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The Impact of Female Board Members on ESG Performance: An Empirical Analysis

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Abstract

This study investigates the impact of female board representation on ESG performance within the German two-tier corporate governance system. Using OLS regression analysis on a sample of 157 DAX, MDAX, and SDAX companies over a two-year period, the findings reveal a positive and significant relationship between the presence of women on both management and supervisory boards and improved ESG performance, regardless of whether measured by percentage or absolute number. Contrary to the critical mass theory, even the presence of a single woman on a board was found to significantly enhance ESG outcomes. No statistically significant effect was observed for female CEOs, although this is likely to be attributed to the low number of female CEOs in the sample. The study highlights both the ongoing underrepresentation of women on boards and the limited scope of current gender quota regulations (FüPoG I & II), suggesting the need for stronger legislative measures to support gender diversity as a driver of corporate sustainability.

Keywords: board gender diversity; board structure; critical mass; corporate governance; ESG performance

1. Introduction

In times of climate change and social inequality, sustainability is becoming an increasingly important issue for companies. More and more companies are pursuing goals and implementing initiatives to increase sustainability to meet consumer expectations and regulatory requirements. Not only is it a moral imperative, but it also has evolved into a strategic priority across industries.[1] Sustainability is of great significance to both shareholders and stakeholders. Recent data shows that 85 per cent of investors include sustainability in their investment decisions.[2] Furthermore, according to legitimacy theory, companies engage in sustainability activities to align with expectations of stakeholders and society in general, to secure their social approval and therefore their continued existence.[3] For this reason, companies should focus on sustainability and look for opportunities and ways to improve their ESG performance, both as a strategic necessity and a driver of competitive advantage.

Women on management and supervisory boards of German DAX, MDAX and SDAX companies are severely underrepresented,[4] although research shows that gender diversity and the presence of women on boards has a positive impact on a wide range of financial and non-financial metrics.[5] These findings have led German legislators to pass two laws aimed at increasing the proportion of women in management positions of listed companies with codetermination; FüPoG I which establishes a fixed quota of 30 per cent for both genders on the supervisory board[6] and FüPoG II which requires at least one member of each gender for management boards with more than three members.[7] In this context, the question arises as to what extent an increased pro-

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1 Cf. Farri et al. (2022), n.p. for these sentences.

2 Cf. Gartner (Ed.) (2021), n.p.

3 Cf. Crossley et al. (2021), p. 3754.

4 Cf. Frauen in die Aufsichtsräte e.V. (Ed.) (2024), p. 4–5.

5 Cf. Arayssi et al. (2016), p. 391–392.

6 Cf. section 96 Abs. 2 AktG.

7 Cf. section 76 Abs. 3a AktG.

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portion of women impacts the ESG performance of the companies where the laws intended for that purpose are mainly applied. This study adds to the existing literature by examining the impact of women on ESG performance from four different perspectives, for the same sample of German DAX, MDAX and SDAX companies, 5 years after the introduction of FüPoG I and shortly after FüPoG II. Firstly, the influence of the proportion of women on the management board is analysed. Secondly, the study addresses the question of whether a certain threshold of women, which is referred to a as a 'critical mass', must be reached to have a positive effect. Thirdly, it examines whether female CEOs positively influence a company's sustainability. Finally, the impact of women on the supervisory board on ESG performance is analysed.

The remainder of this thesis is structured as follows. In section 2 the conceptual background is described, defining relevant terms and describing the regulatory environment in Germany with a particular focus on women on the management and supervisory board. In section 3 the existing literature on the topic is reviewed and from it, four hypotheses are developed. Section 4 describes the research design and statistical model used, to test these hypotheses. The descriptive statistics and results of the regressions are presented in section 5. The results are then put into the context of the previous research and limitations are given. These limitations are addressed by conducting robustness tests which are outlined and discussed in section 6. Additionally further analysis is done, regarding the circumstances that regulate the impact women on boards have on ESG performance. Finally, conclusions are drawn, remaining limitations that could not be addressed by the robustness tests given, and recommendations for actions as well as for future research made.

2. Conceptual and Regulatory Background

2.1. Basic Definitions

Although there is no standardised and universally agreed definition of sustainability, the definition of the Brundtland Commission of the United Nations (1987) is widely accepted, which defines sustainability as „(...) meet(ing) the needs of the present without compromising the ability of future generations to meet their own needs".[8] The sustainability of a company can be viewed in terms of Elkington's (2004) triple bottom line concept, measuring a business's success in three key areas: people, planet and profit, also known as the 3 Ps.[9] This implies that economic success can no longer be measured solely in terms of profits, but rather represents one of three dimensions, alongside social and environmental factors. Taking up the triple bottom line concept companies measure sustainability using environmental, social and governance (ESG) measures.[10] In light of this, the terms 'ESG performance' and 'sustainability performance' are used interchangeably in the context of this study. The actions of companies can have positive or adverse effects on environmental, social and economic systems. ESG performance, the main focus of this study, can be defined as the extent to which a company's actions affect the long-term viability and health of these systems positively or negatively.[11]

Corporate social responsibility (CSR) is a closely related concept. The international standard ISO 26000 defines CSR as the responsibility of organizations for the effects their actions have on society and the environment through transparent and ethical conduct.[12] Differentiating CSR from sustainability, the definition of the ISO standard shows that CSR is rather to be understood as a framework of actions to achieve the normative goal of sustainability. ESG performance can therefore be seen as a link between the two concepts: it indicates the extent to which a company fulfils its sustainability obligations.

2.2. Regulatory

To increase the proportion of women in management positions, the first Leadership Positions Act (FüPoG I) was passed in 2015 and came into force on 1 January 2016. It was intended to enable the equal participation of women in economic life.[13] To this end, a gender quota of at least 30 per cent was set for the supervisory board. This was implemented by requiring new appointments to be made with the underrepresented gender. However, the regulation only applies to listed companies that are also subject to codetermination as they have more than 2,000 employees.[14] Companies that fulfil at least one of these criteria must also set targets for the proportion of women on the management board and upper management levels.[15] A study from 2020, 5 years after FüPoG I came into force, shows that 115 of the 188 companies analysed, still have no women on their management boards. Of these companies, 75 have set a target figure of zero. Although the proportion of women has doubled since the introduction of the FüPoG I, it is still only 10.7 per cent.[16]

With regard to increasing the participation of women on the management board, there was clearly still a need for further regulation. To this end, the Second Leadership Positions Act (FüPoG II) was enacted, which came into force on 1 August 2022. Companies that fulfil the conditions of FüPoG I and whose management board size exceeds three members must have at least one male and one female board member.[17] The minimum participation requirement must be adhered to for new appointments: if the management board has more

[8] United Nations (1987), n.p.
[9] Cf. Elkington (2004), p. 2.
[10] Cf. Crace and Gehman (2023), p. 151.
[11] Cf. Zimek and Baumgartner (2017), p. 1–2 for these sentences.
[12] Cf. International Organization for Standardization (Ed.) (n.d.), n.p.
[13] Cf. Deutscher Bundestag (Ed.) (2021), p. 1 for these sentences.
[14] Cf. section 96 (2) sentence 1 AktG for these sentences.
[15] Cf. section 76 (4) sentence 1 AktG.
[16] Cf. Frauen in die Aufsichtsräte e.V. (Ed.) (2020), p. 3 for these sentences.
[17] Cf. section 76 (3a) sentence 1 AktG.

than three members and no woman is a member of the management board, only one woman can be effectively appointed as a member of the management board; the appointment of another male member would be null and void. An existing board composition does not have to be adjusted, mandates can remain in place until the end of the appointment.[18]

Furthermore, although the target figure can still be set as zero, the supervisory board then must give clear and comprehensible reasons and explain the considerations that led to this decision in the company's management report. The target figure for the management board is set by the supervisory board.[19] Furthermore, the corporate governance statement must include whether the quota of women on the management board and supervisory board has been complied with, how both boards are composed and whether target figures have been met.[20] Violations of these reporting requirements can be penalised with a fine.[21]

At the end of 2022, 84 per cent of management board members in the DAX, MDAX and SDAX were male. A slightly positive trend can be observed compared to the previous year: in the period from 2021 to 2022, the percentage of female management board members rose from 14 to 16 per cent. Of these, the share of women in the DAX is the highest at 23 per cent and also the highest relative increase compared to the previous year (19 per cent). This is followed by the MDAX with 13 per cent (11 per cent in the previous year) and the SDAX with 12 per cent, where no increase compared to the previous year can be seen. Under the FüPoG II, the question of whether at least one woman is represented on the management board is even more relevant. Here too, the DAX is far ahead with 93 per cent, with a large distance to the MDAX and SDAX where only 44 per cent and 42 per cent have at least one woman on the management board, respectively. In 2022, the year in which FüPoG II came into force, the proportion across all three indices increased only slightly, from 53 per cent to 56 per cent. On supervisory boards where the FüPoG I has been in place since 2015, the quota of female board members increased from 32 per cent in 2021 to 34 per cent within a year. Here the same pattern emerges: the DAX has the highest share at 37 per cent, but in contrast to the management board, the differences to the MDAX (33 per cent) and SDAX (31 per cent) are much smaller.[22] As of 2024, 65 of the 104 listed companies that fall under the Codetermination Act are subject to the minimum participation requirement as they have more than three management board members. Of these 65 companies, three still do not have a woman on the management board.[23]

There exist multiple models of corporate governance; the single-tiered model and two-tiered model being two of the most widely used. While the one-tier system is the most widespread in Anglo-Saxon countries, the two-tier system is the most common in European jurisdictions, one of them being Germany.[24]

In the German two-tier system, there are two boards: the supervisory board (Aufsichtsrat) and the management board (Vorstand). The two boards are separated, a member cannot belong to both boards at the same time.[25] Members of the management board are appointed by the supervisory board.[26] The members of the supervisory board are elected by the shareholders at the general meeting.[27] The management board must manage the company under its own responsibility.[28] The supervisory board's task is to supervise the management board[29]; thus it fulfils a control function. Furthermore, the supervisory board must approve decisions that are of fundamental importance to the company.[30] For stock corporations with more than 500 employees, the One-Third Participation Act applies, which requires that one-third of the supervisory board must be made up of employee representatives[31], in corporations with more than 2000 employees, representatives of workers must make up half of the supervisory board members.[32]

3. Previous Literature and Hypothesis Development

The following section provides an overview of the existing research on women in management positions and their impact on ESG performance. To this end, theories are first presented that explain the potential mechanism that leads to women having a positive impact on sustainability. The literature on women on the management board, the supervisory board, in the position of CEO and on critical mass theory is then presented and hypotheses are derived from this.

First, according to principal-agent theory one party, the principal, delegates tasks to another party, the agent. In this configuration, a conflict of interest can arise, when the agent pursues their own goals and interests and acts opportunistically, contrary to the interests of the principal. Since the agent's actions are not fully observable by the principle, information asymmetry arises.[33]

Secondly, stakeholder theory, which was first formulated by Hill and Jones (1992), states that companies should create value for all their stakeholders; these are, among others, employees, suppliers, customers and local communities. Stakeholders supply the firm with critical resources and in exchange can expect their needs to be satisfied by the firm,

[18] Cf. section 76 (3a) sentence 2 AktG for these sentences.
[19] Cf. section 111 (5) AktG for these sentences.
[20] Cf. section 289f (2) no. 3, 4 HGB.
[21] Cf. section 334 (1) no. 3a HGB.
[22] Cf. BDO AG Wirtschaftsprüfungsgesellschaft and Kirchhoff Consult AG (Ed.) (2023), p. 6 for this paragraph.
[23] Cf. Frauen in die Aufsichtsräte e.V. (Ed.) (2024), p. 27 for these sentences.
[24] Cf. Ahmad and Omar (2016), p. 76–77 for these sentences.
[25] Cf. section 105 (1) AktG.
[26] Cf. section 84 (1) sentence 1 AktG.
[27] Cf. section 101 (1) sentence 1 AktG.
[28] Cf. section 76 (1) AktG.
[29] Cf. section 111 (1) AktG.
[30] Cf. section 111 (4) AktG.
[31] Cf. section 1 (1) no. 1 in conjunction with section 4 (1) DrittelbG.
[32] Cf. section 1 in conjunction with section (7) 1 MitbestG.
[33] Cf. Jensen and Meckling (1976), p. 308–309.

thereby entering an implicit contract. An example the authors give is that the public provides firms with infrastructure through paying taxes and in exchange, they can expect that the firm does not reduce their quality of life through its actions.[34]

Bringing together both theories, stakeholder-agency theory posits that managers are the only stakeholders who have a direct influence on the company's decisions. Therefore, they act as agents of the other stakeholder groups to enforce their interests.[35] If firms breach the implicit contracts they entered, they risk losing legitimacy. The risk of losing legitimacy and being unable to continue operation provides the firm with an incentive to act sustainably.[36]

According to upper echelons theory, top managers' experiences and so-called managerial background characteristics have a partial influence on organizational outcomes. Upper echelons characteristics are both psychological base values and observable characteristics of the management personnel like age or education. While Hambrick and Mason (1984), who first formulated the upper echelons theory named managers' characteristics like age, or socioeconomic background as an influence on management outcomes; the directors' gender as a factor that determines the company's management outcomes was not examined in the original study.[37]

From upper echelon theory it follows, that it is important to highlight the values and psychological attributes in which women differ from men to see what influence women have on the company. The underlying characteristics and moral attitudes of the members of the management board therefore have a significant impact on the extent to which the company acts sustainably and thus fulfils the needs of the other stakeholder groups. Adams and Funk (2012) find that women on boards differ in their values from women in the general population. While in the general population, men are more open to innovation, this relationship is reversed in boards.[38] This could drive change processes with regard to sustainable developments in the company.

