

When more is not always better: Non-linear and governance-layer effects of female representation on ESG performance

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Abstract

This study investigates whether more female representation always leads to better ESG performance using European STOXX 600 firms from 2010 to 2023. Across firms, higher female representation in the top management team is associated with better ESG performance. We find limited evidence that this association is non-linear; if anything, the relationship appears to weaken at high levels of representation. Within firms over time, increases in board female representation weaken the positive association between top management female representation and ESG performance, suggesting substitution across governance layers. Overall, our findings suggest that more female representation is not always better for ESG performance.

Relevance to practice

The study highlights that adding more women to executive teams does not automatically improve ESG outcomes. Beyond numerical targets, firms should foster meaningful participation and cross-layer coordination between boards and management. Policymakers and organizations must design governance frameworks that empower diverse leadership to drive sustainability strategically and effectively.

Keywords

Top management team, female representation, gender diversity, ESG performance, corporate governance, board–management interaction

1. Introduction

Prior research finds that firms with high ESG scores tend to experience strong financial performance and access to finance (Luo and Bhattacharya 2006; Cheng et al. 2014; Eccles et al. 2014; Velte 2017). Therefore, understanding what drives a firm's ESG performance has long been a subject of academic interest, with corporate governance characteristics identified as important determinants (e.g., Shrivastava and Addas 2014; Martiny et al. 2024). Within these governance characteristics, female leadership has emerged as a notable factor, as researchers increasingly examine how women's participation in strategic and oversight roles influences firms' social and environmental outcomes (e.g., Manner 2010; Velte 2016; Romano et al. 2020). Many studies report a positive association

between female representation and ESG outcomes (e.g., Glass et al. 2016; Jiang and Akbar 2018; Naveed et al. 2021; Provasi and Harasheh 2021). However, other research reports mixed or insignificant effects (e.g., Rao and Tilt 2016), partly reflecting differences in data sources and ESG rating providers (Aabo and Giorici 2023). Moreover, several studies emphasize the importance of a critical mass effect, suggesting that a meaningful influence emerges only when women constitute around 30% of board members or more than three individuals (Post et al. 2011; Joubert 2022; Al-Shaer et al. 2024). Thus, while greater female representation in leadership is generally viewed as beneficial, it remains unclear whether more is always better. In this paper, we ask the following

question: *Is greater female representation in leadership roles always linked to higher ESG performance?*

Despite progress in recent years, women remain underrepresented in corporate leadership positions. According to the European Institute for Gender Equality (EIGE 2024), women held 33.8% of board seats across the European Union in 2023, but only 22.2% of top management roles, highlighting a persistent gap in executive representation between the two layers. This gap implies that female leadership is not uniform across governance layers, with women serving on boards and in top management teams likely affecting ESG strategies through different decision-making processes. We specifically focus on top management teams (TMTs), defined as the group of a firm's most senior leaders, typically holding C-suite or equivalent positions, who directly influence the firm's policies, performance, and strategic direction. TMTs play an important role in translating the board's ESG objectives into actionable plans, managing relevant KPIs, and overseeing the flow of ESG-related information. In particular, key executives, such as the Chief Financial Officer or Chief Sustainability Officer, can improve the quality of sustainability reporting (Thun and Zülch 2023) and strengthen ESG policies (Peters et al. 2019).

Using multiple regressions on a sample of STOXX 600 companies, we examine two aspects:

- 1) The non-linear effects of female representation in TMT on ESG performance, and;
- 2) The role of female representation across governance layers (TMT vs. board).

Overall, our findings provide limited evidence that the positive impact of female representation in the TMT diminishes as the number of women increases, and more robust evidence that strong female representation on the board lessens the additional effect of having more women in the TMT—highlighting that more is not always better.

2. Literature review and hypotheses

2.1. Upper echelons theory and TMT

According to upper echelons theory (Hambrick and Mason 1984), a company's strategic decisions and organizational outcomes partly reflect the characteristics of its TMT, including tenure, gender, work experience, and educational background. For instance, TMT heterogeneity can foster diverse ideas, perspectives, and expertise in strategic decision-making, leading to greater innovation (Bantel and Jackson 1989) and better financial performance (Carpenter 2002). Multiple studies suggest that women in leadership roles tend to be more socially-oriented and place more emphasis on the discretionary elements of CSR (Ibrahim and Angelidis 1994; Burgess and Tharenou 2002). Consequently, a gender-diverse leadership team is more likely to consider the long-term

interests of a broader range of stakeholders and to promote stronger ESG performance.

