	0.022	0.028	0.023	0.037	0.016	0.006	0.002	0.016	-0.005
rather willing to take risks	0.215	0.170	0.204	0.202	0.208	-0.045*	-0.012	-0.013	-0.007
risk-neutral	0.306	0.374	0.377	0.325	0.382	0.068**	0.071***	0.019	0.076***
rather not willing to take risks	0.313	0.303	0.273	0.296	0.267	-0.010	-0.040	-0.017	-0.046*
not willing to take risks at all	0.144	0.125	0.123	0.139	0.126	-0.019	-0.022	-0.005	-0.018
Experience investing:									
No	0.555	0.572	0.541	0.539	0.526	0.018	-0.013	-0.016	-0.028
Yes	0.417	0.402	0.434	0.450	0.451	-0.015	0.017	0.033	0.034
Don't know	0.028	0.026	0.025	0.011	0.023	-0.002	-0.003	-0.017**	-0.005
Frequency investing:									
less than once/year	0.258	0.294	0.198	0.234	0.247	0.036	-0.059	-0.024	-0.011
1-2 times/year	0.087	0.152	0.130	0.090	0.142	0.064**	0.042	0.003	0.055*
1-2 times/quarter	0.123	0.182	0.149	0.133	0.142	0.059*	0.026	0.010	0.019
1-2 times/month	0.254	0.173	0.271	0.277	0.236	-0.081**	0.017	0.023	-0.018
weekly	0.206	0.139	0.168	0.187	0.167	-0.068**	-0.038	-0.019	-0.039
daily	0.071	0.061	0.084	0.079	0.065	-0.011	0.013	0.008	-0.006
Observations	604	575	604	618	610	1,179	1,208	1,222	1,214

Notes: Balancing checks for demographic variables and study-related characteristics that are used as control variables in regressions by treatment group.

Table 4.A.3: Balancing checks for study-related attitudes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	1M	2M	1F	2F	3F	2M vs 1M	1F vs 1M	2F vs 1M	3F vs 1M
Tried to look up info:									
No	0.899	0.899	0.921	0.903	0.913	0.000	0.022	0.004	0.014
Yes	0.071	0.063	0.055	0.079	0.067	-0.009	-0.017	0.008	-0.004
Yes, but could not find anything useful	0.030	0.038	0.025	0.018	0.020	0.008	-0.005	-0.012	-0.010
Belief share of women as CEOs	28.95	30.43	29.14	28.77	27.78	1.47	0.19	-0.18	-1.17
Desired change in female CEO share:									
Should be significantly lower	0.015	0.010	0.013	0.005	0.011	-0.004	-0.002	-0.010*	-0.003
Should be slightly lower	0.013	0.014	0.012	0.005	0.008	0.001	-0.002	-0.008	-0.005
Should stay same	0.238	0.266	0.232	0.282	0.234	0.028	-0.007	0.043*	-0.004
Should be slightly higher	0.409	0.409	0.382	0.364	0.403	-0.000	-0.026	-0.045	-0.006
Should be significantly higher	0.325	0.301	0.361	0.345	0.343	-0.024	0.036	0.020	0.018
Own CEO gender:									
Male	0.654	0.649	0.657	0.646	0.690	-0.005	0.003	-0.008	0.036
Female	0.180	0.195	0.212	0.197	0.190	0.014	0.031	0.017	0.010
Diverse	0.010	0.007	0.005	0.011	0.008	-0.003	-0.005	0.001	-0.002
Don't know	0.111	0.101	0.089	0.084	0.064	-0.010	-0.022	-0.027	-0.047***
Other	0.045	0.049	0.036	0.061	0.048	0.004	-0.008	0.017	0.003
Observations	604	575	604	618	610	1,179	1,208	1,222	1,214

Notes: Balancing checks for study-related questions that are used as control variables in regressions by treatment group.

Table 4.A.4: Treatment effects on confidence in beliefs about stock performance

Outcome: confidence about expected stock performance (1-5)						
	(1)	(2)	(3)	(4)	(5)	(6)
Baseline mean:	3.07 (1M)			3.09 (Male CEO)		
2M	0.056	0.038	0.037			
	(0.066)	(0.065)	(0.064)			
1F	0.086	0.058	0.058			
	(0.065)	(0.064)	(0.063)			
2F	-0.050	-0.054	-0.045			
	(0.066)	(0.065)	(0.064)			
p-value 1F-2F:	[0.033**]	[0.074*]	[0.096*]			
p-value 3F-2F:	[0.102]	[0.150]	[0.197]			
3F	0.052	0.023	0.031			
	(0.065)	(0.064)	(0.064)			
CEO gender				0.002	-0.010	-0.003
				(0.042)	(0.041)	(0.041)
Control for individual demographics	No	Yes	Yes	No	Yes	Yes
Further study controls	No	No	Yes	No	No	Yes
R-squared	0.002	0.055	0.075	0.000	0.053	0.073
N	3,011	3,011	3,011	3,011	3,011	3,011

Notes: Results of regression of confidence in belief about stock performance in the year after CEO appointment relative to year before on treatment group dummies and control variables, and p-values of treatment effects for different group comparisons (columns 1-3). Results of regression of confidence in belief about stock performance on CEO gender dummy and control variables (columns 4-6). Standard errors in parenthesis, *p <0.10, **p<0.05, ***p<0.01.

Table 4.A.5: Balancing checks for nonsense-answers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	1M	2M	1F	2F	3F	2M vs 1M	1F vs 1M	2F vs 1M	3F vs 1M
Nonsense Q3 Approval reason	0.038	0.038	0.028	0.045	0.018	0.000	-0.010	0.007	-0.020**
Nonsense Q4 Survival reason	0.015	0.029	0.027	0.025	0.007	0.014	0.012	0.010	-0.008
Nonsense Q4 No-Survival reason	0.110	0.046	0.063	0.063	0.072	-0.063	-0.046	-0.046	-0.037
Observations	604	575	604	618	610	1,179	1,208	1,222	1,214

Notes: Balancing checks for answers identified as nonsense for question on reasons for Glassdoor approval and reasons for beliefs about why CEO still in place after 2 years (for participants believing in 'survival') or not (those believing in 'no-survival').

Table 4.A.6: Balancing checks for don't know-answers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	1M	2M	1F	2F	3F	2M vs 1M	1F vs 1M	2F vs 1M	3F vs 1M
Don't know Q3 Approval reason	0.127	0.120	0.126	0.128	0.126	-0.007	-0.002	0.000	-0.001
Don't know Q4 Survival reason	0.077	0.055	0.046	0.061	0.054	-0.022	-0.031**	-0.016	-0.024
Don't know Q4 No-Survival reason	0.233	0.185	0.165	0.238	0.188	-0.048	-0.068	0.005	-0.044
Observations	604	575	604	618	610	1,179	1,208	1,222	1,214

Notes: Balancing checks for answers identified as don't know-answers for question on reasons for Glassdoor approval and reasons for beliefs about why CEO still in place after 2 years (for participants believing in 'survival') or not (those believing in 'no-survival').

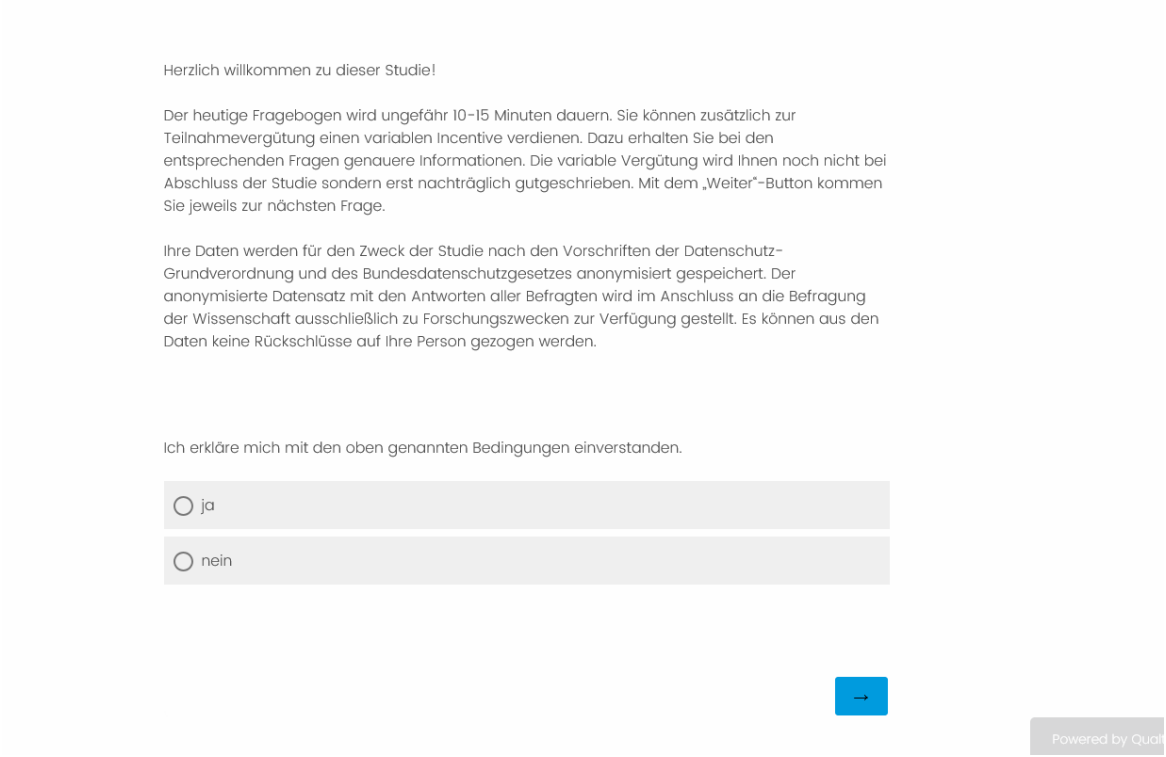
Table 4.A.7: Own exposure, beliefs and opinions about women as CEOs, by gender

	Women	Men	Difference
Own CEO gender: Female	0.297	0.0981	-0.198***
Belief share of women as CEOs	30.17	27.92	-2.249**
Desired change in female CEO share: Should be significantly higher	0.408	0.264	-0.145***
Desired change in female CEO share: Should be slightly higher	0.380	0.407	0.0279
Desired change in female CEO share: Should stay same	0.203	0.296	0.0922***
Observations	2,999		

Notes: Shares of female and male participants whose employers have a female CEO, estimated share of women among CEOs in DAX companies and desired change in this share, by gender.

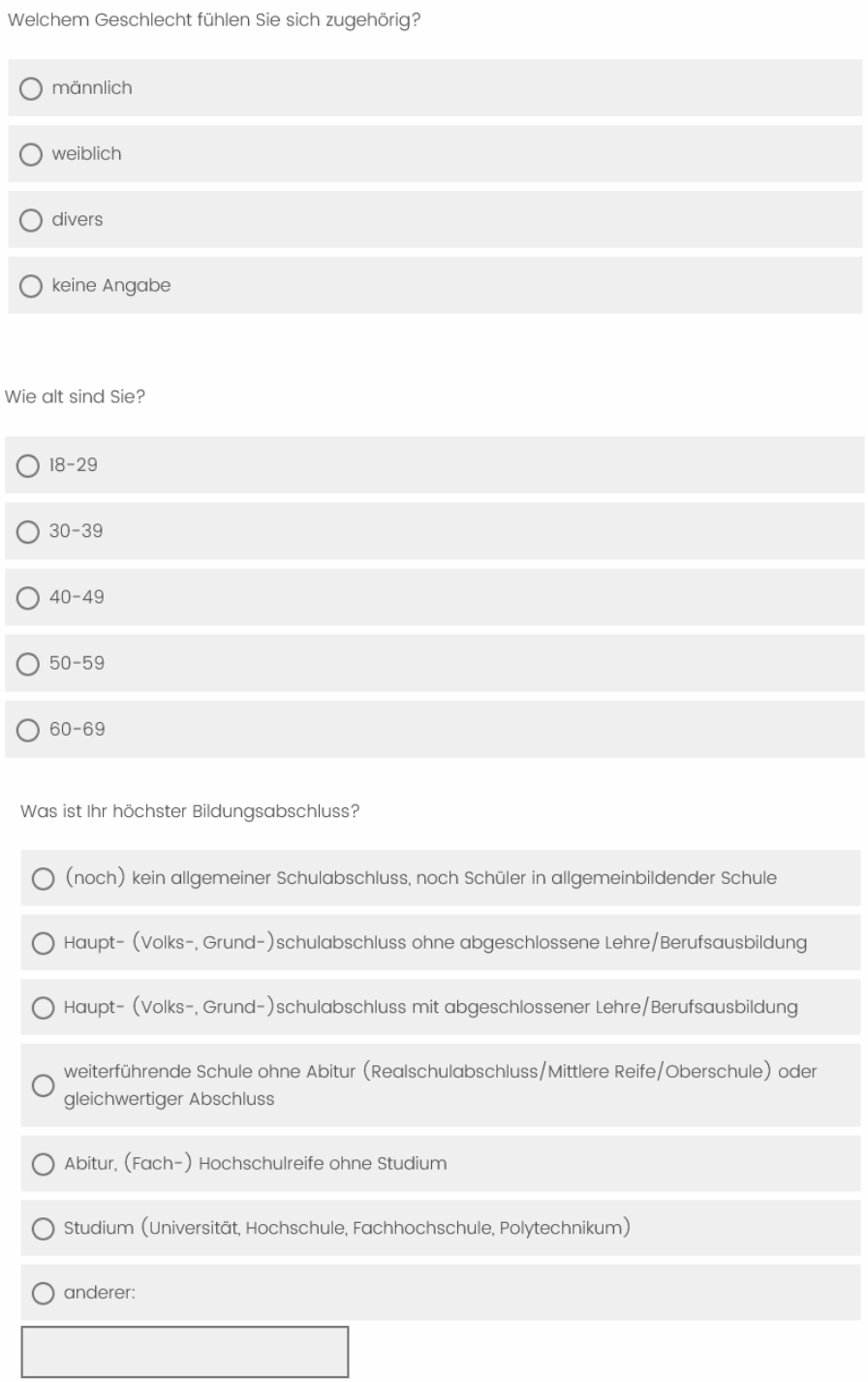
4.A.2 Original German instructions

Figure 4.A.7: Introduction to experiment



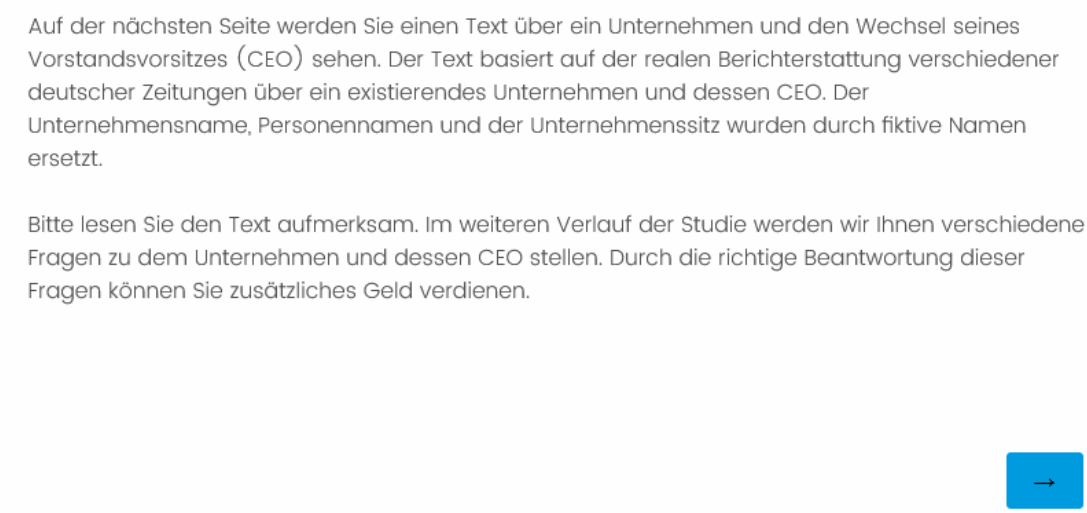
Notes: Screenshots of introduction to experiment and question to agree to terms and conditions.

Figure 4.A.8: Questions for quota sampling



Notes: Screenshots of questions on gender, age and education used for quota sampling. Each question is presented on a separate screen in the survey.

