

With a Little Help from Her Friends? Gendered Networks and ESG Governance

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Abstract

The role of women directors in corporate sustainability remains debated, and the evidence is mixed and often non-linear. We study a feature this debate has overlooked: the gender composition of the external networks female directors bring to the board. On a panel of S&P 500 firms from 2010 to 2023, we use a stacked difference-in-differences design that treats peer ESG enforcement penalties as shocks to the salience of sustainability risk. The gender balance of female directors' outside ties shapes the firm's response in an inverted U: firms whose directors hold a balanced mix of male and female peers improve their environmental performance, while those isolated in male networks or concentrated in female ties do not. The effect runs only through long-standing ties and is absent for financial performance, indicating that accumulated relational trust, not fresh information, is the operative channel. Beyond the number of women on the board, the structure of their networks shapes whether diversity translates into sustainability action.

Keywords: gender diversity, director networks, ESG governance, peer effects, trust capital.

JEL codes: G30, G34, L25, M14.

1. Introduction

Whether and how the gender composition of corporate boards should be regulated is among the most contested questions in corporate governance, and the law is moving in opposite directions across jurisdictions. The European Union has chosen mandates. EU's Women on Boards Directive, agreed in 2022, requires large, listed firms to fill at least 40 percent of their non-executive board seats with members of the under-represented sex by the middle of 2026, building on the binding quota that Norway pioneered in 2003. The United States has moved the other way. In 2022 a California court struck down the state's law requiring women on the boards of locally headquartered firms (*Crest v. Padilla*), and in 2024 the Fifth Circuit vacated the Securities and Exchange Commission's approval of Nasdaq's board diversity disclosure rule (*Alliance for Fair Board Recruitment v. SEC*).

Despite the polarizing landscape policymakers face, the academic evidence is also mixed. A substantial literature reports that firms with more women on the board achieve stronger sustainability outcomes (Atif et al., 2021; Ginglinger and Raskopf, 2023; Post, Rahman, and McQuillen, 2015), but the relationship is uneven in ways that are difficult to reconcile with a simple headcount account. It is non-linear: the benefits of female representation tend to appear only after a critical mass of roughly three women, for outcomes ranging from firm performance to carbon emissions (Joecks, Pull, and Vetter, 2013; Nuber and Velte, 2021). It is also conditional on the firm: gender-diverse boards monitor management more intensively, but the additional oversight raises value only where the firm is otherwise weakly governed and can reduce it where monitoring is already strong (Adams and Ferreira, 2009). Evidence of this kind has led some scholars to argue that uniform quotas are too blunt an instrument, because they impose a single headcount target on firms whose circumstances differ (Ahern and Dittmar, 2012; Adams, 2016). As such, the unresolved question is not only whether to add women but which women, and on what terms, actually change firm behavior, and this remains consequential for scholars and policymakers alike.

We answer this question through the lens of female directors' networks, which remains understudied in the current literature. Directors carry external inter-firm ties, accumulated through prior appointments and shared service, and these ties are consequential: they transmit corporate practice from firm to firm (Davis and Greve, 1997; Haunschild, 1993) and serve as conduits for valuable information (Haunschild and Beckman, 1998). Yet almost all of this evidence comes from boards that have been largely male-dominated and treats connections as gender-blind. We argue, however, that the gender distinction matters, as men and women exhibit different homophily, assemble differently composed networks, and obtain different returns from a given tie (Fang and Huang, 2017; Ibarra, 1992, 1997; Yang, Chawla, and Uzzi, 2019). If what flows through a network depends on its gender composition, a literature that measures ties without regard to gender may face difficulties explaining how female directors drive change through their networks.

We therefore study the gender composition of female directors' external board networks, that is, whether a director's outside ties run mainly to men, mainly to women, or to a balanced mix. We ask whether and how this composition shapes the firm's sustainability performance. Our study contributes to the ongoing debate on women's role in corporate sustainability outcomes (Byron and Post, 2016; Campopiano, Gabaldón, and Gimenez-Jimenez, 2023) and extends it beyond the number of women on the board to the networks in which they are embedded. The current literature has studied how director networks affect financial reporting practices, audit quality, and firm performance (Chiu et al., 2013; He et al., 2017; Larcker et al., 2013), but has yet to consider sustainability strategy as the outcome, or the gender composition of director networks, as a determinant of firm behavior (Bianchi et al., 2022).