Women are more benevolent than men; the well-being of others is important to them, security and tradition are less important to women than to men.[39] Being more benevolent, it is more likely that when there is a conflict between shareholders and stakeholders, women side with the stakeholders.[40] Furthermore, female directors are more sensitive to environmental concerns compared to male directors; gender-diverse boards report more transparently on ecological initiatives, are more involved with stakeholders and communicate more openly with them. Women play a key role in the implementation and success of the initiatives.[41] Women are more likely than men to have worked in non-profit organisations and therefore focus less on shareholders and more on community interests.[42] They are more inclined to give something back to society, which benefits the company's reputation and corporate relations in the long term. This also benefits the company in economic terms.[43] Female directors tend to be more avoidant of litigation and reputation loss,[44] which might cause them to act in line with legislation concerning sustainability.

Isidro and Sobral (2015) find that female board presence is significantly and positively associated with ethical and social compliance, which is valued by investors and consequently increases firm value.[45] Kidwell et al. (1987) find that while male and female managers act the same when faced with an ethical decision, males were more inclined to conceal their errors, while females thought of that behaviour as unethical.[46] This tendency may lead females to foster and promote a culture of transparency and accountability. Based on these theories and gender differences, it can be theoretically explained in what way women on boards have a positive impact in terms of ESG performance.

Turning to empirical research on the influence of women on ESG performance, studies that analyse the impact of women in top management positions on corporate sustainability can be divided into four basic categories: sustainable activity, sustainable performance, sustainable disclosure and finally the impact of sustainability performance on firm performance and value.[47] These domains build on each other logically; top management influences sustainability activities, which in turn have an impact on sustainability performance. The accuracy and scope with which the company reports on activities and performance are measured by the sustainability disclosure.

Mattingly and Berman (2006) identify four classes of CSR, using factor analysis: institutional strengths and weaknesses and technical strengths and weaknesses. The institutional dimension describes measures towards stakeholders that have normative expectations of the company, such as local communities. The technical dimension, on the other hand, describes measures in relation to stakeholders with whom the company exchanges resources, for example, consumers or employees.[48] Building on this, Bear et al. (2010) analyse the relationship between board gender composition, CSR and reputation. They find that women on the board have a significant and positive influence on the institutional strength, but not on the technical strength. Women on the board also have a positive influence on firm reputation; this relationship is mediated by institutional strength, but not by technical strength.[49] Zhang (2012) finds that board diver-

[34] Cf. Hill and Jones (1992), p. 133 for this paragraph.
[35] Cf. Hill and Jones (1992), p. 134 for these sentences.
[36] Cf. Hrasky (2011), p. 179 for these sentences.
[37] Cf. Hambrick and Mason (1984), p. 198 for this paragraph.
[38] Cf. Adams and Funk (2012), p. 228 for these sentences.
[39] Cf. Adams and Funk (2012), p. 226–227.
[40] Cf. Adams and Funk (2012), p. 231.
[41] Cf. Haque and Jones (2020), p. 15 for these sentences.
[42] Cf. Williams (2003), p. 2.
[43] Cf. Williams (2003), p. 8–9 for these sentences.
[44] Cf. Srinidhi et al. (2011), p. 1614.
[45] Cf. Isidro and Sobral (2015), p. 13.
[46] Cf. Kidwell et al. (1987), p. 490.
[47] Cf. Bannò et al. (2023), p. 191.
[48] Cf. Mattingly and Berman (2006), p. 34–37 for these sentences.
[49] Cf. Bear et al. (2010), p. 217 for these sentences.

sity has a positive and significant impact on technical and institutional strength ratings, for technical and institutional weaknesses no significant relationship can be found.[50] Harjoto et al. (2015) examine the effect of multiple diversity characteristics on ESG performance and find that tenure, age and gender diversity have the most positive impact. In contrast to tenure and age which only reduce CSR concerns, gender diversity additionally increases CSR strengths.[51]

Velte (2016b) was the first to examine the impact of the management board's gender diversity for the German and Austrian settings. The study's sample consisted of 1019 firm-year observations for the period 2011-2014. A significant and positive impact of female members on the management board on ESG performance was found. It also found that the existence of a CSR committee significantly increased ESG performance.[52] The study differs from others in that it analyses two European countries in which the two-tier system is applied, which makes it particularly relevant for my study and it is to be expected that the results will be similar. However, the period analysed was more than 6 years ago compared to this study: changes in sustainability reporting and legislation on women on company boards may have had an impact, which could change these findings.

Horbach and Jacob (2018) find for German companies that there is a positive and significant relationship between mixed-gender boards and eco-innovation. This finding is explained by women having inspirational and transformative leadership styles; for innovation collaboration instead of competition is necessary.[53] Glass et al. (2016) analysed this relationship with Fortune 500 companies over a longer period of 10 years. They find that a high proportion of women does not directly lead to greater sustainability; however, if the female board members are also members of other companies' boards, they significantly enhance environmental practices.[54]

A literature review conducted by Velte (2023) finds that the positive influence of board gender diversity on CSR performance can be seen both in countries that have voluntary board quota regimes and in countries that have fixed board quotas.[55] Of the three analysed variables board gender diversity, sustainability board expertise and sustainability-related executive compensation, gender diversity was found to be the most relevant in past research.[56] For the energy sector, as a CSR-sensitive industry, Shahbaz et al. (2020) analyse factors influencing ESG performance. They find that women on the board have a positive impact on overall ESG performance, as well as environmental and governance aspects. Surprisingly, however, there is no significant influence on the social dimension. They highlight the existence of CSR committees as another factor that has a positive influence.[57]

Birindelli et al. (2018) analyse the relationship between women on the board and ESG performance for banks in Europe and the United States. They find an inverted U-shaped relationship: up to the critical mass of three women or until 30 per cent of the members are female, ESG performance increases. After that, it decreases again or becomes insignificant with each additional woman on the board.[58] Nuber and Velte (2021) confirm this curvilinear relationship in their study but add that this could also be because the sample contains many companies with few women and few companies with many women on the board. Furthermore, they find evidence that there have to be at least two women on the board to be able to significantly reduce greenhouse gas emissions.[59]

However, some studies come to different conclusions regarding the impact of women on ESG performance. Rao and Tilt (2021) find that while women bring objectivity and independence to the board, this does not necessarily translate to positive CSR outcomes, as there are barriers that hinder the positive relationship. These barriers include the low number of female board members and the limited support they receive from male board members.[60] This result does not show that women have a negative or no influence, but merely that the positive potential cannot be realised.

A study, with a primary focus on the influence of gender on stock market liquidity, shows that the representation of women on boards in France negatively influences participation in sustainable development projects.[61]

Although there are studies that find a mixed or negative impact, the majority of studies conclude that a higher proportion of women on the management board increases the company's ESG performance. For this reason, I formulate the following hypothesis:

> **Hypothesis 1 (H1):** There is a positive association between the percentage of female management board members and ESG performance.

With regard to the influence that women on the management board have on sustainability, it is not only the relative proportion that is relevant, but it is also assumed that a certain absolute number of women must be represented on the management board to have a significant influence on ESG performance. This number is referred to as the critical mass.Critical mass theory can be traced back to Kanter (1977). She was the first to describe how individual women, in a male-dominated group, are merely tokens; a symbolic representation of their social category. Only when a certain critical mass is reached, women can have an impact in the group.[62] Konrad et al. (2008) conducted interviews

[50] Cf. Zhang (2012), p. 695.
[51] Cf. Harjoto et al. (2015), p. 641–642 for these sentences.
[52] Cf. Velte (2016b), p. 107 for these sentences.
[53] Cf. Horbach and Jacob (2018), p. 931 for these sentences.
[54] Cf. Glass et al. (2016), p. 506–507 for these sentences.
[55] Cf. Velte (2022), p. 14
[56] Cf. Velte (2022), p. 17.
[57] Cf. Shahbaz et al. (2020), p. 11 for these sentences.
[58] Cf. Birindelli et al. (2018), p. 11–12 for these sentences.
[59] Cf. Nuber and Velte (2021), p. 176 for these sentences.
[60] Cf. Rao and Tilt (2021), p. 76–77 for these sentences.
[61] Cf. Loukil et al. (2019), p. 698.
[62] Cf. Kanter (1977), p. 966–968 for these sentences.

with women on the board of directors and used them to develop the critical mass hypothesis specifically for women on boards. This states that women can only make a difference once a critical mass of women has been reached on the board. One woman merely acts as a token, for example, to fulfil demands for female board participation. Although two women have more influence than one, they still have problems being heard, partly because they stand out among the male members. The critical mass is reached when there are three or more women on the board: they are seen as normal, support each other and work together towards common goals.[63]

Yarram and Adapa (2021) also find a positive and significant influence of the percentage of female directors on the CSR score. The study, which looked at Australian companies in the ASX 300, confirms tokenism: this relationship does not hold for companies with only one female director. Only when there are two female directors the relationship becomes significant. Female board members show communal instead of agentic behaviour and support CSR concerns.[64]

The finding of Birindelli et al. (2018), that ESG performance only increases until a threshold of three women on the board is reached and further women have no effect, does not support critical mass theory, in the narrow sense.[65] Rather, it proves the dual critical mass theory of Schwartz-Ziv (2017). The dual critical mass theory states that boards are most effective when genders are balanced and the board has at least three members from each gender.[66] These findings do not contradict the critical mass theory but emphasize that critical mass goes both ways; only increasing the participation of women does not necessarily increase ESG performance. This is also referred to as the too-much-of-a-good-thing effect, where after reaching an inflection point an input, previously having a desirable effect, leads to an unwanted outcome.[67]

Bear et al. (2010) also find support for the critical mass theory, but only to the extent that CSR performance increases with an increasing number of women on the board. Although the statement is made that women are better able to assert themselves in a group, this is not statistically proven.[68] The fact that a critical mass is required to have a sizable effect can be observed not only in ESG performance but also in sustainability disclosure. Alkhawaja et al. (2023) find that a critical mass of three women is necessary to have a highly positive impact on ESG reporting. Although less than three women also have a significantly positive influence, it is far smaller.[69]

The theory of critical mass is widely recognised and has also been confirmed by several studies, both in relation to ESG performance and beyond. Although the exact size of the critical mass certainly depends on the size of the board, qualitative and empirical literature most often cites three women on the board as the threshold at which women leave minority status and have a significant impact. I therefore use this threshold and formulate the following hypothesis:

> **Hypothesis 2 (H2):** There is a positive association between a critical mass of three or more women on the management board and ESG performance.

In comparison to the number of publications that exist on the relationship between board gender diversity and CSR, the influence of the CEO received less attention. This might be due to the relatively low number of female CEOs.[70] Busenbark et al. (2016) present three perspectives from which the CEO can be viewed: the position, the person and the environment.[71] The first two aspects will be considered here. The CEO holds the position of the company's top decision-maker and can significantly influence strategic decisions. Crossland and Hambrick (2010) find that for Germany the CEO accounts for 11 per cent of variance in return on assets, for the United Kingdom even 19.5 per cent.[72] To understand the actions of the CEO, the person and his or her individual characteristics must be considered. In this regard, Busenbark et al. (2016) again draw parallels to the upper echelons theory. CEOs identify strongly with the company and represent the company to stakeholders. The personality and characteristics of the CEO also have a major influence on firm outcomes.[73] While gender is not explicitly mentioned, it can be assumed that there are differences between men and women that are large enough to have an impact on organisational outcomes.