2.2. Female representation in TMT and ESG performance

Prior research highlights that various CEO characteristics play an important role in shaping firms' social responsibility strategies (e.g., Huang 2013; Lewis et al. 2014; Tang et al. 2015). Empirical evidence indicates that TMTs with higher female representation, or specifically firms led by female CEOs, tend to exhibit higher ESG performance, likely due to more inclusive decision-making and greater sensitivity to stakeholder concerns (Jiang and Akbar 2018; Hyun et al. 2022; Chiao et al. 2024; Huang et al. 2025; Yahya 2025). However, these findings are not uniform, as some studies report insignificant or even negative relationships with certain ESG dimensions, showing weaker associations (Dong et al. 2025; Sandretto et al. 2025; van den Eijnde 2025). This inconsistency suggests that a higher proportion of women in TMTs is not always better, as the effect may depend on contextual factors such as the initial level of female representation or the interaction between different governance layers.

2.3. Hypotheses development

Although prior studies generally find a positive link between female leadership and ESG performance, several have proposed the existence of a critical mass of female leaders needed to drive meaningful changes (Konrad et al. 2008). Specifically, reaching a threshold of around three female board members can enhance ESG disclosure and outcomes (Post et al. 2011; De Masi et al. 2021; Al-Shaer et al. 2024).

Kanter (1977) describes individuals from underrepresented groups, such as women, as "tokens" in predominantly homogeneous settings. These individuals often face pressure to conform and may respond through isolation, self-distortion, or reduced visibility. Because women occupy a smaller share of TMT positions compared to board seats, they face even greater pressures to blend in, which may undermine their ability to influence sustainable strategies effectively. This dynamic may change once female representation reaches a critical mass. Critical mass theory posits that while a single woman in leadership is unlikely to influence a firm's strategy, a group of women can do so by providing mutual support, fostering confidence, and increasing the likelihood that their ideas are heard (Konrad et al. 2008). Empirical studies directly examining critical mass in the context of female representation in TMTs and sustainability practices show that significant improvements in voluntary carbon disclosure (Caby et al. 2024), reductions in ESG misconduct (García-Meca and Martínez-Ferrero 2025), and enhancements in corporate social performance (Jouber 2022) occur when women constitute at least 30% of the TMT or exceed three members. However, other studies, such as

Cook and Glass (2018), find that even one or two female directors can be associated with improvements in a firm's CSR policy.

Beyond a certain point, the resources and perspectives contributed by additional women in leadership may become redundant, reducing the marginal benefits of further female representation. Consistent with this view, Meng and Zhu (2024) find an inverted U-shaped relationship between the proportion of female executives and ESG performance, with a turning point around 33%, suggesting a potential over-saturation effect of TMT female representation. Similarly, Birindelli et al. (2018) report an inverted U-shaped relationship between female board representation and banks' ESG performance, indicating that gender-balanced, rather than female-dominated, boards are most effective for sustainability outcomes.

When a perspective becomes dominant rather than complementary, it loses its distinctive influence on strategic priorities. As ESG considerations become more institutionalized and less contested, they may receive less incremental attention and cognitive diversity, potentially leading to a deterioration in associated performance. First, because decision-makers' actions depend on the issues they focus on (Ocasio 1997), if ESG performance becomes taken for granted because of high female representation, it may receive less incremental attention and could be overlooked. Second, as female representation increases, decision-makers can become more homogeneous, especially because women would not be considered tokens anymore and could even become dominant. This could reduce debate and cognitive stimulation, implying possible negative marginal effects at high levels of similarity (Milliken and Martins 1996). Corroborating this perspective, prior studies show that gender-diverse teams often outperform female-dominated teams, which can suffer from emotional overload and insufficient cognitive contrast (e.g., Wegge et al. 2008; Apesteguia et al. 2012).