How such composition affects corporate sustainability, *ex ante*, however, is not obvious. On one hand, the closure view in social capital theory might favor a female-dominated network. strong, repeated ties among similar people build trust. Trust is what lets practices grounded in shared values, rather than formal rules, spread from firm to firm, and corporate sustainability is such a practice (Coleman, 1988; Krackhardt, 1992; Uzzi, 1997). A female director whose ties run

mainly to other women sits within this kind of trusted circle, so a concentration of female ties could help her firm respond. On the other hand, the brokerage view holds the opposite: the most useful information comes from bridging separate groups, not from staying inside one (Burt, 1992, 2004). A director whose network folds in on other women alone misses that outside information, so a balance of male and female ties could serve the firm better.

We take this question to the data, studying S&P 500 firms from 2010 to 2023. One central empirical obstacle is selection: firms with stronger sustainability orientations may both recruit female directors with particular networks and pursue particular ESG strategies, so a cross-sectional association between network composition and sustainability could reflect sorting rather than influence. We mitigate this concern through a stacked difference-in-differences (DiD) design (e.g., Cengiz et al., 2019), which has several advantages. First, we exploit peer ESG enforcement penalties as plausibly exogenous shocks to the salience of sustainability risk: a penalty against an industry peer is a reputationally significant event that travels across firms through board ties (Kang, 2008; Karpoff, Lott, and Wehrly, 2005), and peer-firm actions are an established source of identifying variation (Cao, Liang, and Zhan, 2019; Leary and Roberts, 2014). Second, for each enforcement event we form a cohort of affected firms together with clean, not-yet-affected controls and stack these cohorts, which avoids the bias that contaminates staggered two-way fixed-effects estimates (Baker et al., 2022). Third, the stacked DiD design includes firm-by-cohort fixed effects, which absorb fixed differences across firms within each cohort such as corporate culture or stable governance traits, and cohort-by-year fixed effects, which nonparametrically absorb common time shocks within each cohort, so that the effect of the peer shock is estimated from within-firm variation (Gormley and Matsa, 2011). We combine interlocks from BoardEx, ESG scores from Refinitiv, financials from Compustat, and penalties from the Good Jobs First Violation Tracker (Raghunandan and Rajgopal, 2022) for 6,567 firm-years. Our moderator, *RelFem*, is the share of female directors' pre-existing external ties, those formed more than a year before the outcome and thus predetermined relative to the shock, that run to other women.

We report three findings. First, network composition shapes the response non-monotonically. The interaction of the peer shock with RelFem is positive and significant, with an interior optimum near one-third female-to-female ties and declines at both extremes; moving from the bottom to the top of the RelFem distribution shifts the response from deterioration to improvement, and the loss at the homophily extreme exceeds ten points of environmental performance. Male directors' networks show no such pattern, which rules out both a density-of-women account and a gender-neutral board-capital account and isolates the composition of female directors' ties as what drives the response. Second, the operative channel is accumulated relational trust, not fresh information. Splitting female ties by vintage, the entire effect runs through ties of at least three years; newly formed ties carry none. It strengthens when those long-standing peers serve at high-environmental-score firms and vanishes for peers in the focal firm's own sub-industry, ruling out industry-specific information. This asymmetry settles the closure-versus-brokerage debate at the board level in favor of closure: what moves sustainability practice is the history embedded in a tie, not the novelty of what it carries. Third, the channel is specific to sustainability. The moderation holds across the social, governance, and combined ESG pillars but does not activate for non-ESG peer events and does not extend to return on assets.