Figure 4.A.9: Explanation of study flow before treatment



Notes: Screenshot of the explanation text about the study flow that is shown to participants before treatment exposure.

Figure 4.A.10: Article text group 1M

Wirtschaft

Führungswechsel bei der PHARMA AG: Martin Bauer wird neuer CEO

Anfang nächster Woche wird Martin Bauer der neue Vorsitzende des Vorstands beim Oberdorfer Konzern PHARMA AG. Der Wechsel erfolge planmäßig, hieß es aus Oberdorf. Er hatte sich angekündigt, als Bauer im vergangenen Jahr zum stellvertretenden Vorstandsvorsitzenden berufen worden war.

Die PHARMA AG gehört zu den größten deutschen börsennotierten Unternehmen. Sie wurde vor mehr als 350 Jahren von Ludwig Maier gegründet. Noch heute ist der Konzern mehrheitlich im Familienbesitz. Die PHARMA AG wird in die Geschäftsbereiche Healthcare, Life Science sowie Performance Materials gegliedert und beschäftigt Mitarbeitende in mehr als sechzig Ländern. Derzeit arbeitet die PHARMA AG an der Herstellung von Antikörpern und Proteinen zur Behandlung verschiedener Krebserkrankungen, aber auch an Hightech-Laborausrüstungen für die biopharmazeutische Industrie.

Martin Bauer studierte und promovierte in einem Teilbereich der Medizin. In einem internationalen Pharmazieunternehmen stieg er die Karriereleiter empor, bevor er vor einigen Jahren zur PHARMA AG kam. Als Leiter des Geschäftsbereichs Healthcare, welcher beispielsweise patentgeschützte Arzneimittel entwickelt, ist er bereits mehrere Jahre Mitglied des PHARMA-Vorstands.

Notes: Screenshot of the article shown to participants in group 1M (male CEO without mentioning of family). The participants are able to go back to viewing the article when answering each incentivized question.

Figure 4.A.11: Article text group 1F

Wirtschaft

Führungswechsel bei der PHARMA AG: Martina Bauer wird neue CEO

Anfang nächster Woche wird Martina Bauer die neue Vorsitzende des Vorstands beim Oberdorfer Konzern PHARMA AG. Der Wechsel erfolge planmäßig, hieß es aus Oberdorf. Er hatte sich angekündigt, als Bauer im vergangenen Jahr zur stellvertretenden Vorstandsvorsitzenden berufen worden war.
Die PHARMA AG gehört zu den größten deutschen börsennotierten Unternehmen. Sie wurde vor mehr als 350 Jahren von Ludwig Maier gegründet. Noch heute ist der Konzern mehrheitlich im Familienbesitz. Die PHARMA AG wird in die Geschäftsbereiche Healthcare, Life Science sowie Performance Materials gegliedert und beschäftigt Mitarbeitende in mehr als sechzig Ländern. Derzeit arbeitet die PHARMA AG an der Herstellung von Antikörpern und Proteinen zur Behandlung verschiedener Krebserkrankungen, aber auch an Hightech-Laborausrüstungen für die biopharmazeutische Industrie.
Martina Bauer studierte und promovierte in einem Teilbereich der Medizin. In einem internationalen Pharmazieunternehmen stieg sie die Karriereleiter empor, bevor sie vor einigen Jahren zur PHARMA AG kam. Als Leiterin des Geschäftsbereichs Healthcare, welcher beispielsweise patentgeschützte Arzneimittel entwickelt, ist sie bereits mehrere Jahre Mitglied des PHARMA-Vorstands.

Notes: Screenshot of the article shown to participants in group 1F (female CEO without mentioning of family). The participants are able to go back to viewing the article when answering each incentivized question.

Figure 4.A.12: Article text group 2M

Wirtschaft

Führungswechsel bei der PHARMA AG: Martin Bauer wird neuer CEO

Anfang nächster Woche wird Martin Bauer der neue Vorsitzende des Vorstands beim Oberdorfer Konzern PHARMA AG. Der Wechsel erfolge planmäßig, hieß es aus Oberdorf. Er hatte sich angekündigt, als Bauer im vergangenen Jahr zum stellvertretenden Vorstandsvorsitzenden berufen worden war.
Die PHARMA AG gehört zu den größten deutschen börsennotierten Unternehmen. Sie wurde vor mehr als 350 Jahren von Ludwig Maier gegründet. Noch heute ist der Konzern mehrheitlich im Familienbesitz. Die PHARMA AG wird in die Geschäftsbereiche Healthcare, Life Science sowie Performance Materials gegliedert und beschäftigt Mitarbeitende in mehr als sechzig Ländern. Derzeit arbeitet die PHARMA AG an der Herstellung von Antikörpern und Proteinen zur Behandlung verschiedener Krebserkrankungen, aber auch an Hightech-Laborausrüstungen für die biopharmazeutische Industrie.
Martin Bauer studierte und promovierte in einem Teilbereich der Medizin. In einem internationalen Pharmazieunternehmen stieg er die Karriereleiter empor, bevor er vor einigen Jahren zur PHARMA AG kam. Als Leiter des Geschäftsbereichs Healthcare, welcher beispielsweise patentgeschützte Arzneimittel entwickelt, ist er bereits mehrere Jahre Mitglied des PHARMA-Vorstands. Bauer ist verheiratet und Vater zweier Kinder.

Notes: Screenshot of the article shown to participants in group 2M (male CEO with neutral mentioning of family). The participants are able to go back to viewing the article when answering each incentivized question.

Figure 4.A.13: Article text group 2F

Wirtschaft

Führungswechsel bei der PHARMA AG: Martina Bauer wird neue CEO

Anfang nächster Woche wird Martina Bauer die neue Vorsitzende des Vorstands beim Oberdorfer Konzern PHARMA AG. Der Wechsel erfolge planmäßig, hieß es aus Oberdorf. Er hatte sich angekündigt, als Bauer im vergangenen Jahr zur stellvertretenden Vorstandsvorsitzenden berufen worden war.
Die PHARMA AG gehört zu den größten deutschen börsennotierten Unternehmen. Sie wurde vor mehr als 350 Jahren von Ludwig Maier gegründet. Noch heute ist der Konzern mehrheitlich im Familienbesitz. Die PHARMA AG wird in die Geschäftsbereiche Healthcare, Life Science sowie Performance Materials gegliedert und beschäftigt Mitarbeitende in mehr als sechzig Ländern. Derzeit arbeitet die PHARMA AG an der Herstellung von Antikörpern und Proteinen zur Behandlung verschiedener Krebserkrankungen, aber auch an Hightech-Laborausrüstungen für die biopharmazeutische Industrie.
Martina Bauer studierte und promovierte in einem Teilbereich der Medizin. In einem internationalen Pharmazieunternehmen stieg sie die Karriereleiter empor, bevor sie vor einigen Jahren zur PHARMA AG kam. Als Leiterin des Geschäftsbereichs Healthcare, welcher beispielsweise patentgeschützte Arzneimittel entwickelt, ist sie bereits mehrere Jahre Mitglied des PHARMA-Vorstands. Bauer ist verheiratet und Mutter zweier Kinder.

Notes: Screenshot of the article shown to participants in group 2F (female CEO with neutral mentioning of family). The participants are able to go back to viewing the article when answering each incentivized question.

Figure 4.A.14: Article text group 3F

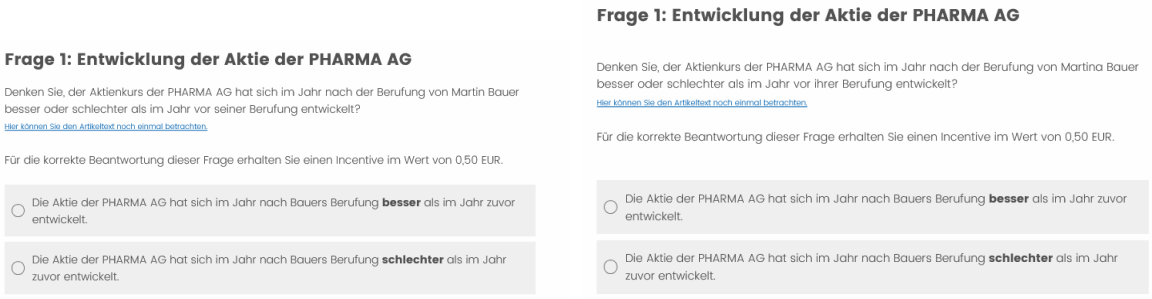
Wirtschaft

Führungswechsel bei der PHARMA AG: Martina Bauer wird neue CEO

Anfang nächster Woche wird Martina Bauer die neue Vorsitzende des Vorstands beim Oberdorfer Konzern PHARMA AG. Der Wechsel erfolge planmäßig, hieß es aus Oberdorf. Er hatte sich angekündigt, als Bauer im vergangenen Jahr zur stellvertretenden Vorstandsvorsitzenden berufen worden war.
Die PHARMA AG gehört zu den größten deutschen börsennotierten Unternehmen. Sie wurde vor mehr als 350 Jahren von Ludwig Maier gegründet. Noch heute ist der Konzern mehrheitlich im Familienbesitz. Die PHARMA AG wird in die Geschäftsbereiche Healthcare, Life Science sowie Performance Materials gegliedert und beschäftigt Mitarbeitende in mehr als sechzig Ländern. Derzeit arbeitet die PHARMA AG an der Herstellung von Antikörpern und Proteinen zur Behandlung verschiedener Krebserkrankungen, aber auch an Hightech-Laborausrüstungen für die biopharmazeutische Industrie.
Martina Bauer studierte und promovierte in einem Teilbereich der Medizin. In einem internationalen Pharmazieunternehmen stieg sie die Karriereleiter empor, bevor sie vor einigen Jahren zur PHARMA AG kam. Als Leiterin des Geschäftsbereichs Healthcare, welcher beispielsweise patentgeschützte Arzneimittel entwickelt, ist sie bereits mehrere Jahre Mitglied des PHARMA-Vorstands. Bauer ist verheiratet und Mutter. Sie hat zwei Kinder großgezogen und dennoch eine stramme Karriere hingelegt.

Notes: Screenshot of the article shown to participants in group 3F (female CEO with mentioning of family-career trade-off). The participants are able to go back to viewing the article when answering each incentivized question.

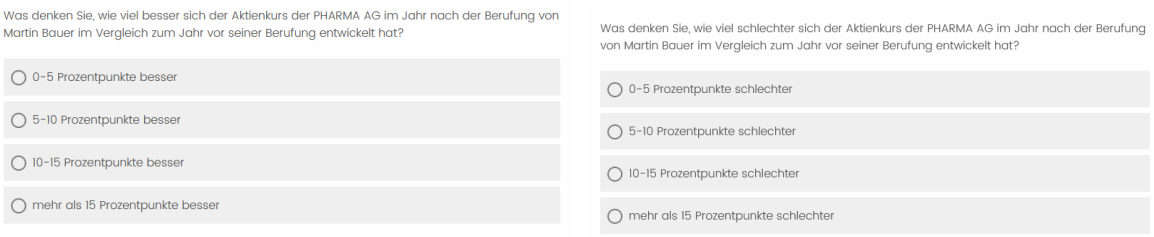
Figure 4.A.15: Question text for incentivized outcome 1



(a) male CEO (b) female CEO

Notes: Screenshot of question text for incentivized outcome 1 (beliefs about stock performance in the year after CEO appointment) for the treatments with a male and a female CEO.

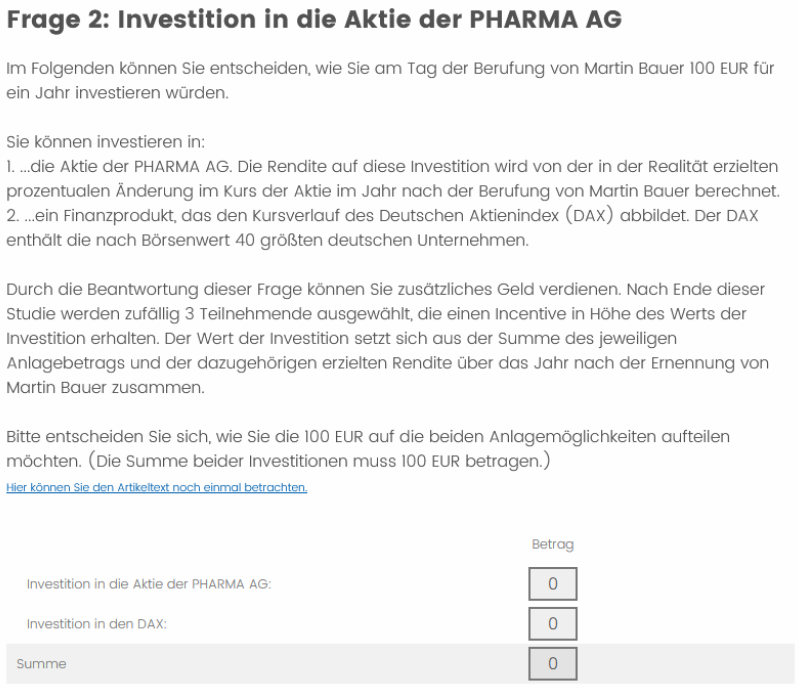
Figure 4.A.16: Question text for detailed assessment of outcome 1 (male CEO)



(a) if responded 'better' to Q1 (b) if responded 'worse' to Q1

Notes: Screenshots of question text for the detailed assessment of outcome 1 asking for the range of better or worse stock performance in the year after CEO appointment for the treatments with a male CEO. For the treatment with the female CEO, the text accordingly says Martina Bauer instead of Martin Bauer.

Figure 4.A.17: Question text for incentivized outcome 2 (male CEO)

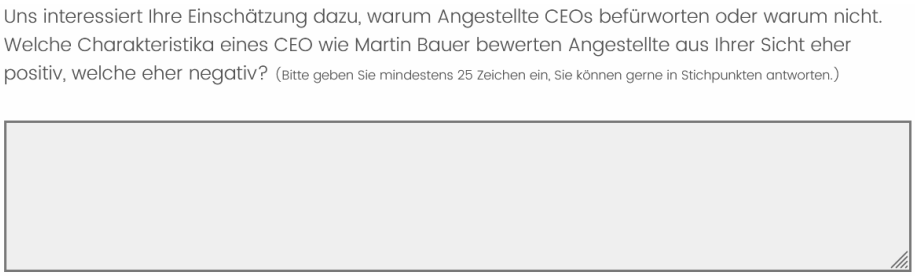


Notes: Screenshot of question text for incentivized outcome 2 (investment in the firm's stock at the date of CEO appointment) for the treatments with a male CEO. For the treatment with the female CEO, the text accordingly says Martina Bauer instead of Martin Bauer.

Figure 4.A.18: Question text for incentivized outcome 3 (male CEO)

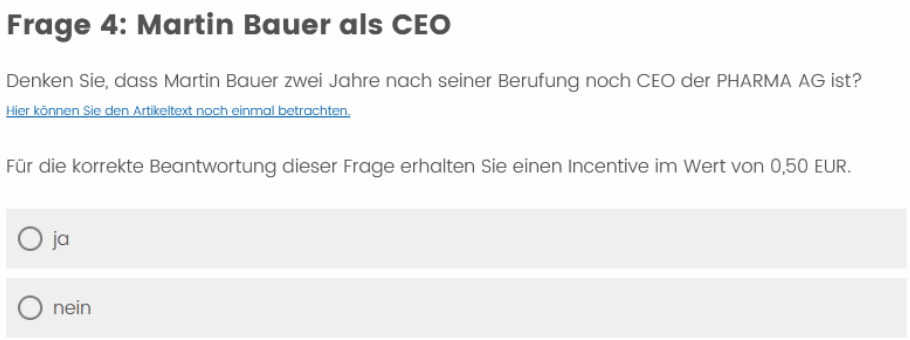
Notes: Screenshot of question text for incentivized outcome 3 (beliefs about CEO approval by employees on Glassdoor) for the treatments with a male CEO. For the treatment with the female CEO, the text accordingly says Martina Bauer instead of Martin Bauer.