Aabo and Giorici (2023) examine the influence of female CEOs on ESG scores. They find a significant and positive association for Bloomberg ESG scores but not for ESG scores provided by Refinitiv, even when the companies in the sample are the same. The results indicate that it makes a difference which provider is used for the ESG scores.[74] For the UK setting Al-Shaer et al. (2024) find that a critical mass of female directors must be met for them to have a positive impact on ESG performance. However, female CEOs have a positive impact without the need to reach this critical mass of female directors. Young female CEOs with a short tenure have an especially positive influence.[75] Contrary to what one might assume, gender-diverse boards are particularly effective in emphasising environmental protection when the CEO is male.[76] The finding that gender diversity on boards with male CEOs is particularly important is supported by Liu (2018): environmentally damaging behaviour is less frequent on diverse boards. On the other hand, a female CEO only has a significant effect, when there are few women on the board.[77]

[63] Cf. Konrad et al. (2008), p. 160 for these sentences.
[64] Cf. Yarram and Adapa (2021), p. 8 for these sentences.
[65] Cf. Birindelli et al. (2018), p. 12.
[66] Cf. Schwartz-Ziv (2017), p. 753.
[67] Cf. Pierce and Aguinis (2013), p. 331.
[68] Cf. Bear et al. (2010), p. 217.
[69] Cf. Alkhawaja et al. (2023), p. 12 for these sentences.
[70] Cf. Velte (2020), p. 1310.
[71] Cf. Busenbark et al. (2016), p. 237.
[72] Cf. Crossland and Hambrick (2010), p. 812.
[73] Cf. Busenbark et al. (2016), p. 248–251 for these sentences.
[74] Cf. Aabo and Giorici (2023), p. 5–6 for these sentences.
[75] Cf. Al-Shaer et al. (2024), p. 24 for these sentences.
[76] Cf. Glass et al. (2016), p. 506–507.
[77] Cf. Liu (2018), p. 137–138 for these sentences.

However, some studies indicate that no significant association between CEO gender and ESG performance exists. For the Indonesian banking sector, Sumarta et al. (2021) find no significant relationship. This finding might be explained by the limited number of female CEOs in the sample companies.[78] Glass et al. (2016) find a positive influence of female CEOs on environmental strengths and a negative influence on environmental weaknesses, but this relationship is not significant after controlling for other variables. In their sample, the proportion of female CEOs is only 2 per cent.[79] Although the low number of female CEOs is not explicitly mentioned by the authors as the reason for the lack of significance, it should be considered as a possible reason.

The findings on the influence of female CEOs on ESG performance are mixed. Whether a positive association is found depends, for example, on the ESG data used. Several studies, however, have found a positive association. Other studies conclude that female CEOs have no significant influence on ESG performance; in these studies, the proportion of female CEOs is consistently very low, which may also be the cause of this result. If one considers the upper echelons theory and sees the CEO as the individual who makes the company's key decisions, it can be assumed that women, with their character traits, have a significant influence on the sustainability of the company. I therefore formulate the following hypothesis:

> **Hypothesis 3 (H3):** There is a positive association between the CEO being female and ESG performance.

Since in the two-tier system the management board is appointed by the supervisory board, there might exist spillover effects from women on supervisory boards to female members on management boards. If this were the case, FüPoG I would also have an indirect effect on the number of women on the management board. This relationship is examined by Bozhinov et al. (2021) who find that indeed there exists a positive and significant relationship between women on the supervisory board and women on the management board. This is especially true if they are appointed by the shareholders (in contrast to being appointed by the employees) and they are serving on the nominating committee.[80] There is evidence that in companies that have more women on the supervisory board, there are also more women on the management board. However, it is questionable whether there exists a causal relationship, or other influences, such as increased pressure for the participation of women on boards, explain this effect.[81]

Dienes and Velte (2016) examine the impact of the percentage of women on the supervisory board on CSR disclosure and find a positive and significant relationship. Companies with a higher percentage of women on the supervisory board report more intensely on CSR topics and disclose more information.[82] In the context of mandatory sustainability reporting in Germany, Gerwing et al. (2022) identify a positive and significant association between the proportion of women on the supervisory board and the reporting quality. Surprisingly, this relationship does not hold to the proportion of women on the management board. One possible explanation for this is that less than 25 per cent of the companies analysed have a woman on their management board, and the overall proportion of women in these positions is low.[83]

A study by HR consultancy Egon Zehnder (2021) in collaboration with the University of Göttingen describes a positive and significant association between the percentage of women on supervisory boards and corporate sustainability. The study analysed 534 companies, but the exact methodology and therefore the significance of the results remain unclear.[84]

Due to the lack of previous (rigorous) studies dealing with the impact of gender diversity on the German supervisory board on ESG performance, it should be analysed to what extent the influence of women on the supervisory board differs from that of women on the management board and women in the one-tier system. From this, it can then be deduced whether a similar positive effect on ESG performance can be expected and whether the previous results can also be transferred to the supervisory board.

Zahra and Pearce II (1989) identify three roles that boards (of directors) assume: service, strategy and control. The service role involves establishing external contacts, providing the organisation with external legitimacy and advising and supporting management with expertise. The control role comprises the supervision, evaluation and monitoring of management.[85] The strategic role includes giving advice to management and proposing strategic changes.[86] In Germany, only the supervisory role of the supervisory board is legally recognised, while the other two roles are not. Based on these roles, Steger and Jahn (2019) conducted a survey of 116 German companies in 2006. In doing so, they attempt to close the research gap as to whether the supervisory board only has the statutory control role, for example, the appointment of board members, or additionally an active and advising role. Up to this point in time, the existing research is ambiguous on this matter.[87] They find that ethical issues play a major role in the work of the supervisory board, even more so than management tasks. Although the control role is considered the most important of the three, the respondents also attached great importance to the service and strategy roles. It can therefore not be said that the supervisory board is merely limited to monitoring the management board. The larger the board size, the more pronounced the service and strategy roles are.[88]

[78] Cf. Sumarta et al. (2021), p. 1027 for these sentences.
[79] Cf. Glass et al. (2016), p. 503–504 for these sentences.
[80] Cf. Bozhinov et al. (2021), p. 1325–1326 for these sentences.
[81] Cf. Kirsch and Wrohlich (2020), p. 49 for these sentences.
[82] Cf. Dienes and Velte (2016), p. 14–15 for these sentences.
[83] Cf. Gerwing et al. (2022), p. 543 for these sentences.
[84] Cf. Egon Zehnder (Ed.) (2021), p. 3 for these sentences.
[85] Cf. Zahra and Pearce II (1989), p. 292–294 for these sentences.
[86] Cf. Zahra and Pearce II (1989), p. 298.
[87] Cf. Steger and Jahn (2019), p. 362–363 for these sentences.
[88] Cf. Steger and Jahn (2019), p. 369–370 for these sentences.

Based on these findings, it is possible to explain why the composition of the supervisory board might influence ESG performance. Sustainability as an ethical issue could be considered as important by the supervisory board and, therefore, be influenced by it. However, it is also to be expected that the results will differ from those of the management board and the existing findings in the one-tier system. In this respect, further evaluation is appropriate. I formulate the following hypothesis:

> **Hypothesis 4 (H4):** There is a positive association between the percentage of female supervisory board members and ESG performance.

4. Research Design

4.1. Data and Sample

My initial sample consists of companies listed on the German stock indices DAX, MDAX and SDAX in the years 2020-2021. This is after the FüPoG I but before FüPoG II came into force. The three stock market indices consist of the 160 largest German companies on the Prime Standard of Deutsche Börse by free-float market capitalization.[89] To be included in the sample the company had to be part of the indices at least once during the 2-year period. Companies that were included for one day after a spin-off and afterwards no longer part of the indices are not included in the sample. This sample composition was selected because the majority (87.4 per cent in 2022) of the companies listed on the regulated market and that were subject to equal codetermination belonged to one of these indices.[90] These are also the companies to which the minimum participation requirements of FüPoG II apply. In line with Velte (2016b) financial institutions are excluded from the sample.[91] This is due to the fact, that financial institutions, like banks and insurance companies, often have a higher leverage[92] and operate in a different regulatory environment. Except for the two variables *LogTA* and *ROA*, which were collected from the Wharton Research Data Service (WRDS), all variables were obtained from the Refinitiv (formerly known as Thomson Reuters) database. The number of women on the management board, the management board size and single missing data points that were not available on Refinitiv or WRDS were hand-collected from the companies' annual reports.

As the study is designed to obtain information specifically on the impact of women on the management board and supervisory board in the two-tier system, companies that do not fulfil this requirement are excluded from the sample. This applies in particular to the European legal form of the SE, where there is a free choice between a one- and two-tier.[93] As a result, 28 company-year observations are excluded. Furthermore, I exclude 27 observations with missing ESG data. The reason for missing ESG scores is often that the company no longer existed in the year or did not yet exist. The final sample consists of 305 firm-year observations from 157 distinct companies.

4.2. Variable Measurement

4.2.1. Independent Variables

To test H1, that is the effect of women on the management board on ESG performance, the independent variable *MBGend* is the percentage of women on the management board on 31 December of the year. It is calculated by dividing the number of women on the management board by board size. The independent variable for testing H4, *SBGend*, is calculated according to the same principle, with the difference that here the number of women on the supervisory board is divided by the size of the supervisory board. The independent variable for H3, *CEO*, is a dummy variable that is equal to one if the CEO of the company on 31 December was female and 0 if the CEO was male. H2 is tested using four dummy variables: *Women0*, *Women1*, *Women2* and *Women3*. *Women0* is equal to one if there are no female members in the management board and zero otherwise. *Women1*, *Women2* and *Women3* are equal to one if there are at least one, two or three female members on the management board, respectively, and zero otherwise. The regression is done four times with each dummy variable as the independent variable.

4.2.2. Dependent Variable

The dependent variable in all main models is *ESG*. ESG scores from the Refinitiv database are used as a proxy for ESG performance. This approach is in line with multiple earlier studies investigating the effect of women on boards on ESG performance.[94] Refinitiv's ESG score is based on more than 630 data points, assessing ESG performance on a scale from 0, being the lowest, to 100 being the highest attainable score. They are collected from companies' annual reports, company websites, stock exchange filings and other publicly available sources. Of these 630 data points the 186 most comparable for each industry are selected and make up the final ESG score. The score consists of a weighted average of three pillar scores 'Environment', 'Social' and 'Governance'. The weights differ for each industry. For the environmental subscore, the categories covered are *Emission*, *Innovation* and *Resource Use*. The social score consists of the categories *Community*, *Human Rights*, *Product responsibility* and *workforce*. The Governance score covers *CSR strategy*, *Management* and *Shareholders*. Refinitiv also provides an ESG controversy score, which is not part of the ESG score used in this study.[95]

[89] Cf. STOXX (Ed.) (2024), p. 33.
[90] Cf. Frauen in die Aufsichtsräte e.V. (Ed.) (2022), p. 4.
[91] Cf. Velte (2016b), p. 102.
[92] Cf. Fama and French (1992), p. 429.
[93] Cf. Council Regulation (EC) No 2157/2001, Article 38.
[94] Cf. Aabo and Giorici (2023), p. 3; Bigelli et al. (2023), p. 5; Velte (2016b), p. 102.
[95] Cf. Refinitiv (Ed.) (2022), p. 4–10 for this paragraph.

4.2.3. Control Variables

Control variables are included in the regression models, to control for other factors that influence ESG performance. First, all independent variables, also act as control variables, because it can be assumed that these have an influence on the ESG score and are therefore included in all models. Only the critical mass dummy variables are not included when testing for the other hypotheses, since *MBGend* controls for the percentage of women on the management board more precisely. Conversely, in regression model 2, where the critical mass hypothesis is tested, the percentage of women on the management board is not included as a control variable, since they would be correlated. The percentage of women on the supervisory board is included in all models, the dummy variable for female CEOs is only included in model 3, where the CEO hypothesis is tested.

Previous research shows that firm and board characteristics influence ESG performance, which have to be controlled for and included in the statistical model. The selection of control variables included in the model is based on previous studies that examine the effects of women on ESG performance.

First, I control for the size of both the management board *MBSize* and the supervisory board *SBSize*. This is the number of members of each board at the end of the year. The size of the board has different influences on corporate governance. On the one hand, larger boards are less efficient at making decisions. This is because coordination and communication in larger groups of people is more difficult than in smaller groups.[96] This can lead to boards being unable to effectively implement strategic changes, which would be particularly necessary for a shift towards more sustainability.[97] On the other hand, Birindelli et al. (2018) argue that larger boards are more diverse, and offer a broader range of expertise and opinion.[98]

The company's leverage or debt ratio is included in the model and calculated by dividing the company's debt by the total assets to form the variable *DebtRatio*. In previous studies, it is very common to include the debt ratio as an independent variable in the model. However, the direction of the effect of high leverage on ESG performance is not clear and some authors find a positive association[99], while others find a negative relationship[100]. This can be explained by two different theories. On the one hand, companies with a high level of debt are very dependent on their creditors, who therefore represent an important stakeholder group. This can lead to the interests of other stakeholders, such as society, and thus the commitment to sustainability, being neglected. On the other hand, high debt is associated with increased agency costs, which can be reduced through sustainability and sustainability disclosure practices.[101] In both cases, it can be assumed that the debt ratio explains part of ESG performance and is therefore included in my model.