Our results speak to several literatures. First, we extend the literature on director networks. Prior work shows that a firm is likelier to manage earnings when tied to one that does (Chiu, Teoh, and Tian, 2013); social ties between auditors and audit committees shape audit quality (He, Pittman, Rui, and Wu, 2017); board centrality predicts performance (Larcker, So, and Wang, 2013); and director ties diffuse strategy and corporate social responsibility across firms (Cao, Liang, and Zhan, 2019; Fracassi, 2017). This work measures ties in the aggregate and emphasizes position, such as centrality, over composition. We show that what travels through an interlock is gendered: the same network structure carries different content depending on whose ties compose it, and the features that govern transmission are the gender composition and the vintage of the ties

rather than their centrality or count. This moves the conduit view from how connected a board is to whom its members are connected to (Bianchi, Causholli, Minutti-Meza, and Sulcaj, 2022).

We also contribute to the literature on board gender diversity. Decades of work ask whether and how women directors change firm outcomes, and the evidence is mixed and frequently non-linear, with effects that turn on critical mass and on firm circumstances (Adams and Ferreira, 2009; Joecks, Pull, and Vetter, 2013; Post and Byron, 2015). We reframe the question from how many women serve to how those women are connected, which offers one account of the unevenness: the same share of women produces different outcomes because the value of female representation depends on the gender composition of directors' external networks. Building on the within-gender connectivity construction of Owen, Temesvary, and Wei (2023), we supply a portable measure, RelFem, decomposed by tie vintage, that can travel to other reporting and governance settings (Nekhili, Javed, Nagati, and Manita, 2023; Srinidhi, Gul, and Tsui, 2011).

We also provide new evidence to the debate on closure versus brokerage in the social capital literature. One tradition locates the value of a network in closure, the dense and trusting ties that build and enforce shared norms (Coleman, 1988; Uzzi, 1997); the other locates it in brokerage, the bridging of disconnected groups that supplies novel information (Burt, 1992, 2004). Tests that separate the two are scarce, especially at the board level. Our vintage result provides one: because the effect runs entirely through long-standing ties and not at all through newly formed ones, it favors closure, indicating that what allows board networks to move sustainability practice is accumulated trust rather than fresh information (Krackhardt, 1992).

Finally, our results speak to the policy debate over board gender quotas. If the sustainability benefits of female representation depend on the composition and history of directors' networks rather than on presence alone, then mandates that raise headcount without regard to connection may deliver less than expected, since the relevant relational capital accumulates over years of shared service and cannot be created at appointment. As the European Union's

requirements take effect, what new female directors are connected to, and not their number alone, will shape whether the mandates change behavior.

2. Literature Review and Hypotheses

2.1. Board Networks as a Strategic Resource for Sustainability

Strategic-management research has long studied the board as a strategic resource of the firm, not merely as a monitoring device. Resource-dependence theory (Hillman, Cannella, and Paetzold, 2000; Hillman and Dalziel, 2003) and the board-capital tradition (Westphal, 1999) frame directors as conduits of human and relational capital—reputation, information access, and inter-firm connections—that the firm draws on to govern its strategic actions. The interfirm network literature gives this intuition empirical support: director ties diffuse governance practices, organisational behaviours, and strategic responses across firms (Davis and Greve, 1997; Haunschild, 1993; Shue, 2013; Westphal and Zajac, 1997), and recent evidence confirms that this diffusion logic extends to corporate sustainability, with peer firms shaping focal firms' CSR investments through shared board ties (Cao, Liang, and Zhan, 2019). For our purposes, the key implication is that the network a director carries into the boardroom is not merely a personal attribute, but a channel through which the firm learns from, compares itself with, and responds to its environment. (Haunschild and Beckman, 1998).

Empirically, however, this literature has worked with director ties at large, mostly on male-dominated boards. The distinctive question of how the structure of female directors' external ties shapes firm outcomes remains less developed. The closest precedent is Owen, Temesvary, and Wei (2023), who study director networks and gender in U.S. banking—a male-dominated setting— and show that the gender composition of board connections, not merely the count of female directors, carries information for firm performance. We build directly on their within-gender connectivity construction but redirect it in two ways: from financial performance to corporate sustainability strategy as the outcome, and from a single industry to the broad S&P 500

cross section, where peer ESG enforcement supplies plausibly exogenous variation in sustainability salience.