Figure 4.A.19: Question text for detailed assessment of outcome 3 (male CEO)



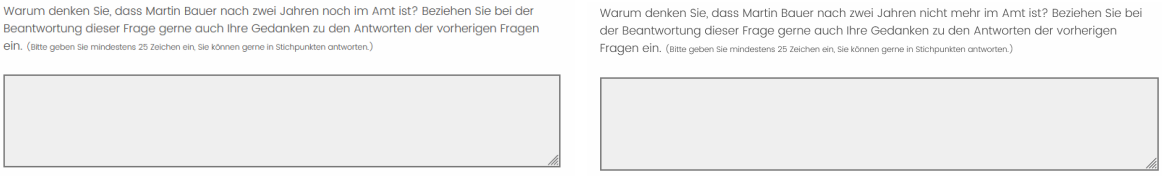
Notes: Screenshot of question text for the detailed assessment of incentivized outcome 3 asking for beliefs on the reasons for CEO approval by employees and qualities employees may value in a CEO for the treatments with a male CEO. For the treatment with the female CEO, the text accordingly says Martina Bauer instead of Martin Bauer.

Figure 4.A.20: Question text for incentivized outcome 4 (male CEO)



Notes: Screenshot of question text for incentivized outcome 4 (beliefs about CEO 'survival') for the treatments with a male CEO. For the treatment with the female CEO, the text accordingly says Martina Bauer instead of Martin Bauer.

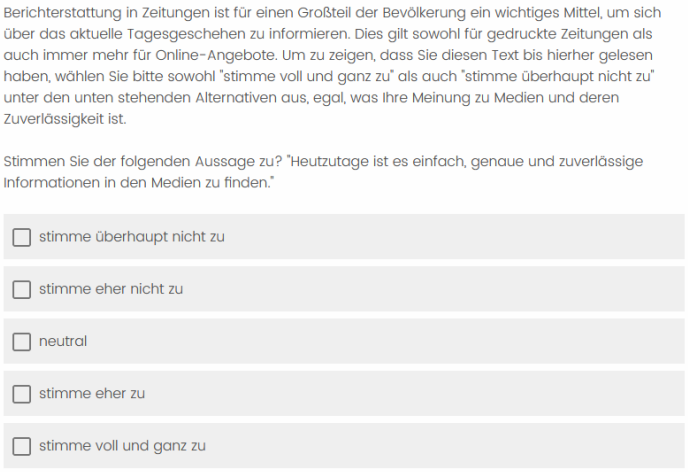
Figure 4.A.21: Question text for detailed assessment of outcome 4 (male CEO)



(a) if responded 'yes' to Q4 (b) if responded 'no' to Q4

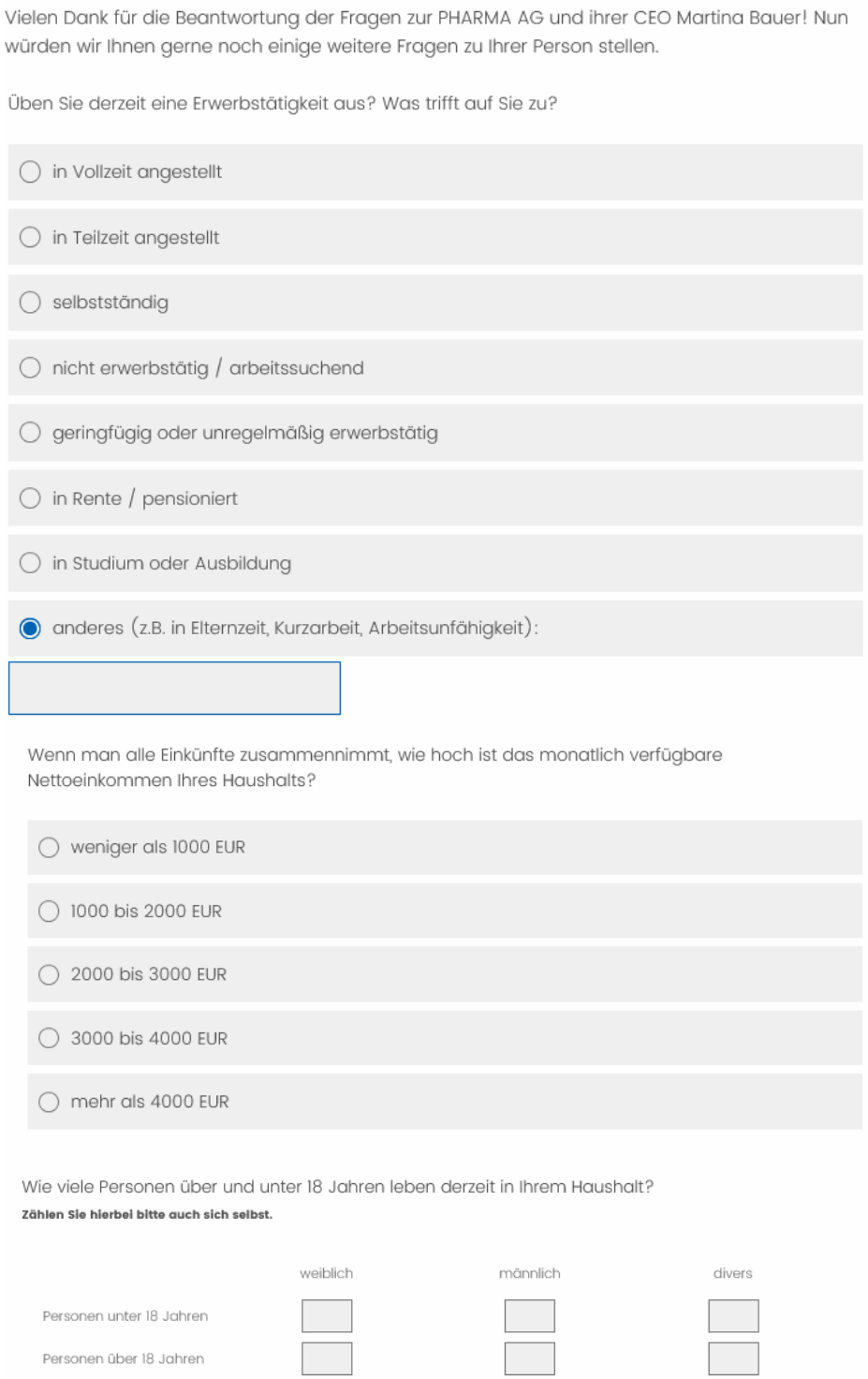
Notes: Screenshot of question text for the detailed assessment of incentivized outcome 4 asking for the reasons why the CEO is still in place or is not in place anymore after 2 years for the treatments with a male CEO. For the treatment with the female CEO, the text accordingly says Martina Bauer instead of Martin Bauer.

Figure 4.A.22: Question text for attention check



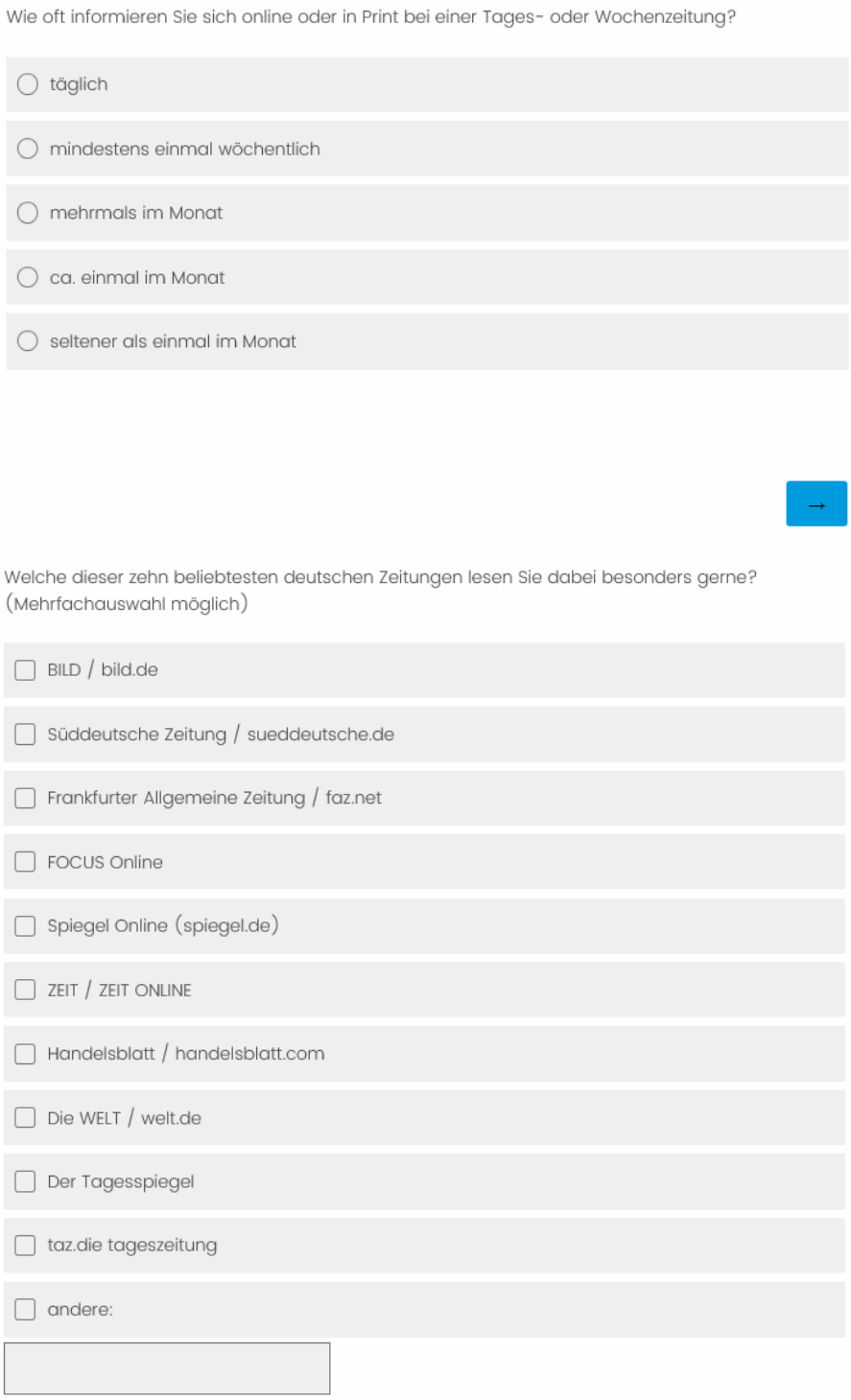
Notes: Screenshot of the attention check conducted after the assessment of the incentivized outcomes.

Figure 4.A.23: Question texts for demographics



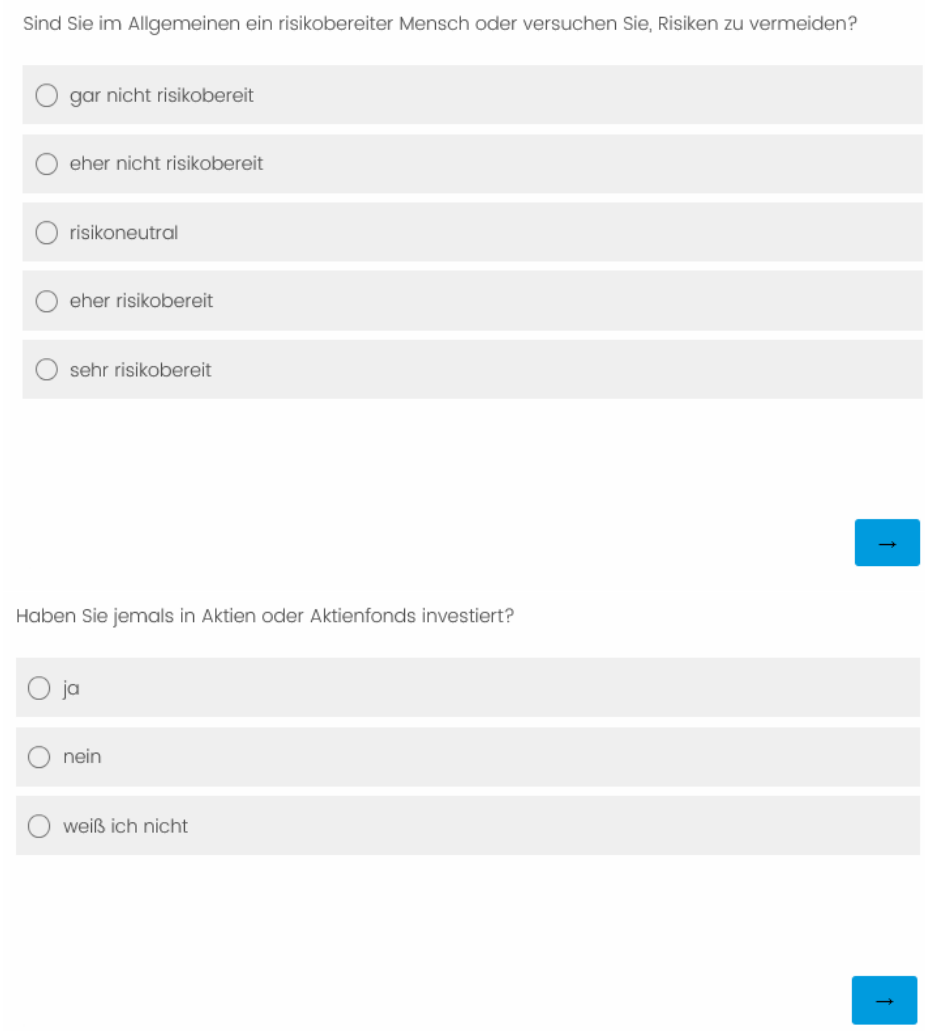
Notes: Screenshots of question texts for demographic variables (employment status, household income, household members). Each question is presented on a separate screen in the survey.

Figure 4.A.24: Question texts for newspaper reading behavior



Notes: Screenshots of question texts for newspaper reading behavior. Each question is presented on a separate screen in the survey.

Figure 4.A.25: Question texts for risk aversion assessment and investment experience

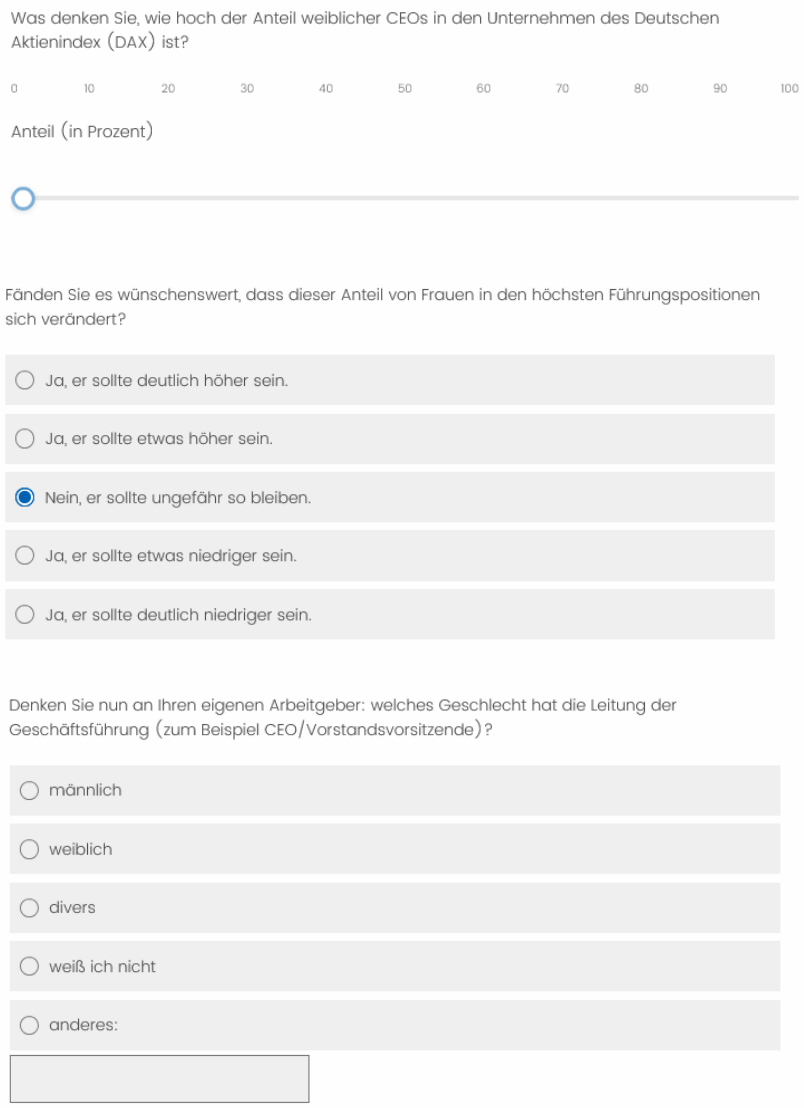


Notes: Screenshots of question texts for risk aversion and experience investing in stocks or funds. Each question is presented on a separate screen in the survey.