As a measure of firm size, the natural logarithm of total assets *LogTA* is used. The natural logarithm is taken to reduce the skewness of the variable. This is common practice in finance literature.[102] Gallo and Christensen (2011) find that company size has a positive and significant influence on the sustainability behaviour of companies. This is because larger companies have more resources at their disposal to deal with sustainability issues and are more in the public eye.[103]

The control variable *ROA* is used to measure financial performance by including the firm's Return on Assets in the model. This is calculated by dividing income before extraordinary items by total assets. Again, arguing with slack resources theory, Waddock and Graves (1997) find that firms with more slack resources, resulting from better financial performance, can spend more of these resources to improve their sustainability. Furthermore, there also seems to be evidence that the causality runs in the reverse direction; financial performance is improved by engaging in sustainability activities which is referred to by the authors as a 'virtuous circle'.[104]

SBMeetings controls for the number of supervisory board meetings in a given year. Meeting frequency data for the management board is not available and thus cannot be controlled for. Evidence for the influence of board meeting frequency is mixed. One study suggests that there is a positive and significant influence of the number of board meetings on sustainable development and stakeholder interest.[105] Frequency is positively associated with sustainability disclosure, implying that firms with more board meetings have more effective CSR strategies.[106] Vafeas (1999) finds the opposite is true; high board meeting frequency is associated with poor financial performance, suggesting that board meeting frequency increases in times of crisis.[107] Applied to sustainability, this would mean that a high number of supervisory board meetings could indicate that the company is in distress and thus also reduce its ESG performance, as fewer resources can be allocated to it. For the German setting, no significant influence of supervisory board meeting frequency on CSR reporting intensity was found.[108]

SBIndependence indicates the ratio of independent members to the total number of supervisory board members. According to the German Corporate Governance Code (2022), a supervisory board member is considered independent if he or she has no personal or business relationship with the company or the management board which could result in a conflict of interest. This is particularly the case if the supervisory

[96] Cf. Huther (1997), p. 263 for these sentences.
[97] Cf. Goodstein et al. (1994), p. 248.
[98] Cf. Birindelli et al. (2018), p. 5.
[99] Cf. Al-Shaer et al. (2024), p. 13.
[100] Cf. Velte (2016b), p. 107.
[101] Cf. Khaled et al. (2021), p. 3 for these sentences.
[102] Cf. Dang et al. (2018), p. 161.
[103] Cf. Gallo and Christensen (2011), p. 36 for these sentences.
[104] Cf. Waddock and Graves (1997), p. 314 for these sentences.
[105] Cf. Dube and Jaiswal (2015), p. 175.
[106] Cf. Jizi (2017), p. 651.
[107] Cf. Vafeas (1999), p. 140–141.
[108] Cf. Dienes and Velte (2016), p. 12.

board member or their close relative has been on the supervisory board for more than 12 years, has been a member of the management board in the last two years, is a close relative of a member of the management board or has had a significant business relationship with the company itself or with a company dependent on the company in the last year.[109] Research shows that board independence is positively associated with the support of sustainable development goals[110] and ESG scores[111] and negatively with greenhouse gas emissions[112]. This is because independent supervisory board members are in a better position to monitor the activities of the management board, are more focused on stakeholder interests and are less focused on achieving short-term objectives[113], with sustainability being a long-term goal[114].

CSRCommittee is a dummy variable that indicates the existence of a CSR Committee and is equal to one if the company has a CSR committee and zero otherwise. It is a sub-committee of either the management or the supervisory board, to increase corporate social performance and create transparency with regard to sustainability issues.[115] Previous research shows that the implementation of a CSR committee has a positive and significant effect on environmental and social scores, but no significant effect on governance in the German setting.[116] Based on this finding and in line with previous research, which finds a positive and significant effect on ESG scores[117], this variable is included in the model.

SusCompIncen is a dummy variable equal to 1 if the members of the management board are compensated with regard to ESG performance and 0 otherwise. Firms that implement such compensation regimes are, on average, more likely to have better CSR performance. CSR-linked compensation is more common in firms with independent boards and better corporate governance. CSR is not seen as an agency cost but rather beneficial to financial performance and thereby to shareholders.[118]

To account for differences between years and industries I include year and industry fixed effects. *YEAR* is a dummy variable equal to 0 for the fiscal year 2022 (t-1: 2021) and equal to one for the fiscal year 2021 (t-1=2020). The industry fixed effects dummy variables are based on the first two digits of the Global Industry Classification Standard (GICS), accounting for 11 industry sectors (10 after excluding financial institutions). They are equal to 1 if the company belongs to that industry sector and 0 otherwise. The energy industry is chosen as the reference point, and is therefore not included in the regression models.

The models does not include a control variable that controls for whether the company falls under the provisions of FüPoG II. There are several reasons for this: firstly, it is not expected that whether a company is subject to the law has a direct impact on its ESG performance as measured by the ESG score. Rather the effect of the FüPoG II on ESG performance is meditated by the number of women in the management board, which is included in the regression. Secondly, it is conceivable that the introduction of such a variable could lead to multicollinearity, as the number of women on boards could in turn depend on whether the law is applied. Furthermore, the majority of the data is from the period before the introduction of FüPoG II. For these reasons, I decided against the inclusion of such a variable.

4.3. Regression Model

In line with Velte (2016b),[119] I use three linear OLS regression models to test the hypotheses. To examine the impact of female management board members and female supervisory board members on ESG performance and test H1 and H4 I use the following model:

$$\begin{aligned} \text{ESG} = {} & \alpha + \beta_1 \text{MBGend} + \beta_2 \text{SBGend} + \beta_3 \text{MBSize} \\ & + \beta_4 \text{SBSize} + \beta_5 \text{DebtRatio} + \beta_6 \text{LogTA} \\ & + \beta_7 \text{ROA} + \beta_8 \text{SBMeetings} + \beta_9 \text{SBIndependence} \\ & + \beta_{10} \text{CSRCommittee} + \beta_{11} \text{SusCompIncen} \\ & + \text{Year FE} + \text{Industry FE} + \varepsilon \end{aligned} \quad (1)$$

α denotes the intercept, βs are the regression coefficients and ε is the error term.

H1 and H4 are tested using the same model, as it can be expected from previous research that the percentage of women on the management board as well as on the supervisory board influences the ESG score, therefore they both explain part of the variance. The dummy variable *CEO* for the CEO being female is not included, since the CEO is part of the management board. Therefore, companies with a female CEO have more women on the management board, which makes *MBGend* and *CEO* not statistically independent and increases the risk of multicollinearity, would they be included in the same model. By adding industry and time-fixed effects, I control for the differences between the two observed years and between industries.

H2, whether a critical mass of women on the management board is necessary to affect ESG performance, is tested using dummy variables that are equal to 1 if a certain absolute number of women on the board is reached and 0 otherwise as the independent variable. Regression model 2 is estimated four times, each time including only one of the independent variables. This determines the impact on ESG performance if a certain threshold of women as members of the management board is met. *MBGend* is no longer used to control for the proportion of women on the management

[109] Cf. DCGK C recommendation C.6-7 for these sentences.
[110] Cf. Tagliatela et al. (2023), p. 2499.
[111] Cf. Bigelli et al. (2023), p. 11.
[112] Cf. Kim et al. (2023), p. 13.
[113] Cf. Zaid et al. (2020), p. 1356.
[114] Cf. Aragón-Correa and Sharma (2003), p. 84.
[115] Cf. Eberhardt-Toth (2017), p. 1926–1927.
[116] Cf. Baraibar-Diez and Odriozola (2019), p. 16.
[117] Cf. Birindelli et al. (2018), p. 14; Velte (2016b), p. 107.
[118] Cf. Hong et al. (2016), p. 205 for these sentences.
[119] Cf. Velte (2016b), p. 104.

board in this model as it would not be statistically independent from the critical mass dummy variables. Again, the *CEO* variable is not included in that model, since it would be correlated with the dummy variables. All control variables that were included in regression model 1 are also included in this model.

$$\begin{aligned} \text{ESG} = \alpha &+ \beta_1\text{Women0} + \beta_2\text{Women1} + \beta_3\text{Women2} \\ &+ \beta_4\text{Women3} + \beta_5\text{SBGend} + \beta_6\text{MBSize} \\ &+ \beta_7\text{SBSize} + \beta_8\text{DebtRatio} + \beta_9\text{LogTA} + \beta_{10}\text{ROA} \\ &+ \beta_{11}\text{SBMeetings} + \beta_{12}\text{SBIndependence} \\ &+ \beta_{13}\text{CSRCommittee} + \beta_{14}\text{SusCompIncen} \\ &+ \text{Year FE} + \text{Industry FE} + \varepsilon \end{aligned} \tag{2}$$

The regression model that is used for testing H3 is the only model, that additionally contains the *CEO* variable, which is the independent variable in this model. *SBGend* is included as a control variable in the model. To avoid multicollinearity issues, *MBGend* is not included in this model; since CEOs are part of the management board, naturally the percentage of female members on the management board will be higher if the CEO is female. This is in line with other studies investigating the effect of female CEOs on ESG performance.[120] Control variables are the same as in regression models 1 and 2, as it can be expected that the factors influencing the ESG score are the same.

$$\begin{aligned} \text{ESG} = \alpha &+ \beta_1\text{CEO} + \beta_2\text{SBGend} + \beta_3\text{MBSize} \\ &+ \beta_4\text{SBSize} + \beta_5\text{DebtRatio} + \beta_6\text{LogTA} + \beta_7\text{ROA} \\ &+ \beta_8\text{SBMeetings} + \beta_9\text{SBIndependence} \\ &+ \beta_{10}\text{CSRCommittee} + \beta_{11}\text{SusCompIncen} \\ &+ \text{Year FE} + \text{Industry FE} + \varepsilon \end{aligned} \tag{3}$$

Linear OLS regression has multiple assumptions which are tested here. They are: normal distribution of the error term, no multicollinearity among the independent variables, homoscedasticity of residues, and linearity.[121] Plotting the residuals it can be seen that there is no perfect linear relationship, but where the most data points are, the line is almost vertical at zero. Checking for normality of the distribution of residuals it can be observed that there is a normal distribution which is slightly negatively skewed. To detect multicollinearity of the independent variables, the variance inflation factor (VIF) is calculated. Except for the industry dummy variables, where some multicollinearity can be expected, the VIFs for regression equation 1 range from 1.1961 to 2.9264 with the mean being 1.5234. For regression equations 2 and 3 the VIFs are very similar, as mostly the same dependent variables are included in the model. VIF values larger than 10 are considered to be problematic and imply multicollinearity.[122] The VIF values in all models are well below the threshold, which indicates no problematic multicollinearity exists. Lastly, to test for homoscedasticity of residue a Breusch-Pagan-Test is used. The null hypothesis of the test is heteroscedasticity.[123] The p-value is below the 1 per cent significance level for all models which means I reject the null hypothesis, which in turn means, heteroscedasticity is likely to be present in the data.[124] Despite this, a linear regression model is used, because the other assumptions are met.

All independent variables are lagged by one year, to account for the delay in the causal effect. The ESG score is compared to the board composition of the previous year. This is because board members who are new to the board need time to settle in and contribute their ideas and suggestions. It also takes time for management decisions, that impact ESG performance, to have an effect. This approach is in line with multiple other studies that analyse the influence of gender diversity on sustainability.[125]

5. Empirical Analysis

5.1. Descriptive Statistics

The descriptive statistics (mean, standard deviation, median, maximum and minimum) are presented in Table 1. The average ESG Score is 0.617, with 0 being the lowest and 1 being the highest attainable score. This is considerably higher than the mean of 0.251, that Velte (2016a) reports for companies belonging to the three DAX indices for the period 2010-2014.[126] Companies in the sample are rated at a wide range of scores, with the lowest score being 0.115 and the highest awarded score at 0.932. The mean of the environmental and social pillars of the ESG score *EnvSocMean*(without the governance pillar) is 0.608. That is only slightly lower than the ESG score itself and it has approximately the same minimum and maximum as the ESG score and also a similar standard deviation.The average management board has 4 members, with the smallest management board in the sample consisting of 2 and the largest of 9 members. On average only 13.9795 per cent of the management board members are female. The highest proportion of females in the sample is 50 per cent, which means there is no board on which there are more women than men. In 59 per cent of the boards, there is not a single female member. The position of the CEO is heavily male-dominated, with only 3.9344 per cent of the companies having a female CEO. There are only 12 firm-year observations with a female CEO. The proportion of women as CEOs is therefore 3.5 times lower than the proportion of women on the management board. In 44.26 per cent of the company-year observations, the remuneration of the management board members was linked to the ESG performance

[120] Cf. Aabo and Giorici (2023), p. 3; Al-Shaer et al. (2024), p. 8.
[121] Cf. Poole and O'Farrell (1971), p. 148.
[122] Cf. Neter et al. (1983), p. 392.
[123] Cf. Breusch and Pagan (1979), p. 1288.
[124] See Appendix B ‚Regression Assumptions' for detailed results for VIFs and Breusch-Pagan-Test
[125] Cf. Menicucci and Paolucci (2022), p. 9–10; Velte (2016b), p. 103.
[126] Cf. Velte (2016a), p. 21.