The composition of women directors' own external networks, however, has received little attention as a strategic resource. Research in the sociology of elite networks finds that high-achieving women assemble a distinctive dual structure: a homophilous female inner circle that carries gender-specific, tacit information, combined with diverse third-party ties. This suggests that neither pure homophily nor pure embeddedness in male networks is optimal (Yang, Chawla, and Uzzi, 2019). Work on women's board networks has emphasized access and status. Women have entered multi-board "inner-circle" positions, yet that access remains partly decoupled from interorganizational influence (Benton, 2021), rather than the strategic content of network composition. We take up that content directly, focusing on its gender balance.

Corporate sustainability has been studied as a board-level strategic function in this same tradition: boards allocate the attention, information, and political capital required to develop a coherent sustainability strategy (Cheng, Ioannou, and Serafeim, 2014; Flammer, 2013; Henisz, Dorobantu, and Nartey, 2014; Ortiz-de-Mandojana and Bansal, 2016; Walls, Berrone, and Phan, 2012). Beyond the boardroom, a large corporate-finance literature documents the external owners and pressures that push firms toward corporate social responsibility (Dyck, Lins, Roth, and Wagner, 2019; see Gillan, Koch, and Starks, 2021, for a review). A parallel literature links board gender diversity to stronger sustainability outcomes (Atif et al., 2021; Ginglinger and Raskopf, 2023; Liu, 2018; Post, Rahman, and McQuillen, 2015), but the empirical record is uneven: gains are non-linear (Joecks et al., 2013; Kanter, 1977; Nuber and Velte, 2021) and the diversity advantage attenuates under pressure (Arnaboldi et al., 2021). Recent work shifts the margin from headcount to relational portfolios: female directors bring distinctive external ties, not (only) distinctive preferences, into the boardroom (Adams and Funk, 2012; Ibarra, 1992, 1997; Kim and Starks, 2016; Matsa and Miller, 2013). This relational distinctiveness has independently observable governance correlates—female directors attend more diligently and serve more

frequently on monitoring committees (Adams and Ferreira, 2009), are appointed under selection patterns shaped by their external networks (Hillman, Shropshire, and Cannella, 2007), and their boards exhibit higher reporting quality (Srinidhi, Gul, and Tsui, 2011). The relational dimension, namely the structure of female directors' external networks, becomes the candidate strategic resource that the headcount literature has under-investigated.

2.2 Closure versus Brokerage in Female Networks

Within the social-capital literature, two competing logics describe how the gender composition of female directors' external ties should affect the firm's sustainability strategy. Same-gender ties are the empirical norm in professional networks. Homophily, the tendency of similar actors to associate, is among the most robust regularities in social structure (McPherson, Smith-Lovin, and Cook, 2001) and operates among corporate directors with measurable governance consequences (Nekhili, Javed, Nagati, and Manita, 2023). This is precisely why the composition of female directors' ties, rather than their sheer density, is the strategically relevant margin. The closure tradition (Coleman, 1988; Granovetter, 1985) emphasises that dense, repeated, within-group interaction builds trust and norm coordination, especially when relationships have meaningful duration. Krackhardt's (1992) restatement sharpens the point: the diffusion of change-laden, values-laden content, including sustainability practice, runs through strong ties of accumulated trust, not through structurally novel weak ones. Uzzi (1997) supplies the empirical anchor: embedded inter-firm ties carry finer-grained information than arm's-length exchanges because participants share a history. The brokerage tradition (Burt, 1992, 2004) holds the opposite: value flows from bridging structurally separated groups, delivering non-redundant information that homogeneous networks cannot.

The two logics generate a sharp aggregate prediction for the gender composition of female directors' external ties. At low values of female-to-female connectivity, where female directors are isolated in male networks, each additional female-to-female tie builds the trust and norm-

alignment capacity that closure emphasises, and the firm's sustainability strategy benefits. Beyond an interior optimum, however, female directors become increasingly concentrated in female-female homophily; at that point, insularity costs take over and the marginal benefit reverses. The prediction is an inverted U-shape in which gender balance is the strategically relevant margin.

Hypothesis 1. Network-balance effect on sustainability. The gender balance of female directors' external ties (RelFem) shapes the firm's sustainability response non-monotonically, following an inverted U-shape with an interior optimum.