Figure 4.A.26: Question texts for look-up behavior and topic of the study

Notes: Screenshots of question texts asking participants if they tried to look up any information on the real company and asking them for their belief about the topic of the study. Each question is presented on a separate screen in the survey.

Figure 4.A.27: Question texts for study-related opinions



Notes: Screenshots of question texts for study-related opinions and beliefs (belief about share of women as CEOs, desired change in the female CEO share, own CEO gender). Each question is presented on a separate screen in the survey.

CHAPTER 5

Women in management and the gender pay gap[1]

5.1 Introduction

Women remain underrepresented in top-level management positions across countries and most industries. Policies to increase the representation of women in these roles are discussed controversially in business, politics, public institutions, and other parts of society. In part, such measures are motivated by the idea that they may not just increase gender equality in the targeted positions but also involve spillover effects that help decrease other gender gaps, such as, for example, those in pay, hiring, and promotions. These spillover effects could work through channels such as female managers[2] being more concerned with gender equality, thus implementing policies to decrease gender gaps and promoting a more gender-equal organizational climate. Also, women in management may serve as role models and mentors for female employees, thereby increasing their productivity, negotiation skills, and likelihood to climb up the career ladder. The presence of women in powerful positions may furthermore constitute a stereotype-disconfirming experience to all employees, thereby decreasing prejudices and implicit biases that perpetuate existing gender gaps.

Several empirical studies have analyzed the effect of women in management on the gender pay gap in the past. For example, the introduction of gender board quotas has been exploited to identify spillover effects of a higher share of women at the supervisory level to women employees' labor market outcomes at lower ranks. The empirical

[1]This chapter is joint work with Katharina Wrohlich (DIW Berlin, University of Potsdam). We gratefully acknowledge funding by the German Science Foundation (grant number 416447477).

[2]We understand that individuals' gender identity can deviate from their sex assigned at birth. Unfortunately, the dataset used in this study, only contains a binary indicator for gender. Therefore, for this study we use both the terms woman and female to refer to individuals labelled as women in the data.

evidence from these studies is, however, not clearcut (Bertrand et al., 2019; Maida and Weber, 2019). In part, this may be due to the relatively short time horizon under consideration. Company-wide policies agreed on at the supervisory level may take time to be implemented by the firm's management and take effect at different levels of the hierarchy. Moreover, non-executive board members might not have a direct or indirect effect on employees of the respective firms because of their rare interactions with employees. Managers that are in closer contact in day-to-day business with employees and make personnel decisions on hiring, salaries, and promotions at lower levels of the company hierarchy or, as leaders of small firms, may have a more direct and immediate impact on pay and career progression of their subordinates. Therefore, an increased share of women in these positions may prove to be effective for reducing gender gaps among subordinates also in the shorter run. Cardoso and Winter-Ebmer (2010) find that female leaders of small-sized Portuguese firms reduce the gender pay gap among their employees. Similarly, Bhide (2020) finds a man-to-woman change of top executive to reduce the gender pay gap relative to a man-to-man change in a sample of small German establishments. Kritikos et al. (2024) corroborate these findings for Finland, showing that the gender of firm-owners affects the gender pay gap in small firms, but not in large firms. Presumably, in large firms managers rather than firm owners affect the salaries and other dimensions of the remuneration of workers. Using personnel data of a large manufacturing firm, Drechsel-Grau and Holub (2024) find gender gaps in bonus payments of subordinates to be smaller for female than for male managers. In studies based on cross-sectional data of German companies, Abendroth et al. (2017) and Hirsch (2013) have found that a higher share of women in (first- and second-level) management is associated with a lower gender pay gap on the company level. This result is also confirmed by Zimmermann (2022) and Zimmermann (2024) using panel data.

We follow these studies for Germany and use linked employer-employee data from a relatively long establishment panel for the years 2004-2018. The data is a representative sample of establishments in Germany and it contains information on women's representation both on the highest (first-) level and on second-level management. Similar to Zimmermann (2022), we employ a two-way fixed effects panel model that includes establishment fixed effects as well as industry-specific time fixed effects. In this way, we control for unobserved time-constant establishment heterogeneity and, thus, selection of women into lower-paying firms, as well as differences in industry-wide trends of addressing gender gaps.

Our study extends the previous literature in several ways. First, we investigate the existence of non-linear effects of the share of women in management on the gender

pay gap within a firm by performing models of different functional form. This is important as critical mass theory (Kanter, 1977b) suggests that single members of minorities in committees cannot change the way the group is working or affect strategic decisions. Second, in separate analyses for East and West Germany, we can investigate the effects of female managers on the firm-specific gender pay gap in labor markets with very different degrees of gender inequalities. Finally, we add a robustness check inspired by the literature on potential identification problems in two-way fixed effects models (Borusyak et al., 2024; De Chaisemartin and d'Haultfoeuille, 2023) showing that potential heterogeneity of treatment effects over time or between groups does not seem to affect the results in this application.

The results of our empirical analysis show significant effects of women's managerial representation on the gender pay gap: an increase in the share of women in first-level management from zero to above 33 (66) percent decreases the adjusted gender pay gap from a baseline of 15 percent by 1.2 (3.2) percentage points. Women in second-level management have an even larger effect on the gender pay gap: an increase in their share from zero to more than 33 (66) percent decreases the gender pay gap by about 3 (6) percentage points. In a separate analysis for East and West Germany, we find very similar patterns in both parts of the country. Even in East Germany, where the gender pay gap is much lower and social norms towards gender roles in the labor market are more egalitarian, female managers have a statistically significant impact on the establishment-specific gender pay gap. Finally, we find larger effects for companies without collective bargaining agreements as compared to those with collective bargaining agreements for first-level management. Robustness checks show that potential bias from heterogeneity in treatment effects does not drive the results in our application.

We conclude from our results that increasing women's managerial representation has the potential to reduce the gender pay gap to a certain extent. Our results corroborate previous findings that daily interaction with the manager seems to play an important role: women benefit from the interaction with a female manager. We show that this is true even in East Germany, which has a much more gender egalitarian labor market than West Germany. The gender composition of management, however, is clearly not the only driver of the existing high gender pay gap in Germany. Further policy measures will be needed in order to fully close the gender gap in pay.

5.2 Theoretical considerations and previous literature

The share of women in management can affect the gender pay gap within the firm through a variety of channels that are related to the different reasons for the existing gender wage inequalities and that have been examined in previous studies. First, to the extent that the existing gender pay gap within the firm is caused by explicit discrimination against women and to the extent to which this discrimination is more prevalent and pronounced among male than female managers, a higher share of women in management will decrease this explicit discrimination, thereby reducing gender inequalities within the firm. Moreover, female managers might affect gender pay inequalities in their firm if they practice a more gender-equal way to reward performance (Flabbi et al., 2019; Theodoropoulus et al., 2022) or if they promote and adopt corporate equal opportunity programs or pay transparency policies.

Gender inequalities, however, are not only driven by explicit discrimination, but are often rooted in implicit and unconscious biases and gender stereotypes (see Ellemers (2017) for a comprehensive overview). In particular, these factors that drive interpersonal interactions are embedded in the structural contexts of corporations, where access to opportunities and power is still unequally distributed among men and women (Amis et al., 2020; Kanter, 1977a). For example, following the theory of homophilous preferences, managers are more inclined to award, promote, and support employees of their own social group, such as their own gender (Ertug et al., 2022).

If present, women in management positions could serve as mentors for their female subordinates (Kunze and Miller, 2017) and provide network opportunities that are beneficial for the promotion of their careers (Cullen and Perez-Truglia, 2023). Furthermore, there might be positive manager-worker interaction effects (Zimmermann, 2022), e.g. female managers might serve as role models and motivate female employees, as well as increase their performance and aspirations (Beaman et al., 2009). More explicitly, female managers could be more inclined to promote other women into more senior positions (Hensvik, 2014). Finally, the mere presence of women in powerful positions might constitute a stereotype-disconfirming experience for all workers in the firm, thereby diminishing implicit biases and gender stereotypes in this entity and, consequently, increasing gender equality on a general level (Adriaans et al., 2023).

In our empirical analysis, we are not able to disentangle all these potential mechanism or identify their quantitative importance. However, we can shed some light on the variation of the impact of female managers by organizational context. In particular, we can differentiate between the share of women in first-level and second-level manage-

ment, providing evidence on the relative importance of closeness of contact between the manager and the employees. Moreover, we perform separate analyses for East and West Germany to detect potential heterogeneities by surrounding cultural norms regarding the role of men and women at the workplace, as well as separate analyses for companies with and without collective bargaining coverage. In this way, we can differentiate the analyses by the level of managers' discretion in the payment of their workers.

Potentially, the impact of women in management on the gender pay gap in the establishment does not increase linearly but jumps at certain thresholds. For example, the critical mass theory (Kanter, 1977b) argues that single women as members of a group are considered as tokens and cannot change the way the group is working or the strategic decisions of the group. Empirically, it has been shown that the critical mass consists of at least a third of the members of the minority group in various settings (Joecks et al., 2013). More recently, a study has shown that a critical mass of women on the board of directors is advantageous for the promotion of women in senior management positions based on data from the UK (Biswas et al., 2023). We therefore estimate models of different functional forms to detect potential non-linearities in the effects of the share of female managers on the gender page gap.

5.3 Data

We use the Linked-Employer-Employee-Data (LIAB Cross-Sectional Model 2 9317) of the German Institute of Employment Research (IAB) for our empirical analysis. The dataset combines the yearly survey of German establishments (Establishment Panel) with administrative data from social security records of individuals employed at the respective establishments. The Establishment Panel contains information on the business and employment situation as well as the expectations of a representative sample of German establishments.[3] The individual-level data of the LIAB Cross-Sectional Model contains information on daily earnings, education, occupation, experience, and other characteristics of all individuals employed at the establishments on a specific cutoff date (June 30) in each year.

The Establishment Panel is supplemented with questions on women's representation in first- and second-level management as part of the modules on women in management

[3]An establishment is a regionally and economically separate unit with employees. This means that branches of one company are considered separately if they are in different districts or if they exercise different economic activities (see Gensicke et al. (2022)).

positions for the years 2004, 2008, 2012, 2014, 2016, and 2018. Based on these years, we construct a panel data set. We impose the following sample restrictions:

- We restrict our sample to private-sector plants only.[4]
- Since we are interested in the impact of female managers on the wages of their subordinates, we do not include individuals in manager and supervisor roles as identified by the 4th digit of the KldB 2010 Classification of Occupations in our analysis.
- We restrict the sample to workers between the ages 20 and 65.
- Since the LIAB dataset contains information on daily wages but no details on daily hours worked, we restrict our sample to full-time employees.[5]

Daily wages in the LIAB dataset are right-censored at the contribution assessment ceiling, which varies by year and between East and West Germany. This affects 15.2 percent of men and 6.5 percent of women. Wages above the contribution assessment ceiling need to be imputed in order to obtain unbiased estimates (Gartner, 2005). For this wage imputation, we follow the 2-step procedure of Dauth and Eppelsheimer (2020), which uses tobit regressions on observable characteristics (step 1) and leave-one-out-means[6] (step 2) similarly as in Card et al. (2013). We run the regressions separately by year, gender, East and West Germany. Figure 5.A.1 shows the gap in the mean and the standard deviation of log daily wages before and after imputation by gender and region. The gaps in mean log wages of 0.02 to 0.04 and in the standard deviation of 0.03 to 0.06 are consistent with those of Card et al. (2013).

5.4 Empirical strategy

We exploit the panel structure of the LIAB dataset to estimate the effect of women's representation in both first- and second-level management on the gender pay gap among subordinates. The representation of women in management may be correlated with unobserved establishment characteristics, such as the importance of gender equality in the workplace culture, that also affect the gender pay gap in the respective establishment.

[4]For this purpose, we follow Dauth and Eppelsheimer (2020) in constructing a 1-digit industry code. We drop observations from the industries Education, Health and Social Work, Non-industrial organizations and public administration. Furthermore, we drop observations from services industries that are public corporations ("Körperschaften des öffentlichen Rechts") or if the establishment is mainly or exclusively publicly owned.

[5]As a robustness check, we also run our main analysis for the full sample of employees, including full-time and part-time workers. The results do not change much, see section 5.7.

[6]These are mean wages over worker and plant without the respective observation under consideration. Thus, they function as firm- or worker-fixed effects within the imputation regression.

By including establishment fixed effects, we can control for time-constant unobserved heterogeneity. In addition, we include industry-specific time dummies to control for potential differences in industry-wide trends of addressing gender gaps. Thus, identification in this model comes from changes in the share of female managers within each establishment over time that are beyond industry-wide developments. The resulting regression model of the impact of women's representation in first-level management is of the form

$$\begin{aligned} w_{ijt} = \beta_0 &+ \beta_1 wom_i + \beta_2 wmanag\_fl_{jt} + \beta_3 wmanag\_fl_{jt} \times wom_i \\ &+ X_{it}(\gamma + \gamma_{wom} wom_i) + Y_{jt}(\delta + \delta_{wom} wom_i) \\ &+ D_{ind,t}(\lambda + \lambda_{wom} wom_i) + c_j + \epsilon_{ijt} \end{aligned} \tag{5.1}$$

where w_{ijt} is the natural logarithm of the wage of individual i at time t in establishment j, wom_i indicates whether individual i is a woman, $wmanag\_fl_{jt}$ is the share of women first-level managers in establishment j at time t. X_{it} is a set of individual characteristics, including experience, tenure, and education. Y_{jt} is a set of establishment characteristics, including size and the presence of a collective wage agreement. c_j is a set of establishment fixed effects and $D_{ind,t}$ are industry-specific time dummies. ϵ_{ijt} is the error term, which we cluster at the establishment level. The coefficient of interest is β_3 capturing the effect of women's managerial representation on the gender pay gap through the interaction of $wmanag\_fl_{jt}$ and wom_i. In order to interpret β_1 as the average adjusted gender pay gap in the sample, we center all regressors around their means.

The corresponding regression model for second-level management includes two additional regressors, $wmanag\_sl_{jt}$ (share of women in second-level management) and $wmanag\_sl_{jt} \times wom_i$.

$$\begin{aligned} w_{ijt} = \beta_0 &+ \beta_1 wom_i + \beta_2 wmanag\_fl_{jt} + \beta_3 wmanag\_fl_{jt} \times wom_i \\ &+ \beta_4 wmanag\_sl_{jt} + \beta_5 wmanag\_sl_{jt} \times wom_i \\ &+ X_{it}(\gamma + \gamma_{wom} wom_i) + Y_{jt}(\delta + \delta_{wom} wom_i) \\ &+ D_{ind,t}(\lambda + \lambda_{wom} wom_i) + c_j + \epsilon_{ijt} \end{aligned} \tag{5.2}$$

The variables of interest, $wmanag\_fl_{jt}$ and $wmanag\_sl_{jt}$ are shares, i.e. range between 0 and 1 (see Figure 3). One possibility is to include this continuous variable linearly in the regression model. Potentially, however, the impact of women in management on gender pay gaps in the establishment does not increase linearly but jumps at certain thresholds, as suggested by the critical mass theory (Joecks et al., 2013;

Kanter, 1977b). Thus, we add another specification of equations 5.1 and 5.2 where we model the share of women among managers as a categorical variable with 4 values, (i) zero, (ii) greater than zero and up to 33 percent, (iii) greater than 33 percent and up to 66 percent, (iv) or greater than 66 percent.

5.5 Descriptive statistics

Table 5.1 presents descriptive statistics of our final dataset separately by employee gender. The table shows that, on average, women earn less than men. While there are some small differences in age and education, there are larger gender differences in duration in employment and job tenure. Moreover, on average, women work in smaller establishments. Further, there is considerable gender-based job segregation: on average, female employees face a higher share of female coworkers as well as female managers in their establishments than male employees.