Table 1: Descriptive Statistics

Variable	Mean	SD	Min	Median	Max
ESG	0.6169	0.1760	0.1156	0.6331	0.9323
EnvSocMean	0.6080	0.2020	0.0118	0.6229	0.9373
MBGend	0.1031	0.1398	0.0000	0.0000	0.5000
SBGend	0.2901	0.1345	0.0000	0.3333	0.6667
MBWomen	0.4590	0.6170	0.0000	0.0000	3.0000
SBWomen	3.3869	2.3483	0.0000	4.0000	9.0000
CEO	0.0393	0.1947	0.0000	0.0000	1.0000
MBSize	4.0000	1.5623	2.0000	4.0000	9.0000
SBSize	10.7475	5.5160	2.0000	12.0000	24.0000
DebtRatio	0.2620	0.1667	0.0001	0.2454	1.0329
LogTA	22.1734	1.7166	18.6200	21.9600	26.9900
LogMarketCap	22.0054	1.4921	18.8515	21.8318	25.7511
ROA	0.0294	0.0640	-0.2433	0.0362	0.2487
SBMeetings	8.0623	4.9477	3.0000	7.0000	52.0000
SBIndependence	0.5282	0.3561	0.0000	0.5000	1.0000
CSRCommittee	0.7836	0.4125	0.0000	1.0000	1.0000
SusCompIncen	0.4426	0.4975	0.0000	0.0000	1.0000
Women0	0.5967	0.4914	2.0000	1.0000	1.0000
Women1	0.4033	0.4914	0.0000	0.0000	1.0000
Women2	0.0459	0.2096	0.0000	0.0000	1.0000
Women3	0.0098	0.0989	0.0000	0.0000	1.0000

Notes: For definitions of the variables, please see Appendix A.

of the company. This means around half of the companies offer monetary incentives to increase ESG activity. The majority of companies have a CSR committee, namely 78.36 per cent. The supervisory board has an average of 10.7475 members, much larger than the average management board. The smallest supervisory board only has two and the largest has 24 members. The average proportion of women on the supervisory board is 29 per cent. This is far higher than the proportion of women on the management board. This is to be expected, as most of the companies in the sample fall under the provisions of FüPoG I, which stipulates a 30 per cent proportion of women by law. However, the average suggests that most companies do not appoint women to the supervisory board beyond the statutory minimum. While in 32 company-year observations, not a single woman is represented on the supervisory board, the 50 per cent mark is only exceeded in 4 firm-year observations.

On average, the supervisory board meets 8.06 times a year, with a very wide range of 3 to 52 meetings. The average proportion of independent supervisory board members is 52.82 per cent, which means that just over half of the supervisory board members are independent. There are also supervisory boards that are completely independent and supervisory boards that do not have a single independent member. The average firm in the sample has total assets of € 4.26 billion. The log of total assets is taken to create the variable *LogTA*. The mean return on assets in the sample is 2.94 per cent and the mean debt ratio is 0.262.

Table 2 presents the Pearson correlation matrix for all variables but the year and industry dummy variables. The results do not suggest any serious multicollinearity in the regression. This is also supported by the low VIFs, as discussed in section 4.3. As expected, the dependent variable *ESG* and the independent variable *MBGend* are positively and significantly correlated, however, the correlation is not very strong (0.2122). The independent variable for the proportion of women on the supervisory board is slightly stronger correlated with *ESG* (0.3247) and the correlation is highly significant at the 1 per cent level. *ESG* is slightly negatively (-0.0284) correlated with the *CEO* dummy, however this correlation is not significant. All independent variables and control variables except *CEO*, *DebtRatio*, *ROA*, *SBMeetings* are significantly correlated with *ESG*. Except for the insignificant *CEO* variable, all correlations are positive.

Table 2: Pearson Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) ESG	1										
(2) EnvSocMean	0.9345***	1									
(3) MBGend	0.2122***	0.1967***	1								
(4) SBGend	0.3247***	0.3003***	0.0327	1							
(5) MBWomen	0.3260	0.3154***	0.8704***	0.0721	1						
(6) SBWomen	0.4436***	0.4847***	0.1596***	0.7019***	0.2970***	1					
(7) CEO	-0.0284	-0.0294	0.3117***	-0.1007*	0.1777***	-0.0262	1				
(8) MBSize	0.3656***	0.3836***	0.2139***	0.1527***	0.5460***	0.4205***	-0.0649	1			
(9) SBSize	0.4177***	0.4901***	0.1523***	0.3679***	0.3057***	0.8753***	0.0062	0.4546***	1		
(10) DebtRatio	0.0773	0.0535	0.1384**	0.0788	0.1890***	0.1121*	-0.0353	0.0507	0.1063*	1	
(11) LogTA	0.5676***	0.5678***	0.2417***	0.2891***	0.4435***	0.6132***	-0.0323	0.5219***	0.6652***	0.2568***	1
(12) LogMarketCap	0.5846***	0.5417***	0.1761***	0.2013***	0.3825***	0.4289***	-0.0613	0.4924***	0.4310***	0.0501	0.7753***
(13) ROA	0.0265	0.0255	0.0267	-0.1534***	0.0311	-0.1606***	0.0089	0.0553	-0.1498***	-0.2668***	-0.148***
(14) SBMeetings	0.0751	0.0494	0.0809	-0.0761	0.0606	-0.0312	0.0043	0.0281	-0.0273	0.1547***	0.1344**
(15) SBIndependence	0.3415***	0.2175***	-0.0131	0.0819	0.0150	0.0015	0.0102	0.0239	-0.0590	0.1685***	0.1908***
(16) CSRCommittee	0.4614***	0.4488***	0.1486***	0.1343**	0.1848***	0.2090***	0.1063*	0.1378**	0.2347***	0.1197**	0.3390***
(17) SusCompIncen	0.2540***	0.1852***	0.2374***	0.1469**	0.2682***	0.2077***	0.0573	0.1270**	0.1775***	0.0334	0.2708***
(18) Women0	-0.3091***	-0.3038***	-0.8987***	-0.0825	-0.9064***	-0.2834***	-0.2462***	-0.4628***	-0.2938***	-0.1406**	-0.3951***
(19) Women1	0.3091***	0.3038***	0.8987***	0.0825	0.9064***	0.2834***	0.2462***	0.4628***	0.2938***	0.1406**	0.3951***
(20) Women2	0.1678***	0.1501***	0.3638***	-0.0213	0.6250***	0.1175**	-0.0444	0.4018***	0.1352**	0.1589***	0.2656***
(21) Women3	0.1425**	0.1404**	0.1942***	0.0855	0.4111***	0.1961***	-0.0202	0.2556***	0.1614***	0.1439**	0.2408***

	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	
(12) LogMarketCap	1										
(13) ROA	0.1315**	1									
(14) SBMeetings	0.0553	-0.2525***	1								
(15) SBIndependence	0.2469***	0.0112	0.1061*	1							
(16) CSRCommittee	0.2606***	-0.0433	0.1404**	0.2495***	1						
(17) SusCompIncen	0.2863***	-0.0104	0.0329	0.0915	0.0996*	1					
(18) Women0	-0.3337***	-0.0191	-0.0708	-0.0006	-0.2210***	-0.2363***	1				
(19) Women1	0.3337***	0.0191	0.0708	0.0006	0.2210***	0.2363***	-1***	1			
(20) Women2	0.2479***	0.0510	-0.0091	0.0104	0.0011	0.1831***	-0.2668***	0.2668***	1		
(21) Women3	0.2029***	-0.0087	0.0458	0.0686	0.0524	0.1118*	-0.1212**	0.1212**	0.4544***	1	

Notes: *, **, *** represent significance levels of 0.10, 0.05, and 0.01, respectively. For definitions of the variables, please see Appendix A.

5.2. Regression Results and Discussion

Table 3 shows the results for the regression model using *MBGend* and *SBGend* as independent variables, investigating the relationship between females on the supervisory and management board on ESG performance (H1 and H4). As a goodness of fit measure, the adjusted R^2 is employed. The adjusted R^2 of the model is 0.546, indicating a good fit of the regression model. Between *MBGend* and *ESG* I find a positive and significant association, with a regression coefficient of 0.1136 at the 5 per cent significance level. This suggests that for a 1 per cent increase in women on the management board, the *ESG* score increases by 0.1136 points. Compared to a company with no women on the management board, a company that has 50 per cent women on the management board, the *ESG* score would be 5.68 points higher. For the interpretation, it should be noted that although the variable *ESG* is coded on a scale of 0 to 1, the *ESG* score itself is given on a scale of 0 to 100. The results are in support of H1 and suggest that a higher proportion of women on the management board positively affects ESG performance. The direction of the effect is in line with earlier studies, that show that female members and gender diversity on the management board have a positive and significant influence on ESG performance.[127] Velte (2016b) also finds a positive and significant association for the German setting, however, the effect size he finds is more than twice as large, with a coefficient of 0.254, which suggests that for every 1 per cent increase in women on the management board, the *ESG* score increases by 0.254 points. Furthermore, the association Velte finds is stronger, with significance at the 1 per cent level.[128] This difference could be explained by the different sample used, which in addition to German companies also consisted of Austrian companies and the fact that an earlier period was examined.

With the average management board only consisting of 4 members and the average proportion of females on the management board being only 10.31 per cent, the results suggest that although there is a relatively low proportion of female management board members in the sample companies, they do have a significant impact on ESG performance. This indicates that a critical mass of female management board members is not needed to have a significant and positive influence on ESG performance and that even few women can make a positive impact. These results are in contrast to Rao and Tilt (2021), who found that although women have a positive influence on sustainability in principle, the low number of women on the board and the associated barriers prevent this positive influence from unfolding.[129] My results reflect what the majority of previous research has found. They show that women, even in small numbers as in the sample, can have a significant positive impact on sustainability. This matter will be analysed in more detail using regression model 2, which uses dummy variables to investigate how the impact of women on ESG performance changes, if the number of women on the management board increases.

Table 3: Female Supervisory and Management Board Members Regression

	ESG	
Independent Variable	Coefficient	p-value
Intercept	-0.4096	0.0039***
MBGend	0.1136	0.0336**
SBGend	0.1802	0.0023***
MBSize	0.0053	0.3373
SBSize	0.0023	0.2304
DebtRatio	-0.0461	0.3226
LogTA	0.0396	0.0000***
ROA	0.1205	0.3282
SBMeetings	0.0009	0.5438
SBIndependence	0.1236	0.0000***
CSRCommittee	0.1068	0.0000***
SusCompIncen	0.0288	0.0572*
Year Effects	included	
Industry Effects	included	
N	305	
Adj. R^2	0.546	

Notes: *, **, *** represent significance levels of 0.10, 0.05, and 0.01, respectively. For definitions of the variables, please see Appendix A.

The regression results for regression model 2 are displayed in Table 4. It tests H2, namely that a critical mass of three or more women on the management board is needed to have a significant effect on ESG performance. For the hypothesis to be accepted, the increase in the coefficient between *Women2* and *Women3* should be significantly higher than the increase from *Women1* to *Women2*. Furthermore, according to tokenism theory the impact of one woman, represented by the coefficient of *Women1*, on the management board should be insignificant. The regression is run 4 times, each time with a different independent dummy variable, which represents a threshold of an absolute number of women on the management board being met. The coefficient -0.0308 for *Women0* is negative and significant at the 10 per cent level. This suggests that having no women on the management board has a negative and significant effect on ESG performance. As expected, having at least one woman on the management board has the opposite effect of having no women on the management board; the sign of the coefficient for *Women1* is switched in comparison to *Women0*, the p-value is the same. This implies that including one woman on the management board has a significant and positive impact on ESG performance. For

[127] Cf. Harjoto et al. (2015), p. 641–642; Bear et al. (2010), p. 217; Shahbaz et al. (2020), p. 11.
[128] Cf. Velte (2016b), p. 106 for these sentences.
[129] Cf. Rao and Tilt (2021), p. 76–77.