This prediction extends critical-mass arguments (Kanter, 1977) that have so far documented inverted U-shape returns on the headcount margin (Nuber and Velte, 2021) to a previously unexamined relational margin—the composition, not just the count, of female directors' external connections. Network composition, however, has more than one strategically relevant dimension. Beyond the gender balance, female directors differ in whom their external ties reach, especially whether those ties extend to peers in senior governance positions in other firms, such as Chair, CEO, Lead Independent Director, and other top-tier roles. Resource-dependence accounts of board capital suggest that ties to high-status peers supply credibility, operational know-how, and agenda-setting capacity beyond what within-network composition alone can deliver (Hillman and Dalziel, 2003). We therefore expect an independent contribution from exposure to high-status female peers in shaping the firm's sustainability response.

Hypothesis 2. Influence endowment. Exposure to high-status female peers strengthens the firm's sustainability response.

2.3 Domain Specificity of the Network Channel

If gender-balanced female networks operate through an ESG-specific governance channel rather than through generic firm or board quality, the moderation should be content-bounded. That is, the effect should appear when the shock and the outcome concern sustainability, but not when firms face unrelated peer shocks or when the outcome is financial performance. We frame the

channel through an attention-based logic (Ocasio, 1997): boards allocate scarce attention to issues in proportion to their salience, and corporate ecological responses are driven by how salient an issue becomes rather than by the substance of any single event (Bansal and Roth, 2000). Peer ESG enforcement raises the salience of sustainability risk—reputationally significant penalties against peers travel across firms through board interlocks (Kang, 2008), and the stakeholder engagement literature locates the board’s strategic value in its capacity to translate externally observed ESG events into implemented sustainability practice (Henisz et al., 2014; Surroca et al., 2010; Walls et al., 2012). This attention-to-salience logic predicts that the network channel should activate on ESG-relevant salience broadly, while remaining silent on dimensions that are conceptually separate, such as non-ESG enforcement and financial-performance margins.

This logic delivers two testable predictions. First, peer enforcement events outside the ESG domain should not activate the network channel: under a generic “board-quality” or “board-attention” reading, any peer shock would mobilize a similar response. Second, the moderation should remain confined to corporate sustainability outcomes and should not extend to financial-performance margins. If female-network composition operates through an ESG governance channel, the gender balance of female directors’ external ties should moderate responses to ESG shocks without producing corresponding effects on financial performance. Because the channel responds to the salience of sustainability risk, the same logic carries a further, exploratory implication: the moderation should generalize across the ESG scorecard and, within environmental performance, concentrate in the operational margins a board can act on rather than in long-horizon innovation.

Hypothesis 3. Domain specificity. The network-balance moderation activates only on ESG-relevant peer events and outcomes; it does not extend to non-ESG enforcement events or to financial-performance margins.

3 Data and Methods

3.1 Sample and Data Sources

Our sample consists of S&P 500 firms observed annually from 2010 to 2023. The empirical study requires three data inputs. *Board network data and board characteristics*—director identities, appointment dates, inter-firm connections, and board-level attributes (board size, gender composition, director age and tenure, CEO duality, board independence, meeting frequency)—come from BoardEx (London Business School), the standard source for board-interlock research and the backbone of both our network-composition measures and the board-level controls used throughout. *Sustainability outcomes* come from Refinitiv (formerly Thomson Reuters Asset4), which provides comprehensive, independently compiled ESG pillar scores and, within the environmental pillar, three category sub-scores (emissions, resource use, and environmental innovation). *Firm financials and industry classification*—firm size (employees), return on assets (*ROA*), and the GICS industry and sub-industry codes used to define peer groups and the sub-industry $\times$ year fixed effects—come from Compustat. *Regulatory peer-shock data*, used as the source of exogenous variation in sustainability salience for identification, come from the Good Jobs First Violation Tracker (VT), matched to S&P 500 firms via SEC CIK codes. The final panel contains 6,567 firm-year observations across 494 unique firms (unbalanced). Because *RelFem* characterises the composition of *female* directors’ external networks, it is only defined for boards with at least one woman; the analysis therefore restricts to firm-years with a positive female board share (dropping the small set of all-male boards) and excludes a handful of implausibly large boards (more than 30 directors, flagged as BoardEx coding errors), leaving 6,036 firm-years in the estimation sample.¹

¹The reduction from the 6,567-firm-year panel to the 6,036-firm-year estimation sample reflects three steps: 211 firm-years with missing Refinitiv *EnvScore*, 315 all-male board-years dropped by the positive-female-share restriction, and 5 outlier board-years above the 30-director cap. Each step removes firm-years, not firms: every one of the 494 firms has at least one female director in at least one sample year, so no firm is dropped and the panel retains all 494 firms throughout.