Table 5.1: Descriptive Statistics

	Men	Women	Difference
Daily wage, imputed	137.7	107.9	29.74***
Age	42.69	41.47	1.216***
College degree	0.171	0.177	-0.00682***
12 years highschool or vocational degree	0.759	0.735	0.0244***
Number of days in employment	6501.0	5498.0	1003.1***
Number of days in job	4013.2	3072.3	940.9***
Number of employees at establishment	8055.7	4499.0	3556.7***
Share of women employees	0.225	0.466	-0.241***
Share of women first-level management	0.0688	0.143	-0.0739***
Share of women second-level management	0.119	0.250	-0.130***
N	5,741,318		

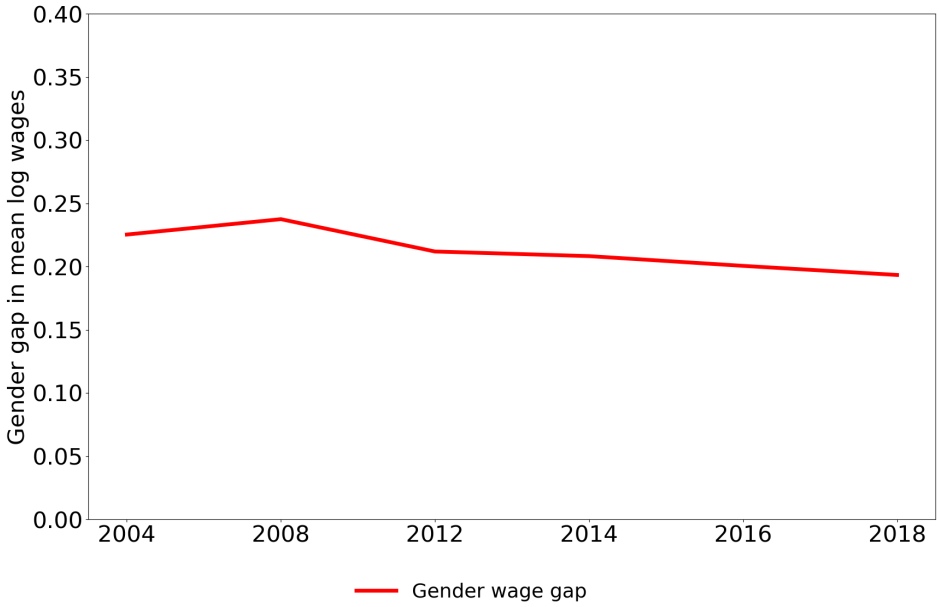
Notes: Means (by gender) and gender difference in means of different variables in LIAB sample of individuals for years 2004, 2008, 2012, 2014, 2016, and 2018.

5.5.1 Gender pay gap

Figure 5.1 shows the raw gender pay gap in the sample over the time period 2004 to 2018. Overall, the raw gender pay gap decreased from 22.5 percent in 2004 to 19.3

percent in 2018.[7] Throughout the whole observation period, the raw gender pay gap is much lower in East (10.7 percent in 2018) than in West Germany (22.6 percent in the same year, see Figure 5.A.2 in the Appendix). This finding is reported by a large body of literature (Schrenker and Zucco, 2020) and attributed inter alia to the higher share of full-time working women and to more gender egalitarian social norms in East Germany (Rosenfeld et al., 2004).

Figure 5.1: Raw gender pay gap over time



Notes: Difference in mean log wages between men and women in LIAB sample of individuals for years 2004, 2008, 2012, 2014, 2016, and 2018.

5.5.2 Women's managerial representation

Figure 5.2 shows the average share of women in first- and second-level management over all establishments (orange line) as well as weighted averages for male and female employees in our sample (blue and grey line, respectively) from 2004 to 2018. On average, women's representation in both, first- and second-level management has slightly increased over time. At the beginning of the observation period, in 2004, the share of female managers over the sample of establishments in the highest management level

[7] The gender pay gap in our dataset is larger than the German Federal Statistical Office's estimation of the raw gender pay gap, which decreased from 24 to 21 percent in West Germany and varied between 6 and 9 percent in East Germany between 2006 and 2018. The main reason for this discrepancy is rooted in differences in the underlying dataset. The Federal Statistical Office determines the raw gender pay gap from the structure of earnings survey ("Verdienststrukturerhebung"), which measures hourly instead of daily wages (Fuchs et al., 2019), therefore accounts for differences in daily working hours between men and women also within the group of full-time employees. Further, we explicitly exclude the public sector from our sample, where many salaries are determined by collective bargaining agreements and the gender pay gap is smaller.

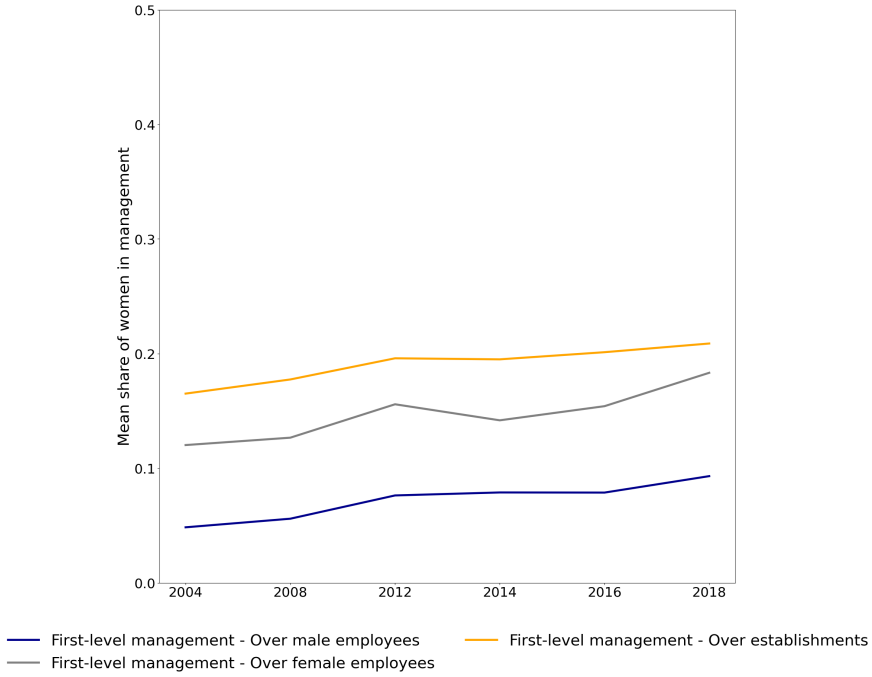
was about 17 percent. It increased up to almost 20 percent in the year 2012 and then increased further, however at a slower rate, up to about 21 percent in 2018. This development of the share of women in first-level management over time is also found in other studies (Kirsch et al., 2022a). In second-level management, the share of women was higher than in first-level management over the whole observation period - it increased from about 26 percent in 2004 to about 36 percent in 2018.

When we separately look at the share of female managers for male (blue line) and female employees (grey line) in our sample, we find that both lines are below the (unweighted) share of female managers over all establishemnts (orange line). This is due to the fact that smaller firms have a higher share of women in management than larger firms (Kohaut and Möller, 2019). We further see that female employees in our sample face a higher share of female managers in their establishment on average than male employees for both first- and second-level management. This is in line with gender-based occupational segregation in the German labor market.

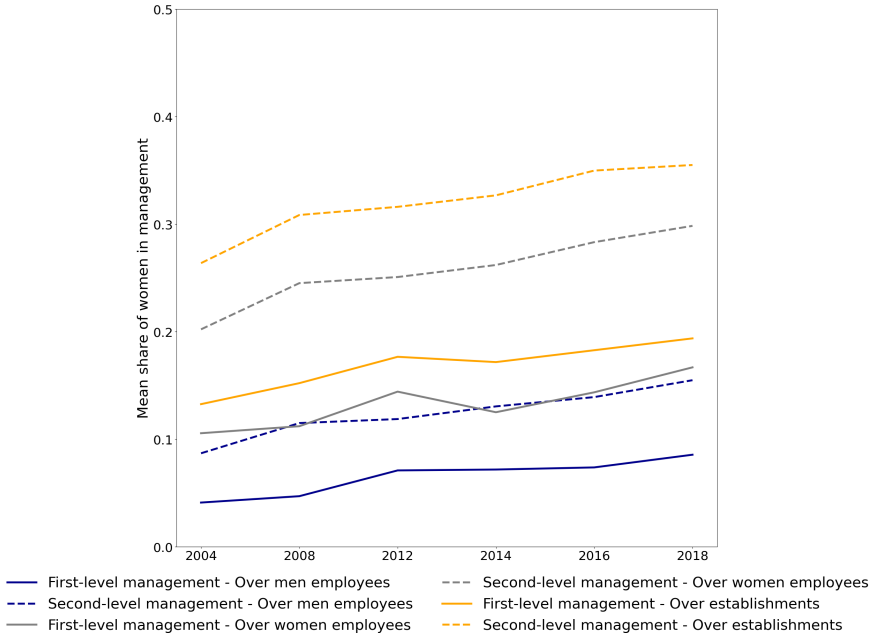
In Figure 5.3, we show the distribution of women in first- and second-level management based on a categorical variable, indicating the share of employees in companies with zero women in management, the share of employees in companies with up to 33%, greater than 33%, and up to 66%, or greater than 66% women in first or second-level management, respectively. Most companies (73 percent in 2019) still do not have any women in first-level management. In contrast, most companies (51 percent in 2018) have between 1 and 33 percent women in second-level management. In both management levels, however, the share of establishments with more than two-thirds of all members being women, is very small.

Figure 5.2: Average share of women in management positions faced by employees by employee gender

(a) Whole sample



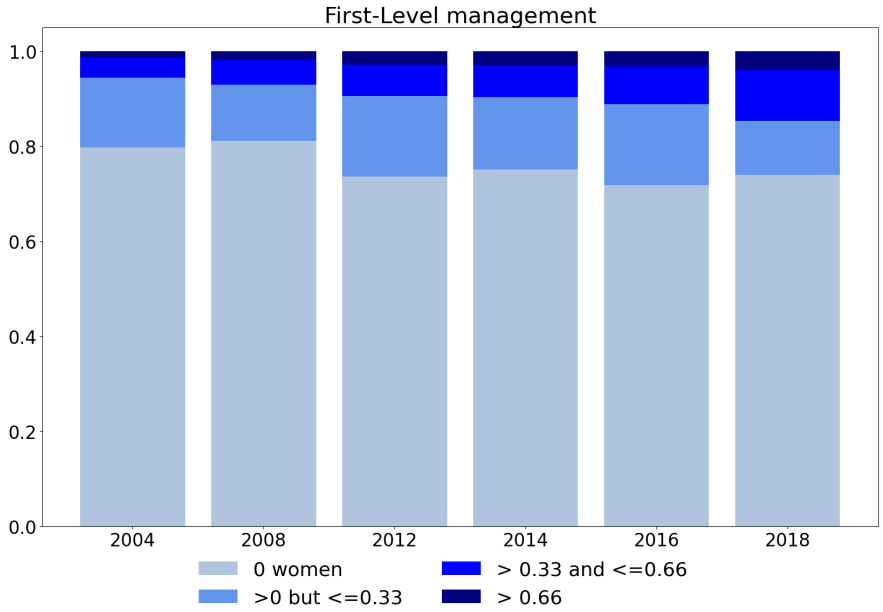
(b) Restricted sample of establishments with second-level management



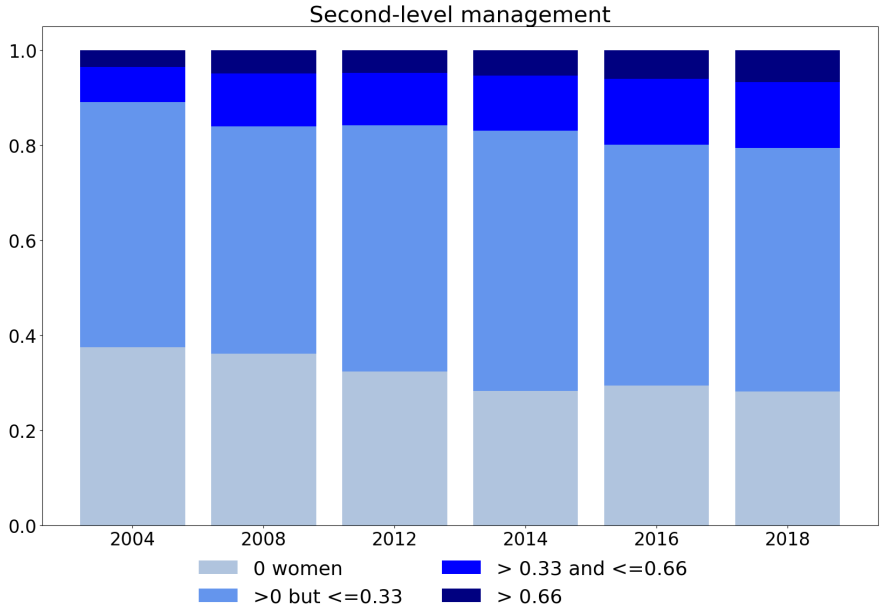
Notes: Average share of women among managers faced by individuals in LIAB sample for years 2004, 2008, 2012, 2014, 2016, and 2018. Shares for second-level management are calculated using the restricted sample of establishments with second-level management.

Figure 5.3: Share of employees facing each category of women's shares in management positions

(a) First-level management



(b) Second-level management



Notes: Shares of individuals facing a each category of women's representation in first- and second-level management in LIAB sample for years 2004, 2008, 2012, 2014, 2016, and 2018. Shares for second-level management are calculated using the restricted sample of establishments with second-level management.

5.6 Estimation results

In the following, we present estimation results of the effect of women's managerial representation on the gender pay gap for both, first- and second-level management. Moreover, we present our results separately for East and West Germany, as well as for establishments with and without collective bargaining coverage.

5.6.1 First-level management

Table 5.2 presents the estimation results of equation (5.1), where the share of female managers is included linearly as a continuous variable. In the model that only controls for observable establishment characteristics (column (1)), we find a negative relationship between daily wages and the share of women in first-level management. This negative effect, however, is partly offset for female employees through a positive interaction effect. This suggests that, in establishments managed by women, all employees, but particularly men, earn less than in establishments managed by men. This finding is in line with the cross-sectional analysis of the 2008 LIAB data in Hirsch (2013).

Once we include establishment fixed effects (columns (2)-(4)), however, we find that the negative relationship between wages and the share of female managers disappears. Thus, the negative relationship seems to be driven by time-constant unobserved establishment heterogeneity. On the other hand, the coefficient of interest, i.e. the coefficient of the interaction between female worker and the share of female managers, β_3, remains substantial in size and highly significant. In our preferred specification, which includes establishment fixed effects, a linear time trend, and industry-specific time dummies (column (4)), the estimate of β_3 amounts to 2.9 log points. This implies that assuming a linear relationship an increase in the women's share in first-level management by 10 percentage points, e.g. from 10 to 20 percent, decreases the gender pay gap from 16.6 percent by approximately 0.3 percentage points.

Table 5.2: First-level management estimation results

	(1)	(2)	(3)	(4)
Woman	-0.167**	-0.146**	-0.163**	-0.166**
Women in first-level management	-0.107**	0.004	-0.000	0.010
Woman * Women in first-level management	0.087**	0.052**	0.049**	0.029**
Control for individual and firm covariates	Yes	Yes	Yes	Yes
Establishment fixed effects	No	Yes	Yes	Yes
Time dummies	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	3,517,320	3,517,320	3,517,320	3,517,320

Notes: Results of regression of log wages on gender dummy, women's representation in first-level management, the interaction of these two variables and different sets of control variables. * $p < 0.05$, ** $p < 0.01$.

In Table 5.3, we show the results of the model with a categorical specification of the share of women in first-level management. As in the model with the linear specification, we find a negative relationship between the share of women in first-level management and the wages within the establishment - at least if the share of female managers exceeds 33 percent (column (1)). This negative association vanishes, however, once we control for establishment fixed effects. In our preferred specification that includes establishment fixed effects, time dummies, and industry-specific time dummies (column 4), we find that a positive share of female managers below 33 percent does not affect the gender pay gap within the establishment (reference category: no women in first-level management). However, if the share of female managers is more than a third, we find a positive impact on the wages of female employees. This effect is even higher when the share of female managers is more than two-thirds. Our results imply that a change in the women's share in first-level management from 0 or below one-third to above one-third decreases the gender pay gap by 1.2 percentage points, i.e. from about 15 to 14 percent. An increase in the women's share to more than 66 percent of the first-level management decreases the gender pay gap by almost 3 percentage points, i.e. to roughly 12 percent.