Table 4: Critical Mass Regression

	ESG							
Independent	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Variable								
Intercept	-0.3679	0.0120**	-0.3987	0.0053***	-0.4128	0.0059***	-0.4320	0.0026***
Woman0	-0.0308	0.0723*						
Woman1			0.0308	0.0723*				
Woman2					0.0437	0.2556		
Woman3							0.0235	0.7549
SBGend	0.1803	0.0024***	0.1803	0.0024***	0.1808	0.0025***	0.1721	0.0038***
MBSize	0.0032	0.5854	0.0032	0.5854	0.0044	0.4511	0.0063	0.2621
SBSize	0.0022	0.2474	0.0022	0.2474	0.0023	0.2275	0.0022	0.2609
DebtRatio	-0.0436	0.3496	-0.0436	0.3496	-0.0428	0.3636	-0.0365	0.4364
LogTA	0.0395	0.0000***	0.0395	0.0000***	0.0397	0.0000***	0.0404	0.0000***
ROA	0.1299	0.2922	0.1299	0.2922	0.1373	0.2670	0.1429	0.2485
SBMeetings	0.0010	0.4954	0.0010	0.4954	0.0011	0.4790	0.0010	0.5101
SBIndependence	0.1228	0.0000***	0.1228	0.0000***	0.1203	0.0000***	0.1187	0.0000***
CSRCommittee	0.1058	0.0000***	0.1058	0.0000***	0.1109	0.0000***	0.1098	0.0000***
SusCompIncen	0.0302	0.0461**	0.0302	0.0461**	0.0326	0.0312**	0.0343	0.0227**
Year Effects	included		included		included		included	
Industry Effects	included		included		included		included	
N	305		305		305		305	
Adj. R^2	0.5439		0.5439		0.5408		0.5389	

Notes: *, **, *** represent significance levels of 0.10, 0.05, and 0.01, respectively. For definitions of the variables, please see Appendix A.

the third dummy variable *Women2*, the coefficient is slightly higher, at 0.0437, however it is insignificant at a p-value of 0.2556. For *Women3* the coefficient is the lowest of the three at 0.0235. Again it is not significant at a p-value of 0.7549. These results are opposite to what would have been necessary to accept H2. The statistical analysis suggests that the first woman on the management board has a positive and significant impact on ESG performance, and that while additional women further improve sustainability, a single woman also makes a major contribution. A critical mass of three women is not needed to have a positive and significant effect on ESG performance.

The conclusion that can be drawn from the data is that not having a woman on the management board has a negative impact on ESG performance. This means that the *ESG* score is on average 3.2 points lower than in companies that have at least one woman on the management board.

The results of regression model 2 also emphasise the results of model 1 and confirm H1, namely that women on the board have a positive influence on ESG performance. The coefficients for *Women2* and *Women3* are not significant, which is why they should be interpreted with caution. However, the interpretation of the coefficients would allow the conclusion to be drawn about an inverted U-shaped relationship; the coefficient of *Women2* is greater than the coefficient of *Women3*, which means that the positive influence on ESG performance decreases again when there are more than 2 women on the management board. These results would be in line with previous research[130], but are based on non-significant results so further research is necessary to confirm these findings.

Part of the critical mass theory also states that a single woman is merely a token woman and has no positive impact on sustainability. The fact that there are so many companies with only one woman in the sample and that both *MBGend* in regression model 1 and regression model 2 with the independent variable *Women1* have a positive and significant effect on the sustainability of the company, allow the conclusion that even a single woman on the board can have a positive effect on the sustainability of the company. This is particularly interesting in the context of FüPoG II, as the law only obliges companies to appoint one woman to the management board.

[130]Cf. Birindelli et al. (2018), p. 11–12; Nuber and Velte (2021), p. 1976.

However, another explanation for the regression results, namely that including a second and third woman on the management board does not lead to a larger increase in ESG performance than the inclusion of the first women, should also be considered: there are only three firm-year observations in the sample that have three women on the board, two of which belong to the same firm. The influence of at least three women on the board on ESG performance is therefore only determined based on these three observations. Also, there are only 14 observations in which 2 or more women are present on the management board. If the dummy variables *Women2* and *Women3* only take the value one in such a small number of observations, the regression coefficient for the independent variable will most likely not be significant, even if there were a significant effect in the population. Although the model does not confirm the critical mass theory, conversely it cannot be said that the critical mass theory is rejected. There are just too few observations in the sample in which the hypothesised critical mass of women is reached to be able to come to a meaningful conclusion about whether the critical mass effect does or does not exist. To conduct a meaningful study with this sample, the number of companies with at least 3 women on the board would have to be significantly higher. Although this regression model again confirms that more women generally have a positive influence on the sustainability of companies, there are too few women on the management boards to be able to make statements about the validity of the critical mass theory.

Regarding the question of whether critical mass holds true for the German setting, my results neither confirm that the critical mass theory is correct, nor can they clearly refute it, due to my sample containing too few companies in which the critical mass is reached. However, one important contribution can be made regarding token women. By describing token women, who have little influence on strategic processes and are included on the board mainly for outward appearances, previous literature often gives the impression that having one woman is as good as having none.[131] However, this would be a serious error, as my results show that a single woman can also have a positive influence and that the inclusion of a woman is the first step, albeit a small one, towards a board with equal representation.

Table 5 shows the results for regression model 3 which tests for H3, whether there is a positive impact on female CEOs on ESG performance, as measured by the *ESG* score. The coefficient of the *CEO* variable is negative at -0.0189. However, the relationship is not statistically significant, as indicated by a p-value of 0.6056. The lack of significance means H3 can be rejected, implying there is no significant relationship between female CEOs and ESG performance. This result is not necessarily because female CEOs have no impact on ESG performance. In fact, there are multiple explanations for such a result. The first, being the most obvious, is that female CEOs indeed have no effect on ESG performance. Another possible explanation is, that the hypothesis is true for the population, but there is just not enough evidence in the sample to support the hypothesis, also referred to as a Type II error.[132] The most probable cause of this error for my sample is, that the sample size is too small, the characteristic hypothesized to have an effect, that is the CEO being female, occurs too rarely. Since only 12 of the total 305 firm-year observations have a female CEO, even if there were a significant effect, it may not be measurable due to the small number of female CEOs. To rule out with certainty that female CEOs have no influence on ESG performance, a sample would be required in which the proportion of female CEOs is higher or the total number of observations is larger. It can be concluded that for my sample of German DAX, MDAX and SDAX firms in the two-year period observed, no significant effect of the female CEOs on ESG performance can be found.

Table 5: Female CEO Regression

	ESG	
Independent Variable	Coefficient	p-value
Intercept	-0.4316	0.0025***
CEO	-0.0189	0.6056
SBGend	0.1695	0.0045***
MBSize	0.0065	0.2468
SBSize	0.0023	0.2448
DebtRatio	-0.0363	0.4374
LogTA	0.0403	0.0000***
ROA	0.1435	0.2462
SBMeetings	0.0010	0.5065
SBIndependence	0.1188	0.0000***
CSRCommittee	0.1108	0.0000***
SusCompIncen	0.0350	0.0205**
Year Effects	included	
Industry Effects	included	
N	305	
Adj. R^2	0.5391	

Notes: *, **, *** represent significance levels of 0.10, 0.05, and 0.01, respectively. For definitions of the variables, please see Appendix A.

Based on the upper echelon theory and the associated assumption that the characteristics of top management have a significant influence on corporate decisions and thus also on sustainability, and the findings that women on management and supervisory boards have a positive influence on sustainability, it is surprising that this relationship should not exist for female CEOs. Especially as the CEO holds the position of top decision maker in the company.[133]

[131] Cf. Kanter (1977), p. 966–968; Konrad et al. (2008), p. 160.

[132] Cf. Visentin et al. (2020), p. 918.

[133] Cf. Busenbark et al. (2016), p. 237.

However, these results are in line with part of the previous research, which also found a non-significant association of female CEOs on ESG performance when using ESG scores specifically provided by Refinitiv. The insignificant nature of my finding could also be due to the data provider that provides the ESG scores as a significant positive relationship was found for Bloomberg ESG scores, but not for ESG scores provided by Refinitiv.[134] My results also match the findings of Sumarta et al. (2021) who also find a non significant relationship and use the same explanation, namely that there are few female CEOs in their sample.[135]

In support of H4, I find a positive and significant association between *SBGend* and *ESG* with a regression coefficient of 0.1802 which is significant at the 1 per cent level. This result suggests that women on the supervisory board have a positive and significant impact on ESG performance. In comparison to the effect women have on the management board, the effect of women on the management board is larger, as the coefficient of *SBGend* is more than 1.5 times higher than the coefficient of *MBGend*. This is rather surprising as members of the management board are more directly involved in managing the company's affairs and its strategic positioning. This would suggest that the positive effect women have, according to the upper echelons theory, would be larger for the management board. But the regression results suggest that the opposite is the case.

To date, there have been no other studies in the German setting that use a regression model to analyse the impact of women on the supervisory board on ESG performance. On the one hand, my results are therefore not comparable with previous study results for the German Setting. On the other hand, however, they provide new and important insights into how women on supervisory boards affect ESG performance. The fact that the gender of supervisory board members, and thus their characteristics according to the upper echelons theory, have an influence on sustainability as a management outcome of the company also ties in with previous findings on the changing role of the supervisory board.[136] It shows that the supervisory board not only has a controlling function but that it also plays a role that leads to strategic changes within the company and therefore has an influence on ethical and social issues such as sustainability. My results are in line with previous research on the impact of women on boards and as expected. They are consistent with findings that women on boards in general have a positive impact on ESG performance. They also complement the research in the German setting that the proportion of women on the supervisory board has a positive influence not only on sustainability reporting[137] but also on ESG performance itself.

As the regression models largely contains the same control variables, these are considered together in the following section and their impact on ESG performance is described and analysed.

The coefficients for both board size variables, *MBSize* for the management board size and *SBSize* for the supervisory board size are insignificant with a p-value of 0.3373 and 0.2304 respectively, for regression model 1. As previous research suggests, board size has no clear effect on ESG performance, as larger boards are, on the one hand, more inefficient at communicating and coordination,[138] and on the other hand, offer a broader range of diversity and opinions.[139] This is also reflected in the insignificant association I find in the data, as the direction of the effect is unambiguous and the results are expected.

The association between *DebtRatio* and *ESG* is found to be insignificant at a p-value of 0.3226 for regression model 1 and a slightly higher p-value for models 2 and 3. As expected from previous studies the coefficient is negative at -0.0461. Findings from previous studies are inconclusive with some studies showing a positive effect of high leverage and others showing a negative effect on ESG performance. As discussed earlier, this can be due to reducing agency costs associated with high debt through sustainable actions or the neglect of the community stakeholders by focusing mainly on creditors, when debt is high, leading to lower ESG performance.[140] As the effect of high leverage can lead to ESG performance going in both directions for different companies, or even within the same company, this can lead to the association being insignificant.

In all regression models, there is a positive and significant association between the natural logarithm of *LogTA* and *ESG*. This suggests that firm size has a positive influence on ESG performance. The regression coefficient in model 1 is 0.0396 and does not deviate in the other models. It is significant at the 1 per cent level. Because of the log transformation of the independent variable, the interpretation of the regression coefficient is not straightforward. The results suggest that if the total assets of a firm increase by 1 per cent the *ESG* score increases by 0.0394 points.[141] The finding that ESG performance increases with increasing firm size, as proxied by total assets, is consistent with previous studies.[142] This was expected as larger firms have more resources available to invest in sustainable development and practices.

The association between *ROA* and *ESG* is positive with a coefficient of 0.1205, however it is insignificant. Previous research would have suggested a positive but significant relationship.[143]

In all models the control variable *SBMeetings* is insignificant, in model 1 the p-value is 0.5438, in models 3 it is also above the 50 per cent significance level. The regression coefficient is close to zero (0.0009) for model 1. This result is not unexpected, as the effects and reasons for a large number of supervisory board meetings are not unambiguous. On

[134] Cf. Aabo and Giorici (2023), p. 5–6 for these sentences.
[135] Cf. Sumarta et al. (2021), p. 1027.
[136] Cf. Steger and Jahn (2019), p. 369–370.
[137] Cf. Dienes and Velte (2016), p. 14–15.
[138] Cf. Goodstein et al. (1994), p. 248.
[139] Cf. Birindelli et al. (2018), p. 5.
[140] Cf. Khaled et al. (2021), p. 3.
[141] $\beta_6 = 0.0396$, $\beta_6 * \ln(1.01) = 0.000394$
[142] Cf. Chang et al. (2024), p. 14; Liu (2018), p. 126; Velte (2016b), p. 106.
[143] Cf. Gallo and Christensen (2011), p. 336.

the one hand, a high number may indicate difficulties in the company or inefficiencies in management; on the other hand, many meetings may also indicate better and more intensive communication and diligence. The finding of an insignificant association between the frequency of board meetings and the ESG score is in line with previous research, which also reports a positive coefficient that is not significant.[144]

SBIndpendence is positively and significantly associated with *ESG* at the 1 per cent significance level. The regression coefficient is 0.1236 for model 1, suggesting that if the percentage of independent members on the supervisory board rose by 1 per cent, the ESG score would increase by 0.1253 points. This finding was expected, as independent board members are more likely to monitor management activities more objectively, and reflects what was found in previous studies.[145]

As expected, the association between *CSRCommittee* and *ESG* is positive and significant at the 1 per cent significance level. The coefficient is 0.1068 implying that a company that has a CSR Committee has an ESG score that is on average 10.68 points higher, than a company that has not implemented a CSR Committee. The results for regression models 2 and 3 also show a significant and positive association with similar coefficients. However, it should also be taken into account that other effects may play a role here. For example, companies that place a particularly high value on sustainability are more likely to implement a CSR committee, meaning that the committee is not the cause of the increased ESG performance, but rather that there is a reverse causality.