Given these contrasting perspectives, we argue that the relationship between female representation and ESG performance could be either convex or concave, or both. We remain agnostic about the specific form and only hypothesize that a non-linear relationship exists:

H1: Female representation in TMTs has a non-linear relationship with ESG performance.

Corporate governance encompasses both boards and TMTs, with TMTs responsible for implementing ESG strategies under board oversight. While the gender composition of TMT may influence ESG performance, its effect could be shaped by board composition. Yet, the interaction between these two layers remains underexplored. This issue is particularly relevant because female representation on boards also contributes to stronger ESG performance (e.g., Galbreath 2011; Boulouta 2013; Velte 2016; Provasi and Harasheh 2021), raising the question of how female representation across both layers jointly affects ESG outcomes.

The relationship between board and TMT diversity can be conceptualized as additive, complementary, or substitutive:

- 1) If female representation on the board and TMT is *additive*, their contributions to ESG performance are independent, meaning that each layer adds value on its own without interacting with the other. This implies that firms could improve ESG performance simply by increasing female representation in either governance layer, without considering how the two layers interact.
- 2) A *complementarity* perspective suggests that joint female representation enhances organizational outcomes more than either layer alone (Ennen and Richter 2010). Consistent with critical mass theory, a board with high female representation can create a supportive environment for female TMT members, reducing the pressures of being a "token" and fostering alignment on ESG goals. In addition, diverse boards are better positioned to provide resources, regulatory insights, and industry expertise, which can facilitate TMT-led sustainability initiatives and improve overall ESG performance.
- 3) A *substitution* effect may arise when the two governance layers perform overlapping strategic functions, so that female representation in one layer reduces the marginal benefit of representation in the other. According to resource dependence theory (e.g., Hillman et al. 2000), if a gender-diverse board already provides ESG-related resources, the additional contribution of TMT female representation may be limited.

Empirical studies on joint female representation on boards and TMTs produce mixed results. For instance, firms with high female representation in both layers tend to exhibit higher innovation (Wu et al. 2022), whereas employee productivity increases particularly when the TMT includes female representation but the board does not (Luanglath et al. 2019). These findings support the idea that greater board female representation can expand the scope of TMT actions, helping them navigate complex environments (Kim et al. 2009), but they also point to potential redundancy. Given these competing perspectives, we formulate the hypothesis in null form:

H2: Board female representation does not moderate the relationship between TMT female representation and ESG performance.

3. Sample and variables

We have selected firms from the STOXX 600 Index, following prior studies (e.g., Bifulco et al. 2023; Priem and Gabellone 2024). The index includes 600 listed firms across 17 European countries, providing a broad and diversified representation of European corporate

activity. The sample reflects the index composition as of March 1, 2025. ESG, corporate governance and financial variables are obtained from the London Stock Exchange Group (LSEG, formerly Refinitiv) for the period 2010–2023, as firms disclosed little non-financial information before 2010 (Lin et al. 2024) and the quality of ESG data was also limited at that time (Bermejo Climent et al. 2021).

The dataset initially includes 8,400 firm-year observations; after excluding those with missing values, 6,701 remain. To assess potential sample selection bias arising due to missing data, we compare included and excluded observations on key firm characteristics (company size, ROA, and leverage) using unpaired t-tests. Untabulated results indicate that firms with missing data are significantly smaller and exhibit higher asset profitability.

We present definitions of all our variables in Table 1. The primary dependent variable is the ESG score (ESGS). Developed by LSEG, this measure evaluates a company's relative ESG performance, commitment, and effectiveness across ten key categories, based on self-reported data (LSEG Data & Analytics 2024). The ESG score aggregates three pillars (Environmental, Social, and Governance) capturing performance across these dimensions. Scores range from 0 to 100, with higher values indicating stronger ESG performance and greater transparency

The moderating variable, board female representation, is measured as the proportion of female directors on the board (FBOD). This variable is also included as a control variable. Other control variables account for firm characteristics that may influence ESG performance beyond FTMT and FBOD. They include firm size (SIZE) (Drempetic et al. 2020), profitability (ROA) and leverage (LEV) (Campbell 2007). We also control for corporate governance characteristics such as CEO duality (DUAL) and board size (NBOD). Finally, we control for the presence of CSR or sustainability committee (CSRC).