These results actually hint at a non-linear relationship between the share of female representation in first-level management and the gender pay gap. It seems that a critical mass of more than a third of women in first-level management is needed to find effects on the gender pay gap within the establishment.

Table 5.3: First-level management estimation results - categorical specification

	(1)	(2)	(3)	(4)
Woman	-0.176**	-0.150**	-0.163**	-0.149**
> 0 and $\leq 33\%$ women first-level mgmt	-0.009	0.008	0.007	0.012*
$> 33\%$ and $\leq 66\%$ women first-level mgmt	-0.046**	0.001	0.001	0.006
$> 66\%$ women first-level mgmt	-0.103**	-0.001	-0.006	0.006
Woman * > 0 and $\leq 33\%$ women first-level mgmt	0.025*	0.002	0.001	-0.001
Woman * $> 33\%$ and $\leq 66\%$ women first-level mgmt	0.034**	0.021**	0.020**	0.012**
Woman * $> 66\%$ women first-level mgmt	0.083**	0.051**	0.053**	0.032**
Control for individual and firm covariates	Yes	Yes	Yes	Yes
Establishment fixed effects	No	Yes	Yes	Yes
Time dummies	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	3,517,320	3,517,320	3,517,320	3,517,320

Notes: Results of regression of log wages on gender dummy, categories of women's representation in first-level management, the interactions of these variables and different sets of control variables. Coefficients for the categorical variables estimated with zero women in management as reference category. * $p < 0.05$, ** $p < 0.01$.

5.6.2 Second-level management

For women in second-level management, we find even stronger effects on the gender pay gap than for women in first-level management. Conditioning on the share of women in first-level management, we find a negative impact of the women's share in second-level management on the gender pay gap among subordinates within the same establishment in all models (1) to (4). This holds in both the linear and the categorical specifications of the share of female managers.

In the linear model that includes establishment fixed effects and industry-specific time dummies (Table 5.4, Model 4) the estimated coefficient amounts to 6.3 log points. *Ceteris paribus*, an increase in the women's share of second-level management by 10 percentage points thus decreases the gender pay gap by approximately 0.63 percentage points, which is more than twice the effect of the same increase of women in first-level management.

When we model the share of women in second-level management as a categorical rather than a continuous variable, we find similar results (Table 5.5). Actually, the share of women in second-level management almost linearly affects the gender pay gap: We find that if the share of women increases from zero to between 1 and 33 percent, the gender pay gap is reduced by 1.3 percentage points, conditional on the share of women in first-level management. If the share of women in second-level management increases from 0 to above one-third, the gender pay gap is reduced by 3 percentage points, whereas it is reduced by almost 6 percentage points if the share of women in second-level management is increased from 0 to more than two-thirds.

Table 5.4: Second-level management estimation results

	(1)	(2)	(3)	(4)
Woman	-0.167**	-0.149**	-0.150**	-0.148**
Share of women first-level management	-0.083**	0.005	-0.009	0.014
Woman * Share of women first-level management	0.070**	0.037**	0.037**	0.023**
Share of women second-level management	-0.125**	0.001	-0.014	0.002
Woman * Share of women second-level management	0.090**	0.080**	0.083**	0.063**
Individual and firm covariates	Yes	Yes	Yes	Yes
Establishment fixed effects	No	Yes	Yes	Yes
Time dummies	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	3,126,769	3,126,769	3,126,769	3,126,769

Notes: Results of regression of log wages on gender dummy, women's representation in first- and second-level management, the interactions of gender and managerial representation and different sets of control variables. * $p < 0.05$, ** $p < 0.01$.

Note that, in this specification, the positive effect of the share of women in first-level management remains significant. This means that both women in first and second-level management have a separate impact on the gender pay gap. Taken together, these effects are sizeable: For example, if an establishment increases both the share of women in first and second-level management from zero to between 33 and 66 percent, the gender pay gap would decrease by 4 percentage points. In the (rather unlikely) case that an establishment would increase both variables from 0 to above 66 percent, the gender pay gap would decrease by almost 8 percentage points (baseline: 16 percent).

So far, our results suggest that women in second-level management, who are in closer contact with employees on a day-to-day basis, are more important for reducing gender inequalities in wages among their subordinates. Moreover, while we find non-linearities in the impact of female managers in first-level management on the gender pay gap within their establishment, the share of women in second-level management seems to have a linear impact on an establishment's gender pay gap.

5.6.3 Differences between East and West Germany

More than three decades after reunification, substantial disparities persist in the labor markets of East and West Germany with respect to gender differences. For one, the gender pay gap is much lower in East (about 11 percent in our sample in the year 2018, see Figure A2 in the Appendix) than in West Germany (about 23 percent in 2018). This difference reflects a higher share of full-time working women in East than in West Germany (Schrenker and Zucco, 2020) as well as shorter employment interruptions due to family-related reasons (Frodermann et al., 2023). Furthermore, the number of women in managerial positions is higher in East than in West Germany: In 2018, the

Table 5.5: Second-level management estimation results - categorical specification

	(1)	(2)	(3)	(4)
Woman	-0.193**	-0.164**	-0.166**	-0.163**
>0 and $\leq 33\%$ women first-level mgmt	-0.017	0.006	0.001	0.009
$>33\%$ and $\leq 66\%$ women first-level mgmt	-0.033**	0.004	-0.003	0.007
$>66\%$ women first-level mgmt	-0.073**	-0.001	-0.012	0.005
Woman * >0 and $\leq 33\%$ women first-level mgmt	0.026*	-0.000	-0.000	-0.002
Woman * $>33\%$ and $\leq 66\%$ women first-level mgmt	0.028**	0.015**	0.014**	0.010*
Woman * $>66\%$ women first-level mgmt	0.060**	0.037**	0.038**	0.024**
>0 and $\leq 33\%$ women second-level mgmt	0.005	0.008	-0.000	0.003
$>33\%$ and $\leq 66\%$ women second-level mgmt	-0.054**	-0.000	-0.006	-0.002
$>66\%$ women second-level mgmt	-0.103**	-0.004	-0.013*	0.000
Woman * >0 and $\leq 33\%$ women second-level mgmt	0.017*	0.012*	0.013**	0.013**
Woman * $>33\%$ and $\leq 66\%$ women second-level mgmt	0.045**	0.036**	0.038**	0.029**
Woman * $>66\%$ women second-level mgmt	0.090**	0.071**	0.071**	0.056**
Individual and firm covariates	Yes	Yes	Yes	Yes
Establishment fixed effects	No	Yes	Yes	Yes
Time dummies	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	3,126,769	3,126,769	3,126,769	3,126,769

Notes: Results of regression of log wages on gender dummy, categories of women's representation in first- and second-level management, the interactions of gender and managerial representation and different sets of control variables. Coefficients for the categorical variables estimated with zero women in management as reference category. * $p < 0.05$, ** $p < 0.01$.

share of women in first-level management was about 23 percent in East and 19 percent in West Germany (see Figure A3 in the Appendix). These differences in the labor market mirror the much more egalitarian social norms with respect to gender roles in East than in West Germany (Jessen, 2022; Rosenfeld et al., 2004).

Given these persisting disparities between East and West Germany, we conduct separate estimations our preferred model, which includes the share of women in first- and second-level management as a categorical variable, for both parts of the countries. Despite the contextual differences, we find very similar patterns (Table 5.6). In East and West Germany, the effect of second-level female managers is higher than first-level female managers. While most coefficients tend to be slightly higher in West Germany, even in East Germany, where the gender pay gap is half of the gap in West Germany, female managers have a statistically significant impact on the establishment-specific gender pay gap.

The consistency of our results in two very different labor markets suggests that frequent interactions with female managers play an important role for the positive development of wages of female employees.

Table 5.6: Second-level management estimation results for East and West Germany - categorical specification

(a) West

	(1)	(2)	(3)	(4)
Woman	-0.206**	-0.180**	-0.181**	-0.177**
>0 and $\leq 33\%$ women first-level mgmt	-0.0187	0.0096*	0.0037	0.0123
$>33\%$ and $\leq 66\%$ women first-level mgmt	-0.0379**	0.0026	-0.0055	0.0055
>0.66 women first-level mgmt	-0.0956**	-0.0096	-0.0239*	0.0004
Woman * >0 and $\leq 33\%$ women first-level mgmt	0.0198	-0.0025	-0.0026	-0.0040
Woman * $>33\%$ and $\leq 66\%$ women first-level mgmt	0.0273**	0.0159**	0.0155**	0.0119*
Woman * $>66\%$ women first-level mgmt	0.0662**	0.0484**	0.0483**	0.0393**
>0 and $\leq 33\%$ women second-level mgmt	0.0073	0.0100	0.0005	0.0019
$>33\%$ and $\leq 66\%$ women second-level mgmt	-0.0399**	-0.0009	-0.0085	-0.0052
$>66\%$ women second-level mgmt	-0.103**	-0.0082	-0.0165*	-0.0031
Woman * >0 and $\leq 33\%$ women second-level mgmt	0.0192*	0.0133*	0.0148**	0.0156**
Woman * $>33\%$ and $\leq 66\%$ women second-level mgmt	0.0401**	0.0360**	0.0380**	0.0285**
Woman * $>66\%$ women second-level mgmt	0.0964**	0.0751**	0.0759**	0.0595**
Individual and firm covariates	Yes	Yes	Yes	Yes
Establishment fixed effects	No	Yes	Yes	Yes
Time dummies	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	2,492,355	2,492,355	2,492,355	2492355

(b) East

	(1)	(2)	(3)	(4)
Woman	-0.144**	-0.110**	-0.110**	-0.101**
>0 and $\leq 33\%$ women first-level mgmt	0.0227	-0.0186	-0.0189*	-0.0135
$>33\%$ and $\leq 66\%$ women first-level mgmt	-0.0377**	0.0050	0.0028	0.0086
$>66\%$ women first-level mgmt	-0.0544**	0.0063	-0.0030	0.0122
Woman * >0 and $\leq 33\%$ women first-level mgmt	0.0456**	0.0125	0.0132*	0.0114*
Woman * $>33\%$ and $\leq 66\%$ women first-level mgmt	0.0345*	0.0151**	0.0121*	0.0102*
Woman * $>66\%$ women first-level mgmt	0.0531**	0.0217*	0.0262**	0.00932
>0 and $\leq 33\%$ women second-level mgmt	0.0169	0.0048	0.0014	0.0036
$>33\%$ and $\leq 66\%$ women second-level mgmt	-0.0652**	-0.0013	-0.0013	-0.0007
$>66\%$ women second-level mgmt	-0.102**	-0.0007	-0.0078	0.0024
Woman * >0 and $\leq 33\%$ women second-level mgmt	0.0062	0.0039	0.0038	0.0020
Woman * $>33\%$ and $\leq 66\%$ women second-level mgmt	0.0442**	0.0322**	0.0332**	0.0261**
Woman * $>66\%$ women second-level mgmt	0.0758**	0.0611**	0.0609**	0.0440**
Individual and firm covariates	Yes	Yes	Yes	Yes
Establishment fixed effects	No	Yes	Yes	Yes
Time dummies	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	634,414	634,414	634,414	634414

Notes: Results of regression of log wages on gender dummy, categories of women's representation in first- and second-level management, the interactions of gender and managerial representation and different sets of control variables separately by East and West Germany. Coefficients for the categorical variables estimated with zero women in management as reference category. * $p < 0.05$, ** $p < 0.01$.

5.6.4 Differences by collective bargaining coverage

In a next step, we separate our sample by coverage of a collective bargaining agreement. First, we find that in companies without collective bargaining agreement (Panel (b) in Table 5.7), the adjusted gender pay gap is considerably higher than in companies with collective bargaining agreement (Panel (a)). In these companies, also the effect of the share of first-level female managers on the gender pay gap is lower than in those without collective bargaining agreement. In our preferred model with a categorical variable, the coefficient on having between 33 percent and 66 percent (more than 66 percent) women in first-level management is 0.013 (0.045) for establishments without collective bargaining agreements while only amounts to 0.007 (0.026) for those with collective bargaining agreements (Table 5.7). As far as the share of female managers in second-level management is concerned, we do not find differences between establishments with and without collective bargaining agreements (Table 5.8).

Table 5.7: First-level management estimation results for establishments with and without collective bargaining agreement - categorical specification

(a) With collective bargaining agreement

	(1)	(2)	(3)	(4)
Woman	-0.152**	-0.135**	-0.152**	-0.153**
>0 and $\leq 33\%$ women first-level mgmt	-0.008	0.010	0.009	0.012
$>33\%$ and $\leq 66\%$ women first-level mgmt	-0.039**	0.005	0.004	0.010*
$>66\%$ women first-level mgmt	-0.101**	0.009	0.005	0.011
Woman * >0 and $\leq 33\%$ women first-level mgmt	0.018	0.000	-0.001	-0.002
Woman * $>33\%$ and $\leq 66\%$ women first-level mgmt	0.027**	0.019**	0.015**	0.007
Woman * $>66\%$ women first-level mgmt	0.071**	0.044**	0.045**	0.026**
Control for individual and firm covariates	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes
Time dummies	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	2657377	2657377	2657377	2657377

(b) Without collective bargaining agreement

	(1)	(2)	(3)	(4)
Woman	-0.244**	-0.200**	-0.226**	-0.221**
>0 and $\leq 33\%$ women first-level mgmt	0.004	-0.007	-0.003	-0.001
$>33\%$ and $\leq 66\%$ women first-level mgmt	-0.057**	-0.011*	-0.009*	-0.004
$>66\%$ women first-level mgmt	-0.097**	-0.020*	-0.025**	-0.018**
Woman * >0 and $\leq 33\%$ women first-level mgmt	0.031*	0.009	0.007	0.004
Woman * $>33\%$ and $\leq 66\%$ women first-level mgmt	0.044**	0.026**	0.024**	0.013**
Woman * $>66\%$ women first-level mgmt	0.087**	0.064**	0.063**	0.045**
Control for individual and firm covariates	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes
Time dummies	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	859,943	859,943	859,943	859,943

Notes: Results of regression of log wages on gender dummy, categories of women's representation in first-level management, the interactions of gender and managerial representation and different sets of control variables separately for establishments with and without collective bargaining agreement. Coefficients for the categorical variables estimated with zero women in management as reference category. * $p < 0.05$, ** $p < 0.01$.

Table 5.8: Second-level management estimation results for establishments with and without collective bargaining agreement - categorical specification

(a) With collective bargaining agreement

	(1)	(2)	(3)	(4)
Woman	-0.172**	-0.148**	-0.150**	-0.148**
> 0 and ≤ 33% women first-level mgmt	-0.017	0.009	0.003	0.012
> 33% and ≤ 66% women first-level mgmt	-0.026*	0.009	0.000	0.012*
> 66% women first-level mgmt	-0.063**	0.005	-0.008	0.010
Woman * > 0 and ≤ 33% women first-level mgmt	0.023	-0.002	-0.002	-0.003
Woman * > 33% and ≤ 66% women first-level mgmt	0.022*	0.014*	0.013*	0.009
Woman * > 66% women first-level mgmt	0.044*	0.032**	0.034**	0.018*
> 0 and ≤ 33% women second-level mgmt	0.008	0.013	0.001	0.005
> 33% and ≤ 66% women second-level mgmt	-0.052**	0.004	-0.005	-0.002
> 66% women second-level mgmt	-0.102**	-0.001	-0.010	0.001
Woman * > 0 and ≤ 33% women second-level mgmt	0.020*	0.010	0.012*	0.013*
Woman * > 33% and ≤ 66% women second-level mgmt	0.043**	0.033**	0.036**	0.028**
Woman * > 66% women second-level mgmt	0.090**	0.069**	0.070**	0.055**
Individual and firm covariates	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes
Time dummies	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	2,398,137	2,398,137	2,398,137	2,398,137

(b) Without collective bargaining agreement

	(1)	(2)	(3)	(4)
Woman	-0.255**	-0.220**	-0.220**	-0.212**
> 0 and ≤ 33% women first-level mgmt	0.007	-0.013	-0.016*	-0.009
> 33% and ≤ 66% women first-level mgmt	-0.051**	-0.010	-0.013*	-0.006
> 66% women first-level mgmt	-0.086**	-0.010	-0.016	-0.007
Woman * > 0 and ≤ 33% women first-level mgmt	0.024	0.008	0.007	0.007
Woman * > 33% and ≤ 66% women first-level mgmt	0.039**	0.019**	0.019**	0.010*
Woman * > 66% women first-level mgmt	0.074**	0.045**	0.045**	0.034**
> 0 and ≤ 33% women second-level mgmt	-0.005	-0.006	-0.007	-0.004
> 33% and ≤ 66% women second-level mgmt	-0.051**	-0.010	-0.011*	-0.007
> 66% women second-level mgmt	-0.096**	-0.011	-0.014	-0.006
Woman * > 0 and ≤ 33% women second-level mgmt	0.004	0.013*	0.013*	0.013**
Woman * > 33% and ≤ 66% women second-level mgmt	0.037**	0.042**	0.042**	0.030**
Woman * > 66% women second-level mgmt	0.072**	0.074**	0.074**	0.054**
Individual and firm covariates	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes
Time dummies	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	728,632	728,632	728,632	728,632

Notes: Results of regression of log wages on gender dummy, categories of women's representation in first- and second-level management, the interactions of gender and managerial representation and different sets of control variables separately for establishments with and without collective bargaining agreement. Coefficients for the categorical variables estimated with zero women in management as reference category. * $p < 0.05$, ** $p < 0.01$.