I find that there exists a positive association between the existence of sustainability compensation incentives and ESG performance. The association is significant at the 10 per cent level for regression model 1 and for regression model 3 even at the 5 per cent level. The regression coefficient for *SusCompIncen* in model 1 is 0.0288, implying that for companies that have linked management board remuneration to the achievement of sustainability targets, the ESG score is on average 2.88 points higher, compared to companies that have no sustainability compensation incentives. Although the association is positive and significant the effect is relatively small. This is in line with previous research, which found that integrating CSR criteria into executive compensation leads to improved ESG performance, by increasing management long-term orientation, increasing environmental and social initiatives, increasing environmental innovation and reducing greenhouse gas emissions.[146]

Year and industry dummies were included in all three models. The year dummy was significant at the 10 per cent level for model 1 and 2 and insignificant for model 3.

One limitation of this study is that the operationalisation of ESG performance was based on Refinitiv's ESG scores. It should be noted that there are ESG scores available from other providers, like Sustainalytics or MSCI. These scores significantly differ from each other, with the main driver of this divergence being how the ESG score is measured. Furthermore, there is a rater effect, meaning that if a company receives a good score in one category, it also receives good scores in other categories.[147] These findings should be taken into account when interpreting the regression results. Chatterji et al. (2016) find that ESG scores from different raters have a low correlation and that they vastly differ from one another, although raters are measuring the same theoretical construct, that is ESG performance.[148] Depending on which ESG score is used, different associations between board characteristics and ESG performance can be found. Aabo and Giorici (2023) find no association between the CEO gender and ESG performance when using ESG scores provided by Refinitiv, but when using ESG scores by the data provider Bloomberg a positive and significant association can be found. This is mainly due to differences in the environmental and social scores.[149] It would be interesting to repeat the study with ESG data from other data providers, like Bloomberg and see if the outcomes match or are different.

Furthermore, the data covers only a period of two years. During these two years, changes, especially those that occurred due to legislation, are difficult to observe. This would require more than two years of data. While the impact of women on the management board is important to understand the potential effect of FüPoG II, the law only went into effect in August of 2022. This period is only covered by the lagged *ESG* variable and only by half a year. The effects of FüPoG II are not contained in the data, especially for the number of women on the management board since the independent variables are from the years 2020 and 2021. To address this limitation, another study would have to be carried out covering a longer period both before and after the introduction of the law. This is not possible with the data currently available, as ESG data is available for 2022 at the latest.In my research so far, I have assumed that the influence of women on ESG performance is linear; more women lead to more sustainability. This is also reflected in my choice of a linear regression model. However, it is also conceivable that the underlying mechanism is not the proportion of women, which increases sustainability, but gender diversity. This would mean that from a certain proportion of women, for example, 50 per cent, the ESG performance decreases again, as male perspectives are missing. In this case, there would be an inverted U-shaped relationship in which the ESG performance first increases with an increasing proportion of women, reaches its maximum at an unknown point and then decreases again, as found in previous studies.[150] Regression model 2 provides an indication of this relationship, but it is based on non-significant coefficients. To investigate this relationship further, it would be necessary to have a sample in which all distributions of men and women occur, including

[144] Cf. Al-Shaer et al. (2024), p. 13; Birindelli et al. (2018), p. 11.
[145] Cf. Al-Shaer et al. (2024), p. 13.
[146] Cf Flammer et al. (2019), p. 1097.
[147] Cf. Berg et al. (2022), p. 1341 for these sentences.
[148] Cf. Chatterji et al. (2016), p. 1607–1608.
[149] Cf. Aabo and Giorici (2023), p. 5 for these sentences.
[150] Cf. Birindelli et al. (2018), p. 11–12; Nuber and Velte (2021), p. 1976.

companies where women are overrepresented. In my sample of DAX, MDAX and SDAX companies, the highest proportion of women on the management board is 50 per cent. There are no management boards in the sample, in which men are in the minority. In 4 firm-year observations, there are more women on the supervisory board than men. Again, not enough to analyse what happens when women outnumber men. However, it is probable that the positive trend in the number of women on supervisory boards and management boards will continue, making it possible to analyse this matter in the future.

A further limitation results from the sample size in combination with the fact that the proportion of women on the management board and in the CEO position is relatively low. Although the results regarding the critical mass and CEO hypotheses are insignificant, a significant association cannot be ruled out. This is because a small sample size reduces the statistical power of the regression and therefore a true effect that potentially exists cannot be detected.[151] This may change if more women are represented on the management board, also because of FüPoG II. However, the law only requires that a woman be represented on the management board if there are at least three members. It is therefore questionable whether the number of companies with four or more women would increase. This would be necessary to adequately test the critical mass hypothesis. Possibly, an increase in the number of women on the board would also increase the number of female CEOs, which would in turn improve the situation for testing the CEO hypothesis (H3). Another possibility would be to extend the analysis to a larger number of companies and thus increase the number of women in the sample.

6. Robustness Test and Further Analysis

In the following section, I will carry out several robustness checks. I will test the same hypotheses but change some model specifications and check whether I obtain the same results. Regression model 1 is addressed in particular, as this was the focus of the work and delivered significant results. I will test whether these significant results persist when the model specifications are changed. In addition, interaction effects are used to analyse the conditions under which the influence of women on the supervisory board and management board on ESG performance changes or is particularly pronounced.

One issue with the Refinitiv ESG score and my regression model is that the calculation for the governance subscore also included how diverse the management is, how the compensation of the management is structured, and which committees exist in the company. These factors are also included in my regression models as the dependent variables *MBGend* and *SBGend*, which indicate the proportion of women on the management and supervisory board but also as control variables such as *CSRCommittee* and *SusCompIncen*. As these factors are included in the calculation of the ESG score itself, it is quite clear that there must exist a significant relationship between these control variables and the dependent variable *ESG*. The following section analyses whether and to what extent the percentage of women has an impact on sustainability if these factors are not included in the variable that approximates ESG performance. Furthermore, excluding the governance score from the dependent variable addresses endogeneity and reverse causality issues.[152]

Therefore, in the first robustness test, the dependent variable *EnvSocMean* only includes the environment and social subscores. This is done by calculating the mean of both scores as provided by Refinitiv. The governance score is no longer part of the dependent variable.

The following regression model is estimated:

$$\begin{aligned}\text{EnvSocMean} = \alpha &+ \beta_1 \text{MBGend} + \beta_2 \text{SBGend} \\ &+ \beta_3 \text{MBSize} + \beta_4 \text{SBSize} \\ &+ \beta_5 \text{SBMeetings} + \beta_6 \text{SBIndependence} \\ &+ \beta_7 \text{CSRCommittee} \\ &+ \beta_8 \text{SusCompIncen} + \beta_9 \text{LogTA} \\ &+ \beta_{10} \text{DebtRatio} + \beta_{11} \text{ROA} \\ &+ \text{Year FE} + \text{Industry FE} + \varepsilon\end{aligned} \tag{4}$$

The adjusted R^2 is 0.4974, which is 0.0487 lower than the original model. This was to be expected, as some of the independent variables are no longer included in the regression and therefore the model has lower explanatory power. Both the coefficients of *MBGend* and *SBGend* are still positive and there is a significant association at the 10 per cent level for *MBGend* and the 5 per cent level for *SBGend*. The effect size remains largely the same with coefficients for *MBGend* at 0.1069 and *SBGend* at 0.1587. This suggests that the results of the main model are not due to the board's diversity being included in the calculation of the ESG score, but rather that women on both the supervisory board and the management board do indeed have a positive impact on sustainability.

A large difference can be seen in the control variable *SusCompIncen*, which controls for the sustainability-oriented remuneration of the management board. This was positive in the main model and significant at the 10 per cent level. The p-value in this model is 0.5217, indicating that the relationship between sustainability compensation incentives and the mean of sustainability and social scores is no longer significant. This sharp drop in significance due to the exclusion of compensation in the dependent variable is rather surprising as previous research did not find a significant relationship between sustainability related compensation and the governance score for the German setting.[153] Based on this research it would have been expected that the relationship between *SusCompIncen* and *EnvSocMean* would have become even more significant after the exclusion of the governance score, but the opposite was the case.

[151] Cf. Button et al. (2013), p. 365.

[152] Cf. Bigelli et al. (2023), p. 10.

[153] Cf. Baraibar-Diez et al. (2019), p. 1469.

Table 6: Excluded Governance Score Regression

	EnvSocMean	
Independent Variable	Coefficient	p-value
Intercept	-0.3410	0.0455**
MBGend	0.1069	0.0971*
SBGend	0.1587	0.0257**
MBSize	0.0066	0.3241
SBSize	0.0070	0.0027***
DebtRatio	-0.0660	0.2410
LogTA	0.0388	0.0000***
ROA	0.1502	0.3130
SBMeetings	0.0002	0.8992
SBIndependence	0.0802	0.0026***
CSRCommittee	0.1268	0.0000***
SusCompIncen	0.0116	0.5217
Year Effects	included	
Industry Effects	included	
N	305	
Adj. R^2	0.4974	

Notes: *, **, *** represent significance levels of 0.10, 0.05, and 0.01, respectively. For definitions of the variables, please see Appendix A.

The second robustness test deals with the operationalisation of the independent variable. In line with the majority of existing research, the percentage of women on the entire board was used in the main model. However, another approach would be to use the number of women on the board as an independent variable. The dependent variable is, as in the main model, *ESG*. The following regression model is used:

$$\begin{aligned} \text{ESG} = \alpha &+ \beta_1 \text{MBWomen} + \beta_2 \text{SBWomen} + \beta_3 \text{MBSize} \\ &+ \beta_4 \text{SBSize} + \beta_5 \text{SBMeetings} \\ &+ \beta_6 \text{SBIndependence} + \beta_7 \text{CSRCommittee} \\ &+ \beta_8 \text{SusCompIncen} + \beta_9 \text{LogTA} \\ &+ \beta_{10} \text{DebtRatio} + \beta_{11} \text{ROA} \\ &+ \text{Year FE} + \text{Industry FE} + \varepsilon \end{aligned} \tag{5}$$

The regression model shows that the results are robust to changes to the operationalisation of the independent variables. There is a positive and significant association between the number of women, both on the management and the supervisory board, and the ESG score. For both variables, it is significant at the 10 per cent level. Here, the coefficient for *MBWomen* is 0.0246, which is about twice as large as the coefficient for *SBWomen*, which is 0.0119. In the main model, it was the exact opposite; the influence of women on the supervisory board was twice as high as that of women on the management board. This could be due to the fact that the supervisory board is generally larger: the same increase in absolute terms, leads, in relative terms, to a smaller increase in the supervisory board compared to the management board.

Table 7: Absolute Number of Women Regression

	ESG	
Independent Variable	Coefficient	p-value
Intercept	-0.3485	0.0172**
MBWomen	0.0246	0.0918*
SBWomen	0.0119	0.0654*
MBSize	0.0013	0.8284
SBSize	-0.0007	0.8218
DebtRatio	-0.0471	0.3206
LogTA	0.0393	0.0000***
ROA	0.1011	0.4157
SBMeetings	0.0006	0.6797
SBIndependence	0.1257	0.0000***
CSRCommittee	0.1097	0.0000***
SusCompIncen	0.0301	0.0502*
Year Effects	included	
Industry Effects	included	
N	305	
Adj. R^2	0.5351	

Notes: *, **, *** represent significance levels of 0.10, 0.05, and 0.01, respectively. For definitions of the variables, please see Appendix A.

The third robustness test is intended to check whether changes in the control variables lead to the same regression result. The results are displayed in Table 8. For this purpose, variables are omitted from the models or other proxies are used.

First, I omit all control variables from the model and only use the variables *MBGend* and *SBGend* as explanatory variables. This is to estimate a baseline of the model, before including any other factors that influence ESG performance. The following regression equation is used:

$$\text{ESG} = \alpha + \beta_1 \text{MBGend} + \beta_2 \text{SBGend} + \varepsilon \tag{6}$$

Both coefficients remain positive and significant. The p-value for both coefficients is much smaller compared to the main model, and the coefficients are larger. This indicates that there is still a significant association between women on boards and ESG performance without controlling for any other factors and that adding control variables decreases the significance of the two independent variables. However, the fit of the model without control variables is very poor, with an

Table 8: Alternate Control Variables Regression

	ESG					
Independent Variable	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Intercept	0.46995	0.0000***	-0.4225	0.0016**	-0.7651	0.0000***
MBGend	0.2541	0.0002***	0.1257	0.0175**	0.0890	0.1441
SBGend	0.4163	0.0000***	0.1889	0.0012***		
MBSize			0.0054	0.3207	0.0037	0.5579
SBSize			0.0050	0.0035***		
DebtRatio			-0.0003	0.9953	-0.0164	0.7591
LogTA					0.0604	0.0000***
LogMarketCap			0.0397	0.0000***		
ROA			-0.0635	0.6095	0.1415	0.3043
SBMeetings			0.0008	0.5844		
SBIndependence			0.1101	0.0000***		
CSRCommittee			0.1111	0.0000***		
SusCompIncen			0.0233	0.1235	0.0336	0.0539*
Year Effects	excluded		included		included	
Industry Effects	excluded		included		included	
N	305		305		305	
Adj. R^2	0.1405		0.5554		0.3955	

Notes: *, **, *** represent significance levels of 0.10, 0.05, and 0.01, respectively. For definitions of the variables, please see Appendix A.