Table 2 reports descriptive statistics for all variables. The average ESG score (ESGS) is 64.2, while the environmental (ENS) and social (SOS) pillar scores are slightly higher than the overall ESG score. The wide range between the minimum (2.69) and maximum (95.9), combined with a high standard deviation, indicates substantial heterogeneity in ESG performance among European listed firms. The mean and median female representation in the TMT (FTMT) are 15.1% and 14.3%, respectively, which are substantially lower than the corresponding figures in the board (FBOD, 28.6% and 30%). These results indicate that women are under-represented in TMT relative to boards, consistent with EU reports and quota regulations.

Table 1. Variable definitions.

Type	Name	Definition
Dependent variables	ESGS	LSEG ESG score
	ENS	LSEG Environmental pillar score
	SOS	LSEG Social pillar score
Main independent variable	FTMT	Percentage of female executives
Moderating and control variable	FBOD	Percentage of female board members
Control variables	SIZE	Natural logarithm of total assets (in euro)
	ROA	EBIT scaled by total assets
	LEV	Total debt scaled by total assets
	DUAL	Dummy variable equal to 1 if the CEO simultaneously serves as board chair, and 0 otherwise
	NBOD	Natural logarithm of the total number of board members
	CSRC	Dummy variable equal to 1 if the firm has a committee related to CSR, ESG, or sustainability, and 0 otherwise

Note: this table defines all variables used in the regressions.

in reporting on material ESG issues. Because female representation in top management may influence ESG outcomes through pillar-specific mechanisms, its effects need not be uniform across ESG dimensions. Consistent with prior evidence that TMT female representation positively affects social scores but may negatively influence environmental scores (Dong et al. 2025), we also consider the environmental (ENS) and social (SOS) pillar scores as alternative dependent variables. The governance pillar score is excluded because it might incorporate gender diversity indicators (i.e., female representation), which could introduce reverse causality concerns.

Top management female representation, the independent variable of interest, is measured as the percentage of women in the top management team (FTMT).

Table 2. Descriptive statistics.

	Obs.	Mean	Median	Std. Dev.	Min.	Max.
ESGS	6701	64.2	67.5	17.8	2.69	95.9
ENS	6701	65.2	70.3	23.3	0	99.1
SOS	6701	67.2	71.8	20.7	1.56	98.5
FTMT	6701	15.1	14.3	13.6	0	100
FBOD	6701	28.6	30	13.7	0	75
SIZE	6701	16.4	16.2	1.73	10.6	21.7
ROA	6701	6.0	5.13	5.02	-0.84	18.0
LEV	6701	24.8	23.9	15.2	0.01	132
DUAL	6701	0.119	0	0.324	0	1
NBOD	6701	2.37	2.4	0.34	0.69	3.64
CSRC	6701	0.832	1	0.374	0	1

Note: this table presents descriptive statistics for all variables used in the regressions.

The variable NBOD, representing the natural logarithm of the number of board members, has a mean of 2.37 and varies between 0.69 and 3.64. Approximately 83% of firm-year observations report the presence of a CSR committee (CSRC), while only 11.9% exhibit CEO duality (DUAL). The average firm size (SIZE) is 16.4, with an average ROA of 6.0%. Leverage (LEV) averages 24.8%, suggesting a moderately leveraged capital structure, though some firms exhibit substantially higher leverage levels.

4. Results

4.1. Baseline regressions

Before presenting the main results, we first test whether a higher proportion of women in the TMT is positively associated with ESG performance by estimating the following regressions:

$$\text{ESGS}_{it} \text{ or } \text{ENS}_{it} \text{ or } \text{SOS}_{it} = \beta_0 + \beta_1 \text{FTMT}_{it} + \text{Controls}_{it} + \text{Fixed effects} + \varepsilon \quad (1)$$

Controls include all variables identified as control variables in Table 1, including FBOD. All regressions include year fixed effects, and depending on the specification, either industry or firm fixed effects. While firm fixed effects control for time-invariant firm-specific characteristics, industry fixed effects only capture differences across

sectors and do not account for heterogeneity among firms operating within the same industry. Controlling at least for industry is relevant, as firms in sensitive industries tend to exhibit higher ESG performance (Garcia et al. 2017). Firm fixed effects might be more appropriate, but they could be overly conservative given the limited within-firm variation in female representation. The results are reported in Table 3.