5.7 Robustness checks

5.7.1 Inclusion of part-time workers

The LIAB data only contains information on daily wages, as well as a discrete variable indicating part-time or full-time work, but not the exact hours worked. Therefore, computing hourly wages is not possible. Thus, we restrict our main analysis presented in section 5.6 to full-time employees. However, since the share of women working part-time is very high, whereas part-time among men is very rare in Germany (Ilieva and Wrohlich, 2022), it is not clear whether our results obtained from a sample of full-time workers hold for the whole workforce. In particular, selection into full-time and part-time work affects the gender pay gap among full-time employees if it depends on both earnings expectations as well as social norms regarding the role of men and women in the labor market. Further, women's managerial representation may be related to selection into and out of part-time work. For example, female managers might be more inclined to implement policies aimed at the reconciliation of family and career in order to encourage women to stay in full-time positions. In a similar manner, they may also encourage men to challenge gender stereotypes and take on part-time jobs. In these cases, women with lower earnings prospects would remain in full-time work (compared to the counterfactual case of not having the policy and encouragement of the manager in place) while men with higher earnings prospects would decide to switch to part-time work. Accordingly, the gender gap in hours worked would decrease but the gender pay gap among full-time employees would rise and bias our estimates of the causal effects of female managers on the unexplained gender pay gap towards zero.

To analyze whether these potential selection mechanisms drive our results obtained for the sample of full-time workers, we estimate a model including all full-time and part-time workers. Estimation results of this model (Table 5.9) show that the effect of women's managerial representation in first- and second-level management are of similar magnitude as in our main estimation.

5.7.2 Right-censoring of wages

Daily wages in the LIAB dataset are right-censored at the contribution assessment ceiling and wages above the contribution assessment ceiling need to be imputed. To ensure that our results are not entirely driven by imputed wages, we repeat our analysis while excluding these from the estimation. Excluding all right-censored observations reduces our sample size from about 3.7 million observations to about 2.7 million. Comparing

Table 5.9: Robustness of estimates to including part-time workers: second-level management - categorical specification

	(1)	(2)	(3)	(4)
Woman	-0.214**	-0.182**	-0.183**	-0.178**
>0 and $\leq 33\%$ women first-level mgmt	-0.016	0.006	-0.000	0.008
$>33\%$ and $\leq 66\%$ women first-level mgmt	-0.036**	0.001	-0.006	0.005
$>66\%$ women first-level mgmt	-0.081**	-0.008	-0.021**	0.000
Woman * >0 and $\leq 33\%$ women first-level mgmt	0.032*	0.004	0.004	0.003
Woman * $>33\%$ and $\leq 66\%$ women first-level mgmt	0.030**	0.017**	0.016**	0.011**
Woman * $>66\%$ women first-level mgmt	0.076**	0.047**	0.048**	0.033**
>0 and $\leq 33\%$ women second-level mgmt	0.003	0.009	-0.001	0.002
$>33\%$ and $\leq 66\%$ women second-level mgmt	-0.062**	-0.004	-0.011*	-0.005
$>66\%$ women second-level mgmt	-0.111**	-0.015	-0.024**	-0.007
Woman * >0 and $\leq 33\%$ women second-level mgmt	0.023**	0.015**	0.016**	0.017**
Woman * $>33\%$ and $\leq 66\%$ women second-level mgmt	0.044**	0.040**	0.042**	0.033**
Woman * $>66\%$ women second-level mgmt	0.097**	0.080**	0.081**	0.061**
Individual and firm covariates	Yes	Yes	Yes	Yes
Establishment fixed effects	No	Yes	Yes	Yes
Time dummies	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	3,660,607	3,660,607	3,660,607	3,660,607

Notes: Results of regression of log wages on gender dummy, categories of women's representation in first- and second-level management, the interactions of gender and managerial representation and different sets of control variables including part-time employees. Coefficients for the categorical variables estimated with zero women in management as reference category. * $p < 0.05$, ** $p < 0.01$.

these results to the main estimation based on all full-time workers (Table 5.5), we find that the gender pay gap is, in general, lower (12.5 log points as compared to 16.3 log points), which is in line with previous findings showing a particularly high gender pay gap at the top of the wage distribution (Gallego Granados and Wrohlich, 2019). The main coefficients of interest, however, i.e. the interaction terms between female managers and female workers, are similar in size as compared to our main specification. The only exception is the coefficient of the share of female managers between 1 and 33 percent in first-level management, which is almost zero and not statistically significant in this specification.

5.7.3 Robustness of two-way fixed effects estimation under heterogeneous treatment effects

In the models presented in Section 5.6, we estimate the impact of women's managerial representation on the gender pay gap at the establishment level in a fixed-effects regression framework with both establishment-fixed effects as well as industry-specific time fixed effects. A stream of literature (as surveyed in De Chaisemartin and d'Haultfoeuille (2023)) shows that, under heterogeneity of treatment effects over time or between groups, two-way fixed-effects (TWFE) estimators in general are not unbiased for the

Table 5.10: Robustness of estimates to excluding imputed wages: second-level management - categorical specification

	(1)	(2)	(3)	(4)
Woman	-0.154**	-0.129**	-0.130**	-0.125**
>0 and $\leq 33\%$ women first-level mgmt	-0.016	0.007	-0.001	0.006
$>33\%$ and $\leq 66\%$ women first-level mgmt	-0.027**	0.008	0.000	0.007*
$>66\%$ women first-level mgmt	-0.070**	0.006	-0.009	0.000
Woman * >0 and $\leq 33\%$ women first-level mgmt	0.025*	0.002	0.002	0.000
Woman * $>33\%$ and $\leq 66\%$ women first-level mgmt	0.018*	0.009*	0.007*	0.002
Woman * $>66\%$ women first-level mgmt	0.051**	0.026**	0.028**	0.018**
>0 and $\leq 33\%$ women second-level mgmt	0.005	0.010	-0.000	-0.001
$>33\%$ and $\leq 66\%$ women second-level mgmt	-0.051**	0.002	-0.005	-0.004
$>66\%$ women second-level mgmt	-0.102**	0.000	-0.011*	-0.008
Woman * >0 and $\leq 33\%$ women second-level mgmt	0.015*	0.008	0.009*	0.009*
Woman * $>33\%$ and $\leq 66\%$ women second-level mgmt	0.038**	0.025**	0.027**	0.022**
Woman * $>66\%$ women second-level mgmt	0.078**	0.057**	0.058**	0.048**
Individual and firm covariates	Yes	Yes	Yes	Yes
Establishment fixed effects	No	Yes	Yes	Yes
Time dummies	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	2,701,681	2,701,681	2,701,681	2,701,681

Notes: Results of regression of log wages on gender dummy, categories of women's representation in first- and second-level management, the interactions of gender and managerial representation and different sets of control variables excluding observations where wages had to be imputed since they are above the contribution assessment ceiling. Coefficients for the categorical variables estimated with zero women in management as reference category. * $p < 0.05$, ** $p < 0.01$.

average treatment effect, i.e. they may not identify a convex combination of treatment effects over time and groups weighted by their relative number of observations in the sample. Further, some of the weights attached to each time- and group-specific treatment effect may be negative. This is due to so-called "forbidden comparisons" (Borusyak et al., 2024) of outcomes (i) between groups that switch treatment status between some periods $t-1$ and t to groups that are treated in both of these periods, as well as (ii) groups that are exposed to different intensities of treatment in case of non-binary treatments.

Several ways to evaluate robustness of TWFE estimation to heterogeneous treatment effects have been suggested. Each of these apply to different estimation setups depending on whether dynamic effects can be ruled out or not, whether treatment adoption is staggered, and the specific nature of the treatment variables (binary, discrete, or continuous).

In our application, heterogeneity in the impact of women's managerial representation on the gender pay gap between establishments and over time may arise for several reasons. First, the effectiveness and implementability of policies that aim to reduce the gender pay gap may depend on the current level of the gender pay gap in an establishment. Second, wages in some establishments may be stickier than in others,

e.g. due to collective bargaining agreements or differing levels of employee turnover. Third, the ability of female managers to influence wages as a function of their share in management could be non-linear and vary between different levels of representation since a critical mass of supporters may be needed to change a certain policy. Since the treatment variables in our application are non-binary, both of the above-mentioned "forbidden comparisons" are relevant for our analysis.

We calculate the size of the negative weights as well as the heterogeneity-robust estimator suggested by De Chaisemartin and d'Haultfoeuille (2020) to assess the robustness of our estimates to heterogeneous treatment effects. In their framework, treatment varies at the group level and affects all units within a group. In our analysis, however, we are interested exactly in how managerial representation of women affects men and women within one group, i.e. one establishment, differently. Therefore, we cannot directly apply the suggested tools to our specification of a TWFE regression. Instead, we estimate the regression equation separately for men and women. This allows us to estimate the size of negative weights occurring in our original regression as the treatment variable varies at the establishment level, thus establishment-time specific weights attached to each treatment effect are the same in the equations estimated separately by men and women. Only for establishments where there are either only men or women employed will the size of potential negative weights differ. Thus the sum of negative weights in our baseline regression should be close to the sum of the negative weights obtained in the regressions that we run separately by gender. Moreover, we include means of employee characteristics, including tenure, experience, and education by year and establishment.

Table 5.11 shows that estimating the regression equations separately by gender yields a positive effect of women's managerial representation in first-level management on wages of men and women, but more so for women. These results are in line with our finding of a negative impact of women's managerial representation in first-level management on the gender pay gap from Section 5.6.

To assess how much negative weights (by which year- and establishment specific treatment effects are weighted in the calculation of the ATE) may affect the sign and bias our estimates, we calculate the sum of the negative weights attached to the year-establishment cells in each of the regression models. Table 5.12 shows that the sum of negative weights is small in regressions both for women and for men. From this small sum of negative weights in these regressions we conclude that heterogeneity of treatment effects over time or between groups does not seem to play a major role in

our application. Thus, we trust our results in the specifications of the two-way fixed effects model presented in section 5.6.

Table 5.11: Two-way fixed effects regressions of log wages on women's representation in first-level management separately by gender

	(1)	(2)
Men - Women's share in first-level management	0.013	0.012
Men - > 0 women's share in first-level management	0.002	0.003
Men - >33% women's share in first-level management	0.004	0.003
Men - ≥50% women's share in first-level management	0.007	0.006
N	2,892,416	2,892,272
Women - Women's share in first-level management	0.02**	0.018**
Women - >0 women's share in first-level management	0.008**	0.009**
Women - >33% women's share in first-level management	0.008**	0.008**
Women - ≥50% women's share in first-level management	0.009*	0.008*
N	1,334,109	1,334,045
Control for firm covariates	Yes	Yes
Establishment fixed effects	Yes	Yes
Industry-specific time dummies	Yes	Yes
Added firm-mean of individual covariates	No	Yes

Notes: * $p < 0.05$, ** $p < 0.01$. Heterogeneity-robust TWFE estimation (De Chaisemartin and d'Haultfoeuille, 2020) of log wages on categorical variable of women's share in first-level management and different sets of covariates (on the establishment level). All coefficients for the categorical variables estimated with zero women in management as reference category.

5.8 Conclusion

Gender inequalities in the labor market are still prevalent in all countries of the world. While some convergence has been achieved in dimensions such as educational attainment and labor force participation in many industrialized countries, other gender gaps remain strikingly constant, in particular the gender gap in pay. Similarly, the gender gap in leadership positions at the workplace is decreasing only very slowly, despite several policies that have been introduced, such as gender quotas for corporate boards. While one aim of these policies is to increase women's representation on boards, policy makers hope that by increasing the share of women in powerful positions, other gender inequalities can be decreased as well.

The empirical analysis presented in this paper shows that the share of women in management negatively affects the gender pay gap within an establishment. While we cannot pin down the exact mechanism through which women in management affect equal pay in their firm, we can document some notable (non-)variation by corporate and cultural context.

Table 5.12: Sum and count of positive and negative weights in two-way fixed effects regressions separately by gender

	Positive	Negative
Men - Women's share in first-level management	1.11	-.11
Men - > 0 women's share in first-level management	1.03	-.03
Men - >33% women's share in first-level management	1.01	-.01
Men - ≥50% women's share in first-level management	1.01	-.01
Women - Women's share in first-level management	1.14	-.14
Women - >0 women's share in first-level management	1.05	-.05
Women - >33% women's share in first-level management	1.04	-.04
Women - ≥50% women's share in first-level management	1.03	-.03

Notes: Positive and negative weights in the TWFE estimation of log wages on categorical variable of women's share in first-level management and firm covariates as well as firm-means of individual covariates.

First, we find that the share of women in second-level-management has a greater effect on the gender pay gap than the share of women in first-level management. These results suggest that women particularly benefit from frequent interactions with female managers. This corroborates results from previous studies showing that daily interactions between managers and their employees are an important channel for inequalities in pay (Cullen and Perez-Truglia, 2023; Zimmermann, 2022).

Second, we find relatively similar effects of female managers on the gender pay gap within an establishment in east and west Germany. Given that gender gaps in the labor market are so much more pronounced in west than in east Germany, this is a remarkable result. It implies that, even in a context of a labor market with relatively low gender gaps in pay, lower gender gaps in leadership positions, and relatively egalitarian social norms with respect to gender roles (Jessen, 2022; Rosenfeld et al., 2004), the gender of the manager plays a significant role when it comes to gender pay inequalities within the firm. We interpret this as even stronger evidence that frequent interactions with a female manager can positively affect wages of women.

Finally, we find functional form differences in the effect of female managers on the gender pay gap for first-level and second-level management. Our results show that the share of women in first-level management affects the gender pay gap in a non-linear way. Only if the share of women in first-level management exceeds the threshold of one-third do we find significant effects on the gender pay gap. On the other hand, we do not find these non-linearities for second-level managers. Against the background of the much higher existing representation of women in second-level than in first-level management, these results provide empirical support for the theoretical notion of a critical mass and the theory of tokenism. In contexts where the presence of women is still rather rare, such as in first-level management, a critical mass of women needs to

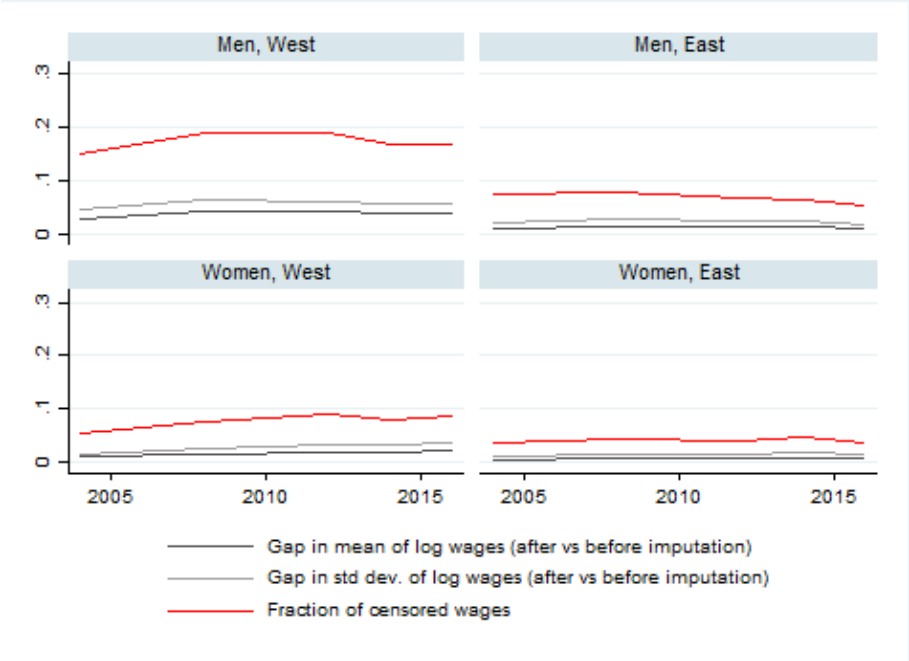
be present in order to impact the gender pay gap within the firm. In contexts where representation of women is already higher, such as in second-level management, these critical thresholds no longer play a role.