R^2 of 0.1405, which is significantly improved, when adding more control variables.

In model 7 I use a different firm size proxy: the natural logarithm of the market capitalization *LogMarketCap*. This is also a commonly used measure of firm size in financial modelling[154] and is therefore well suited to replace the total assets in the model. The following model is used:

$$\begin{aligned} \text{ESG} = \alpha &+ \beta_1 \text{MBGend} + \beta_2 \text{SBGend} + \beta_3 \text{MBSize} \\ &+ \beta_4 \text{SBSize} + \beta_5 \text{SBMeetings} \\ &+ \beta_6 \text{SBIndependence} + \beta_7 \text{CSRCommittee} \\ &+ \beta_8 \text{SusCompIncen} + \beta_9 \text{LogMarketCap} \\ &+ \beta_{10} \text{DebtRatio} + \beta_{11} \text{ROA} \\ &+ \text{Year FE} + \text{Industry FE} + \varepsilon \end{aligned} \tag{7}$$

The results show that the coefficients and significance levels for the independent variables of interest *MBGend* and *SBGend* are very similar to the main model. The results are therefore robust to changes in the firm size proxy. There has been one noteworthy change in the results. The coefficient for the size of the supervisory board *SBSize* is now significant at the 1 per cent level. The coefficient (0.0050) implies that each additional member of the supervisory board would increase the ESG score by an average of 0.50 points.

Thirdly, I estimate a model, that excludes all variables that are related to the supervisory board, to test the robustness of the regression results regarding the independent variable *MBGend*. These variables are *SBGend*, *SBSize*, *SBMeetings*, *SBIndependence* and *CSRCommittee*:

$$\begin{aligned} \text{ESG} = \alpha &+ \beta_1 \text{MBGend} + \beta_2 \text{MBSize} \\ &+ \beta_3 \text{SusCompIncen} + \beta_4 \text{LogTA} \\ &+ \beta_5 \text{DebtRatio} + \beta_6 \text{ROA} \\ &+ \text{Year FE} + \text{Industry FE} + \varepsilon \end{aligned} \tag{8}$$

The results for model 8 show that the coefficient for *MBGend* is still positive but no longer significant. However, the p-value for *MBGend* is 0.1441, which is above the 10 per cent significance level. The R^2 of 0.3955 is decreased which indicates that important explanatory variables, compared to the main model which had an R^2 of 0.5461, have been removed. The robustness test therefore indicates that the supervisory board variables improve the fit of the model and should not be omitted. The inclusion of the supervisory board variables is also justified as the activities of the management board and supervisory board are closely related.

[154] Cf. Dang et al. (2018), p. 1.

To further analyse the relationship between the independent variables and how they interact with each other to affect ESG performance, I add interaction effects between the independent variables and between the independent variables and the control variables. This leads to a better understanding of the conditions under which women on boards have a particularly positive influence and the conditions under which this influence may be reduced. Table 9 displays the coefficients and p-values for all 21 combinations of independent and control variables, including two interaction terms with the independent variables and the year dummy variable. Each regression contains the interaction term, and all independent and control variables, used in regression model 1. Two of the interaction terms have a statistically significant coefficient. The statistically significant terms are *SBGend*DebtRatio* and *SBGend*CSRCommittee*. The other 19 interaction terms are insignificant. There is no significant interaction term that contains *MBGend*. Also, the interaction of the two independent variables *MBGend*SBGend* is insignificant with a p-value of 0.5717. This suggests that the percentage of women on one board does not change the impact the women on the other board have. This could have been the case, for example if women on management boards and supervisory boards had supported each other.

In regression model 9 the interaction term *SBGend*DebtRatio* is negative (-0.5687) and significant at the 10 per cent level. The following regression equation was used to estimate model 9:

$$\begin{aligned} \text{ESG} = \alpha &+ \beta_1 \text{SBGend*DebtRatio} + \beta_2 \text{MBGend} \\ &+ \beta_3 \text{SBGend} + \beta_4 \text{MBSize} + \beta_5 \text{SBSize} \\ &+ \beta_6 \text{DebtRatio} + \beta_7 \text{LogTA} + \beta_8 \text{ROA} \\ &+ \beta_9 \text{SBMeetings} + \beta_{10} \text{SBIndependence} \\ &+ \beta_{11} \text{CSRCommittee} + \beta_{12} \text{SusCompIncen} \\ &+ \text{Year FE} + \text{Industry FE} + \varepsilon \end{aligned} \tag{9}$$

This suggests that the higher the debt ratio of the firm, the lower the impact of women on the supervisory board on ESG performance. This could be possibly explained by the fact that companies with higher levels of debt are in a worse economic situation and women therefore have fewer opportunities to realise their positive effects on sustainability. For example, there is a lack of financial resources to implement sustainability measures or changes. The interaction between these two variables with influence on sustainability has not yet been described in the literature and should be investigated in more detail in the future.

Regression model 10 shows for the interaction term *SBGend*CSRCommittee* a positive coefficient at 0.2195 which is significant at the 5 per cent level with a p-value of 0.0458.

Table 9: Interaction Terms

	ESG	
Interaction Terms	Coefficient	p-value
MBGend*SBGend	-0.2069	0.5460
MBGend*MBSize	0.0060	0.8711
MBGend*SBSize	-0.0115	0.2243
MBGend*DebtRatio	0.3243	0.2869
MBGend*LogTA	0.0140	0.6501
MBGend*ROA	-0.9770	0.2783
MBGend*SBMeetings	0.0075	0.4759
MBGend*SBIndependence	-0.0862	0.5528
MBGend*CSRCommittee	-0.0466	0.7184
MBGend*SusCompIncen	0.0260	0.8003
MBGend*Year	0.0084	0.9331
SBGend*MBSize	-0.0487	0.2262
SBGend*SBSize	-0.0175	0.1398
SBGend*DebtRatio	-0.5687	0.0744*
SBGend*LogTA	0.0274	0.4989
SBGend*ROA	0.7742	0.3870
SBGend*SBMeetings	0.0000	0.5793
SBGend*SBIndependence	0.1476	0.3293
SBGend*CSRCommittee	0.2195	0.0459**
SBGend*SusCompIncen	-0.0553	0.6351
SBGend*Year	0.0156	0.8807

Notes: *, **, *** represent significance levels of 0.10, 0.05, and 0.01, respectively. For definitions of the variables, please see Appendix A.

The regression equation is:

$$\begin{aligned} \text{ESG} = \alpha &+ \beta_1 \text{SBGend*CSRCommittee} + \beta_2 \text{MBGend} \\ &+ \beta_3 \text{SBGend} + \beta_4 \text{MBSize} + \beta_5 \text{SBSize} \\ &+ \beta_6 \text{DebtRatio} + \beta_7 \text{LogTA} + \beta_8 \text{ROA} \\ &+ \beta_9 \text{SBMeetings} + \beta_{10} \text{SBIndependence} \\ &+ \beta_{11} \text{CSRCommittee} + \beta_{12} \text{SusCompIncen} \\ &+ \text{Year FE} + \text{Industry FE} + \varepsilon \end{aligned} \tag{10}$$

These results imply that if a company has a CSR committee, women on the supervisory board have a higher impact on ESG performance. Since the CSR committee is a sub-committee of the supervisory board it is likely that when there is a higher percentage of women on the supervisory board, there are also more women on the CSR committee. The CSR committee would then act as an outlet for the female members to increase their positive influence and focus on policies and strategies positively affecting the company's ESG performance. Interestingly the coefficient for *SBGend* is no longer significant in model 10.

Table 10: Significant Interaction Terms Regressions

	ESG			
Independent Variable	Coefficient	p-value	Coefficient	p-value
Intercept	-0.4295	0.0024***	-0.3877	0.0061***
SBGend*DebtRatio	-0.5687	0.0744*		
SBGend*CSRCommittee			0.2195	0.0458**
SBGend	0.3146	0.0011***	0.0450	0.6138
DebtRatio	0.1115	0.2632	-0.0373	0.4231
CSRCommittee	0.1006	0.0000***	0.0469	0.1823
MBGend	0.1154	0.0303**	0.1060	0.0467**
MBSize	0.0042	0.4477	0.0051	0.3579
SBSize	0.0028	0.1542	0.0022	0.2499
LogTA	0.0397	0.0000***	0.0394	0.0000***
ROA	0.1276	0.2991	0.1295	0.2912
SBMeetings	0.0009	0.5369	0.0011	0.4564
SBIndependence	0.1334	0.0000***	0.1216	0.0000***
SusCompIncen	0.0298	0.0488*	0.0292	0.0527*
Year Effects	included		included	
Industry Effects	included		included	
N	305		305	
Adj. R^2	0.5495		0.5508	

Notes: *, **, *** represent significance levels of 0.10, 0.05, and 0.01, respectively. For definitions of the variables, please see Appendix A.

7. Conclusion

In my analysis, I examined what impact women on boards have on ESG performance in the German two-tier system. For a sample of 157 DAX, MDAX and SDAX companies over a period of 2 years, I find that the presence of women on management boards as well as supervisory boards increases ESG performance. This relationship applies to both the percentage of women and the absolute number of women on the boards.

Further, the theory that women only have an impact on ESG performance once a critical mass of women has been reached has also been tested. However, no evidence to support that theory could be found in the data. In contrast to previous literature, I showed that even the inclusion of a single women, often referred to as a 'token women' has a significant and positive impact on ESG performance.

The analysis of the data failed to confirm that having a female CEO has a significant impact on ESG performance. However, it is not appropriate to conclude that female CEOs do not have a positive impact on sustainability or that the critical mass theory does not hold for German companies. Rather, there are too few CEOs and too few management board members in the sample companies who have reached the hypothetical critical mass of women to be able to make a statement about how this affects the sustainability of the company in question.

Two important findings emerge from this study: firstly, that women in management positions can greatly improve the sustainability of a company. Secondly, the proportion of women in management positions, both as CEOs and as members of the management board, is significantly underrepresented. The situation is more favourable on supervisory boards, but here often only the legal minimum is met. With the introduction of FüPoG I and FüPoG II, the first steps were taken to increase the proportion of women on supervisory boards to 30 per cent and on management boards with more than three members to at least one woman. However, these laws only apply to a small number of German companies that fulfil certain size criteria. In recent years, there has also been an increase in the number of women on these committees. In this respect, the FüPoG I and FüPoG II not only strengthen the position of women at the management level but are also expected to contribute to sustainability. If the critical mass theory is correct, which can be assumed according to the current state of research and which cannot be refuted in the context of my study, further regulation is required. With the FüPoG II only requiring companies to include one woman on the management board, the proportion of women, especially on large

management boards, will not be significantly increased. The FüPoG II thus goes just so far as to ensure that a woman is on the board when a certain board size is reached; although I found that even one woman has a positive effect on sustainability, critical mass theory that was shown to be true in previous research should not be disregarded. It would therefore be desirable to increase the minimum quota for women on management boards further, to include more women in top management positions.

Two main limitations could not be addressed as part of the robustness tests. Firstly, the small sample size and thus the small number of female CEOs and companies with several women on the board. An observation period of more than two years would also have been desirable, particularly following the entry into force of FüPoG II. Secondly, the high subjectivity of the operationalisation of ESG performance through the ESG scores. Here, ESG scores from other data providers, such as Bloomberg, could have been used as a dependent variable to check whether the results are robust to this change in variable measurement. However, as I did not have this data available, this robustness test was not performed.

Companies must face up to the challenges posed by climate change and develop sustainable strategies to remain competitive and environmentally and socially responsible in the long term. On the one hand, research clearly shows that women have a positive influence on many financial and non-financial performance metrics and that companies should therefore be motivated to appoint more women to management positions. On the other hand, it also shows that legislative action is necessary to increase the proportion of women, as in many cases companies do not appoint women to the management and supervisory boards beyond the legal minimum. Further research is needed into the conditions that must be in place for the positive effect of women to unfold. This includes, for example, the association between increasing debt levels and the decreasing positive effect of women on the supervisory board on sustainability, which was found in this study. Gaining further insights could also lead to an increase in the proportion of women in companies, as the findings should motivate those responsible to utilise the positive influence that women have to the benefit of the company's shareholder and stakeholders.

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