With industry fixed effects (Columns (1), (3), and (5)), the coefficients of FTMT are consistently positive and significant (p-value < 0.01 in Columns (1) and (5), p-value < 0.05 in Column (3)). A 10-percentage-point increase in FTMT is associated with a 1.260-point rise in ESGs. This result is consistent with previous research using industry fixed-effects models (e.g., Hyun et al. 2022; Sandretto et al. 2025). When firm fixed effects are introduced (Columns (2), (4), and (6)), the coefficients become smaller and even significantly negative in Column (6) (p-value < 0.05). Overall, the difference between industry and firm fixed-effects results suggests that the positive association between TMT female representation and ESG performance reflects stable differences across firms, rather than within-firm changes over time. In other words, raising TMT female representation in an individual firm does not necessarily translate into improved ESG performance. The negative coefficient observed for the social pillar under firm fixed effects further indicates that the effect of within-firm changes in female representation may vary across ESG dimensions.

Table 3. Baseline regressions.

	ESGS		ENS		SOS	
	(1)	(2)	(3)	(4)	(5)	(6)
FTMT	0.1260*** (0.0239)	0.0222 (0.0203)	0.0973** (0.0464)	-0.0367 (0.0274)	0.1084*** (0.0269)	-0.0525** (0.0260)
FBOD	0.1292*** (0.0336)	0.1310*** (0.0223)	0.1752*** (0.0414)	0.0733** (0.0306)	0.0959** (0.0447)	0.0974*** (0.0288)
SIZE	5.5614*** (0.4190)	4.8893*** (0.8439)	6.4693*** (0.5810)	6.5191*** (1.1310)	5.8904*** (0.5083)	4.7406*** (1.2312)
ROA	0.1005 (0.0903)	0.0108 (0.0411)	0.1315 (0.1667)	-0.0119 (0.0601)	0.2643** (0.1122)	0.0773 (0.0603)
LEV	0.0154 (0.0442)	-0.0686*** (0.0260)	0.0580 (0.0571)	-0.0266 (0.0375)	0.0228 (0.0506)	-0.1139*** (0.0357)
DUAL	-1.5591 (1.0449)	-1.5428** (0.7596)	2.3368* (1.2206)	-1.1878 (0.9730)	0.6866 (1.2746)	-0.7745 (1.0483)
NBOD	2.8309** (1.1748)	3.2161** (1.5068)	5.9666*** (1.9677)	4.6885** (1.9062)	6.3735*** (1.8535)	5.8920*** (1.6486)
CSRC	13.9484*** (1.2332)	8.4771*** (0.8117)	16.2321*** (1.8791)	10.7175*** (1.1652)	13.0039*** (1.4043)	8.9008*** (1.0774)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	No	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes	No	Yes
Observations	6701	6701	6701	6701	6701	6701
R ²	0.597	0.861	0.546	0.848	0.517	0.823

Notes: standard errors are reported in parentheses. Statistical significance is indicated by: * p < 0.10, ** p < 0.05, and *** p < 0.01. Industry fixed effects are included by grouping firms into the 74 categories defined under the Global Industry Classification Standard (GICS). The results are similar if we consider the ESG scores in the next year.

4.2. Non-linear effects of female representation on ESG performance

To test H1, we estimate a polynomial regression model specified as follows:

$$\text{ESGS}_{i,t} \text{ or } \text{ENS}_{i,t} \text{ or } \text{SOS}_{i,t} = \beta_0 + \beta_1 \text{FTMT}_{i,t} + \beta_2 \text{FTMT}_{i,t}^2 + \text{Controls}_{i,t} + \text{Fixed effects} + \varepsilon \quad (2)$$

The results are presented in Table 4. Across Columns (1) to (6), the coefficients of FTMT are mostly positive, but statistically significant only when industry fixed effects are used in Columns (1), (3), and (5). The coefficients of FTMT² are negative, reaching significance only in Column (1) with industry fixed effects (p-value < 0.1), suggesting that the impact of increasing female representation in TMTs diminishes across firms. For this column, the maximum effect is reached at FTMT = 56 (max 0.2017 FTMT - 0.0018 FTMT²), which largely exceeds the value of most observations as the mean of FTMT is 15.1 and its standard deviation is 13.6. Thus, while adding women is not detrimental before this threshold, the incremental benefits decrease as female representation rises. A similar pattern is observed in Column (2) when firm fixed effects are included, with the maximum effect reached at 35, although the coefficient of the FTMT² term is insignificant.