Overall, our results show that women in management influence the size of the gender pay gap within their firms. One important channel seems to be worker-manager interactions, where women benefit from interaction with female managers. However, our results also show that increasing the share of women in management alone will not make gender differences in pay disappear. Even if the share of women in first-level and second-level management increases to levels of gender parity, substantial gender differences in pay will remain. Thus, policies aiming at increasing the share of women in management positions need to be complemented by many other policies, e.g. family policies incentivizing more gender equality in care responsibilities (Frodermann et al., 2023) or pay transparency policies (Cullen, 2024).

5.A Appendix

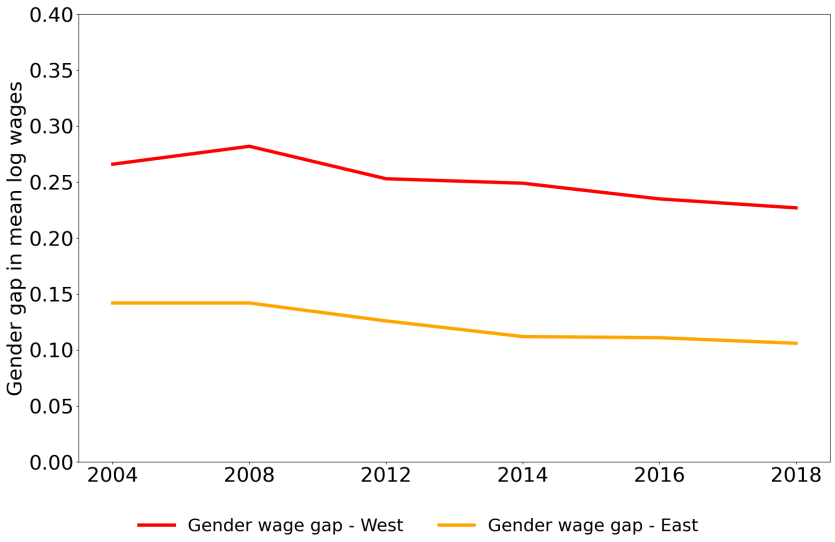
5.A.1 Additional figures and tables

Figure 5.A.1: Gap in mean and standard deviation of wages before and after imputation



Notes: Differences in mean and standard deviation of log wages before and after the imputation of censored wages above the contribution assessment ceiling, separately by gender and East and West Germany.

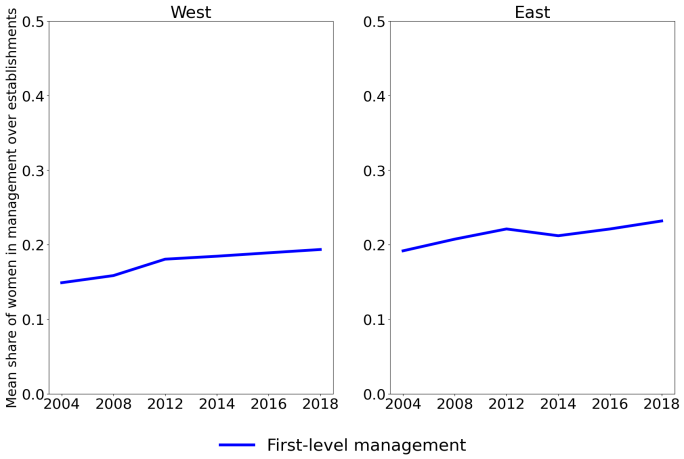
Figure 5.A.2: Gender pay gap in West vs. East Germany



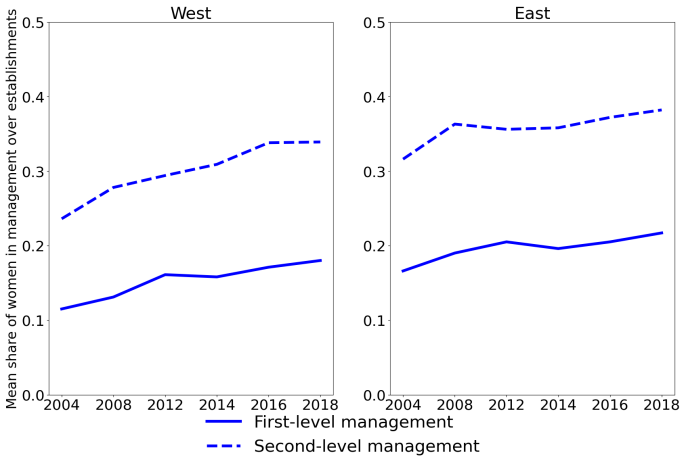
Notes: Difference in mean log wages between men and women in LIAB sample of individuals separate by West and East Germany for years 2004, 2008, 2012, 2014, 2016, and 2018.

Figure 5.A.3: Women's representation in management in West vs. East Germany

(a) First-level management



(b) Second-level management



Notes: Average shares of women among managers over establishments in LIAB sample for years 2004, 2008, 2012, 2014, 2016, and 2018. Shares for second-level management are calculated using the restricted sample of establishments with second-level management.

CHAPTER 6

Conclusion

This dissertation comprises four chapters contributing to the literature on labor and gender economics. More specifically, this dissertation advances our understanding of the role of women in management within firms and labor markets, the causes and consequences of their (under)representation, and the ways in which gender stereotypes interact with these factors. **Chapter 2** documents the underrepresentation of women on boards of German companies by presenting data from the DIW Women Executives Barometer. **Chapter 3** provides initial evidence of gender differences in newspaper coverage of company board members, which align with gender stereotypes: women are more strongly associated with family and communion, while men are associated with career and agency. These differences in coverage cannot be explained by actual differences in characteristics of men and women in managerial roles. **Chapter 4** then assesses how the stereotypical newspaper coverage of male and female CEOs affects readers' economic decision-making and their assessment of CEO competence. In an online experiment, participants are more pessimistic about stock performance under female CEOs irrespective of coverage in a newspaper article; however, investments in the firm are significantly lower when the female CEO's family is neutrally mentioned in the article text. Finally, **Chapter 5** examines spillover effects of female leadership finding a positive causal impact of women's representation in management on gender equality in pay among subordinates on the establishment level. In this conclusion, I highlight policy implications of my findings as well as limitations and resulting avenues for future research.

Chapter 2 shows that women are still heavily underrepresented on executive and supervisory boards in Germany. Given that a balanced gender representation in corporate management is a declared policy goal (European Parliament and Council of the EU, 2022; OECD, 2020), the results presented in this chapter imply that further ef-

forts from companies and policymakers are needed to increase women's representation in these roles of power. Germany has seen two pieces of legislation being introduced in the last years that mandate a certain level of gender representation: the *FüPoG I* from 2015 stipulating a gender quota of 30 percent for supervisory boards, and the *FüPoG II* from 2021 stipulating a minimum participation requirement for executive boards. These policies have led to an increase in women's representation on the respective boards (Sondergeld et al., 2024). Both laws, however, apply only to publicly listed companies with full co-determination on the supervisory board, and there is an additional requirement on board size for the minimum participation requirement, resulting in a group of approximately 100 and 60 companies that are affected by the policies, respectively. In an international comparison (see Kirsch et al. (2022b)), this is a relatively narrow scope. Extending the legislation to a broader group of companies could accelerate progress toward achieving more gender-balanced representation on corporate boards.

Chapter 3 shows that gender stereotypes are present in newspaper coverage of women in managerial roles, shaping public perceptions of female leaders and limiting their ability to serve as role models for other women or as counter-stereotypical examples for a broader audience. **Chapter 4** further shows that these stereotypes in newspaper coverage have consequences for real financial decision-making. Stereotypes are deeply ingrained in culture, and their presence in the media reflects the interplay between journalists' biases on the 'supply' and readers' expectations on the 'demand' side, making it difficult for policies to directly address biased newspaper coverage. However, policies do have the power to challenge gender stereotypes by promoting counter-stereotypical decision-making among individuals in the labor market and society at large. For instance, tax and parental leave policies can incentivize a more gender-balanced distribution of market and non-market labor, such as caregiving and household work. Although the share of fathers taking parental leave in Germany has increased in recent years, childcare responsibilities remain unevenly distributed, with most mothers taking twelve months of leave while fathers typically take only two months, often overlapping with the mother's leave (Samtleben et al., 2019; Wrohlich, 2023). A recent policy reform, which stipulates that both parents can take at most one month of leave together[1], is a step in the right direction, but there remains room for further redesign to incentivize a more gender-equal uptake of parental leave. Additionally, proposals to reform Germany's joint taxation system for married couples

[1]See website of the German Federal Ministry for Family Affairs, Senior Citizens, Women and Youth, `https://www.bmfsfj.de/bmfsfj/themen/familie/familienleistungen/neuregelungen-beim-elterngeld-fuer-geburten-ab-1-april-2024-228588` (Last accessed: 15 November 2024).

(*Ehegattensplitting*) could increase incentives for secondary earners — often women in heterosexual marriages — to increase their labor supply (Bach et al., 2020). Finally, interventions that encourage people of all genders to enter counter-stereotypical professions, such as women in STEM fields or men in social work or nursing, not only help reduce stereotypes and promote gender equality but also improve the efficient allocation of talent. This can decrease labor market mismatches and help address Germany's skilled labor shortage.

By providing evidence on positive spillover effects of women in managerial roles, **Chapter 5** suggests that increasing women's representation in leadership can help reduce other gender gaps on the labor market, such as those in pay. This finding supports 'top-down' policies mentioned in the introduction of this dissertation, such as quotas that directly target women's representation in leadership to improve women's overall labor market outcomes. However, the size of the coefficients found for the effect on the unexplained gender pay gap suggests that increasing representation in leadership alone will not be sufficient to fully close this pay inequality. Additional policies, such as family policies that incentivize greater gender equality in caregiving responsibilities are necessary to address gender gaps and can also support a 'bottom-up' approach to reducing barriers for women in reaching leadership positions in the first place. Further, the found nonlinearities show that an effect of women's representation in management on the unexplained gender pay gap is only to be expected when a level of more than 1/3 of women is reached. This is in line with the theory of a critical mass stating that a minimum threshold of female representation is needed within leadership groups to influence decision-making (Kanter, 1977b). In **Chapter 2**, however, we have seen that the current level of women's representation on executive boards is still below this value of 1/3 across groups of companies. Thus, based on the results found in **Chapter 5**, we would not expect any significant spillover effects of women's representation on German company boards (yet).

The studies presented in this dissertation have limitations that may affect the generalizability of the findings to other contexts and their implications for policy.

An overarching limitation is the focus on women in management within Germany, using German data. Germany serves as an important case study as a major economy where women's integration into labor markets has followed a trajectory similar to that of other high-income countries in recent decades, and where women remain underrepresented in leadership roles, as is common across jurisdictions. However, the specific barriers women face in attaining leadership positions can vary between countries due to differences in institutional factors, such as parental leave policies, childcare availability,

and anti-discrimination legislation. Additionally, gender stereotypes, particularly those related to caregiving responsibilities, are shaped by cultural context. As a result, the extent to which care-related stereotypes (or potentially their violation) are activated by mentioning a female CEO's family status in newspaper coverage — and whether this leads to negative investment reactions, as found in **Chapter 4** — may depend on the strength of traditional gender roles in a given cultural context. In a European comparison, Germany demonstrates a more progressive culture regarding gender equality than most countries in Southern and Eastern Europe but is less progressive than Scandinavian countries (Menkhoff and Wrohlich, 2024). Accordingly, treatment effects may be larger in Southern and Eastern Europe and smaller in Scandinavian countries. Whether this is actually the case, however, would need to be investigated empirically. Supporting the broader relevance of the findings on the causes and consequences of women's representation in management to other cultural contexts is the result from **Chapter 5**, where spillover effects of women in management on their subordinates are observed in both East and West Germany, despite traditionally more egalitarian social norms in East Germany. Pointing in the same direction, De Acutis et al. (2024) recently found in their meta-analysis that the effects of gender quotas for leadership positions on labor market and firm outcomes appear to be largely independent of country context.

The policy implications of **Chapter 4** are further constrained by the specifics of the selected sample and the experimental design. As we were the first to conduct an online experiment examining the impact of gender stereotypes in media coverage of corporate leaders on perceptions of CEO competence and financial decision-making, we aimed to work with a broad and representative sample of the German population. However, this sample naturally does not reflect the characteristics of individuals who predominantly hold financial resources and make investment decisions in capital markets, such as fund managers or other financial professionals. In our sample, 43 percent of participants reported having ever invested in stocks, and 24 percent were active on the stock market less than once per year. Thus, the observed 6.5 percent reduction in investment in a female-led firm with a neutral mention of the family may not be sufficient to quantify the consequences of stereotype-driven underinvestment in female-led firms — and the resulting implications for gender equality and welfare — as our sample may not accurately represent the behavior of typical investors controlling significant shares of capital on the German stock market. An avenue for future research would thus be to conduct a similar experiment with a targeted sample of financial professionals to get a more precise estimate of the financial impact that the stereotype-driven lower investment has on female-led firms. Another limitation of **Chapter 4** is its focus on the impact

of stereotypes in written newspaper text. As media consumption increasingly shifts to visual formats, the relevance of findings based solely on text content may diminish in a future media landscape. As a future project, we are considering to conduct an investment experiment in which written news content on women and men as CEOs is accompanied by visual elements that vary in their gender-stereotypical associations. Finally, the external validity of **Chapter 4** is limited by its focus on a single company in the pharmaceutical industry. The reason for this choice in the experimental design was that we wanted to incentivize economic decision-making of participants by linking it to the performance of a real firm and real CEOs. However, the limited number of female CEOs in Germany restricted the selection of companies. While in the experiment we covered gender stereotypes related to care responsibilities, there are also stereotypes related to skills and occupations that may play a role in evaluating a CEO's competence and these may interact with stereotypical newspaper coverage. The pharmaceutical industry covers occupations from STEM as well as medicine and nursing, making it neither strongly male- nor female-stereotyped. It would be valuable to examine whether the treatment effects of stereotypical media coverage differ if the CEO led a company in a more male- or female-stereotyped industry. We are therefore planning future experiments with hypothetical scenarios that cannot be incentivized but allow for more variation in the industries and occupations covered in the presented newspaper articles.

Chapter 5 finds positive spillover effects of women's managerial representation on gender equality in pay on the establishment level. While this finding is encouraging in showing that increased representation in management can positively influence broader labor market outcomes for women, it should be taken into account that the study considers relatively low levels of management[2]. The stronger effects found for second-level compared to first-level management suggest that direct interaction between managers and their subordinates may be an important channel for spillover effects. This implies that spillover effects might diminish as one examines more senior levels of management, which could limit the relevance of these findings in discussions about women's representation at the highest levels, such as corporate boards, and related policies like quotas. Evidence on spillover effects of gender quotas for supervisory boards in Norway and Italy (Bertrand et al., 2019; Maida and Weber, 2019) so far is not clearcut. For Germany, a similar analysis has not yet been conducted, but could be pursued by linking the data from the DIW Women Executives Barometer from **Chapter 2** with firm personnel or administrative data. It would also be of interest here to extend the

[2]An establishment can consist of up to several thousands but also of as little as five employees.

analysis beyond the unexplained gender pay gap to examine gender differences in hiring and promotion.

In conclusion, this dissertation provides insights on multiple aspects of the causes and consequences of women's (under)representation in corporate leadership. The findings have policy implications that can guide efforts to improve women's representation in leadership and advance gender equality in labor markets and society more broadly. The mentioned limitations should be taken into account when drawing policy conclusions and provide avenues for future research.

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