Table 4. Polynomial regressions.

	ESGS		ENS		SOS	
	(1)	(2)	(3)	(4)	(5)	(6)
FTMT	0.2017*** (0.0576)	0.0559 (0.0395)	0.1553* (0.0827)	-0.0159 (0.0525)	0.1811** (0.0726)	0.0061 (0.0492)
FTMT ²	-0.0018* (0.0011)	-0.0008 (0.0008)	-0.0014 (0.0016)	-0.0005 (0.0010)	-0.0018 (0.0014)	-0.0014 (0.0010)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	No	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes	No	Yes
Observations	6701	6701	6701	6701	6701	6701
R ²	0.598	0.861	0.546	0.849	0.518	0.823

Notes: standard errors are reported in parentheses. Statistical significance is indicated by: * p < 0.1, ** p < 0.05, and *** p < 0.01. Industry fixed effects are included by grouping firms into the 74 industry categories defined under the Global Industry Classification Standard (GICS).

Table 5. Moderating effect of board female representation.

	ESGS		ENS		SOS	
	(1)	(2)	(3)	(4)	(5)	(6)
FTMT	0.2047*** (0.0703)	0.1465*** (0.0431)	0.2244** (0.1102)	0.1321** (0.0550)	0.1823** (0.0819)	0.0810 (0.0555)
FBOD	0.1624*** (0.0448)	0.1832*** (0.0287)	0.2288*** (0.0560)	0.1443*** (0.0404)	0.1271** (0.0573)	0.1535*** (0.0366)
FTMT × FBOD	-0.0024 (0.0018)	-0.0038*** (0.0011)	-0.0039 (0.0026)	-0.0051*** (0.0015)	-0.0023 (0.0022)	-0.0041*** (0.0015)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	No	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes	No	Yes
Observations	6701	6701	6701	6701	6701	6701
R ²	0.597	0.862	0.547	0.850	0.518	0.824

Notes: standard errors are reported in parentheses. Statistical significance is indicated by: * p < 0.10, ** p < 0.05, and *** p < 0.01. Industry fixed effects are included by grouping firms into the 74 industry categories defined under the Global Industry Classification Standard (GICS).

To complement the polynomial analysis, we also conduct untabulated regressions to examine whether the effect of FTMT varies across different thresholds. Specifically, we regress ESGs on FTMT, an indicator variable equal to one if FTMT exceeds a given threshold, and the interaction between FTMT and this indicator. The thresholds considered are 10, 15, 20, 25, 30, 35, and 40. We find that the interaction term is consistently negative but not statistically significant, implying no meaningful difference in the effect at higher thresholds.

Because the coefficients are largely insignificant, we do not provide unambiguous support for H1 and do not conclude that the relationship between female representation in TMTs and ESG performance is non-linear.

4.3. Comparing the role of female representation across governance layers

To test H2, we estimate the following model including the interaction between FTMT and FBOD:

$$\text{ESGS}_{i,t} \text{ or } \text{ENS}_{i,t} \text{ or } \text{SOS}_{i,t} = \beta_0 + \beta_1 \text{FTMT}_{i,t} + \beta_2 \text{FBOD}_{i,t} + \beta_3 \text{FTMT}_{i,t} \times \text{FBOD}_{i,t} + \text{Controls}_{i,t} + \text{Fixed effects} + \varepsilon \quad (3)$$

The results are presented in Table 5. In Columns (1) and (2), the coefficients of the interaction term are negative, but only significant in Column (2), which uses firm

fixed effects (p -value < 0.01). We find consistent results in Columns (4) and (6) for our dependent variables ENS and SOS. The significant negative interaction with firm fixed effects indicates that, within firms over time, increases in board female representation weaken the association between TMT female representation and ESG performance. A one-standard-deviation increase in TMT female representation is associated with a change in ESG performance of 1.99 when board female representation is zero ($13.6 \times (0.1465 - 0.0038 \times 0)$), 1.22 when board female representation is 15, 0.44 when board female representation is 30, and -0.33 when board female representation is 45, all other things equal. Overall, our results suggest that when both governance layers have high female representation, their influence on ESG outcomes may partially overlap, reducing the marginal effect of additional representation in one layer. Therefore, we reject H2.

5. Discussion

This paper investigates how female representation within top management teams is associated with ESG performance in European firms, with particular attention to potential non-linear effects and cross-layer interactions with boards. The study employs fixed-effect models using panel data from companies in the STOXX 600 Index between 2010 and 2023. We have used the percentage of women in the executive team as a proxy for TMT female representation, and measured ESG performance using ESG scores from LSEG. After establishing that higher female representation is associated with higher ESG performance across firms but not within firms over time, our main results are twofold.

First, there is only limited evidence of a non-linear relationship between female representation in TMTs and ESG performance. As the proportion of women increases, the improvement in ESG performance becomes marginally smaller but the coefficients are mostly not significant. If anything, our results provide no evidence in support of critical mass theory (Jouber 2022; Caby et al. 2024), which would predict a convex, rather than concave, relationship. In contrast, our results would be more consistent with the findings of Meng and Zhu (2024), who identify an inverted U-shape relationship between female representation in TMTs and ESG scores in a Chinese sample.

Second, we find that the positive association between TMT female representation and ESG performance is weaker when the board includes a higher proportion of women, suggesting a potential substitution effect between the roles of female directors and executives. This indicates that the non-linear effect of TMTs mostly operates across governance layers, and not within. More broadly, these findings enhance our understanding of how female representation interacts across different layers of corporate governance, contributing to the literature on the interdependence of those layers (Luciano et al. 2020). This

could also help reconcile mixed findings in the existing literature. For instance, following the EU Directive on Gender Balance on Corporate Boards, European boards tend to have higher female representation than boards in other regions of the world. This higher baseline implies that the marginal impact of additional women in TMTs may be lower in Europe, which can help explain regional differences in results. We therefore encourage future research to more systematically consider how institutional contexts make each setting unique, potentially shaping observed relationships and outcomes. This observed pattern of diminishing returns also raises important theoretical questions about how and under what conditions female representation translates into organizational outcomes, which future research could further explore.

From a practical perspective, the observed offsetting effect between the TMT and the board suggests that increasing female representation across governance layers does not automatically generate synergies, as overlapping roles or conflicting dynamics may limit the overall benefits. Organizations should therefore aim to foster a context-sensitive and gender-balanced leadership structure that goes beyond numerical representation to consider the specific roles, responsibilities, and interactions of female leaders. Equally important is ensuring alignment between the board and the TMT to promote cohesive decision-making and reduce governance frictions that could hinder ESG performance.

This study has several limitations, which also open avenues for future research. First, while we examine the overall relationship between female representation and ESG performance, we do not investigate the underlying mechanisms through which strategic objectives are translated into concrete practices that drive ESG outcomes. Distinguishing the influence of key leadership positions, such as CEOs, CFOs, or CSOs—whose responsibilities are more directly linked to ESG—could provide a clearer understanding of how gender diversity translates into improved performance. Future research should also explore how sustainability strategies are differently designed and operationalized by women in practice. These questions may be particularly well suited for qualitative approaches, such as interviews or case studies, which can capture the processes and decision-making dynamics that quantitative analyses alone cannot fully reveal.

Second, while we empirically treat critical mass theory and diminishing marginal effects of women as opposing mechanisms, both may coexist in practice. It is possible that a minimum level of female representation is required to generate an effect, after which the marginal influence of additional women declines. We do not explicitly consider this possibility, although we remain cautious in interpreting our results. What our analyses indicate is that, in our data, a diminishing marginal influence of women, as captured by a second-degree polynomial specification and untabulated threshold regressions, is more prevalent than evidence consistent with the need of a critical mass.

Third, we acknowledge that our findings regarding governance layers may partly reflect that some women

serve on both the TMT and the board. While we cannot account for this potential double counting in our sample, future research could examine whether the results hold in

settings where TMT and board memberships are clearly distinct, providing a cleaner test of the interplay between women across governance layers.

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