3.2 Variables

3.2.1 Outcome variables: corporate sustainability.

The main dependent variable is the Refinitiv Environmental Score (*EnvScore*, 0–100, higher = stronger environmental management), which captures the firm’s revealed sustainability strategy along its environmental dimension. We anchor on *EnvScore* for three reasons. First, it is the most externally auditable and most investor-monitored component of the Refinitiv index—the dimension on which firms credibly demonstrate sustainability action to the market. Second, it has the largest cross-sectional variation among the Refinitiv pillars (SD = 26.0 vs. 17–20 for the others), maximising statistical power. Third, the identifying peer-shock variation is concentrated on environmental enforcement: although social violations are most numerous in the Violation-Tracker microdata, environmental violations dominate by dollar magnitude (\$77.9B vs. \$59.7B for social and \$61.2B for governance over 2010–2023; Appendix Table A2), and the $\geq \$1\text{M}$ peer-shock floor isolates the financially material events that the environmental pillar disproportionately drives.

The Refinitiv combined *ESG* score, the two remaining pillars (*SocialScore*, *GovernanceScore*), and the three environmental category sub-scores (*Emissions*, *Resource Use*, and *Environmental Innovation*) are used for robustness and sensitivity analysis—to verify that the headline pattern is not an artefact of the particular pillar we select, that it generalizes across the ESG scorecard, and to locate it within the environmental score (Table 5). As a complementary outcome on the financial-performance margin we use *ROA* (return on assets, winsorized at the 1st and 99th percentiles and expressed in percentage points),² which lets us verify that the network channel operates on sustainability rather than on profitability.

²We winsorize *ROA* at the 1st and 99th percentiles to limit the influence of outliers. Among the financial-performance measures available in Compustat for our sample, *ROA* has the fewest missing observations, which is why we adopt it as the financial-margin outcome; it is also a standard accounting measure of operating financial performance in the strategy literature (Waddock and Graves, 1997).

3.2.2 Board network structure: gender composition.

Our key independent variable captures the compositional structure of female directors’ external inter-firm networks, following the within-gender connectivity-index construction proposed by Owen, Temesvary, and Wei (2023) for board-network analysis; Appendix B details the construction of all network measures. *RelFem* is the mean proportion of female directors’ *pre-existing* external connections—ties established more than one year before t (tie age > 1 year), hence non-contemporaneous with the outcome—that go to other female directors:

$$\text{RelFem}_{ft} = \frac{1}{|\mathcal{F}_{ft}|} \sum_{i \in \mathcal{F}_{ft}} \frac{n_{i,t-1}^F}{n_{i,t-1}} \quad (1)$$

where $\mathcal{F}_{ft}$ is the set of female directors on firm f ’s board, $n_{i,t-1}^F$ is the number of director i ’s *pre-existing* connections (ties already in place more than one year before t) that run to other female directors, and $n_{i,t-1}$ is her total number of pre-existing external connections. Restricting attention to ties older than one year makes *RelFem* predetermined with respect to the contemporaneous peer shock and sustainability outcome, so the moderator reflects established relational capital rather than connections formed in response to the shock—addressing the endogeneity of network formation that is central to identifying director-network effects on governance (Fracassi and Tate, 2012). *RelMale* is defined analogously, as the mean share of male directors’ pre-existing external connections that run to other male directors—the parallel male-to-male homophily measure. Both measures are bounded $[0, 1]$. In our panel, *RelFem* has mean 0.246 (SD 0.117) and *RelMale* has mean 0.741 (SD 0.044). Figure 1 provides a stylized visual representation of three values of *RelFem* (low, balanced, high) to build intuition for the construct before the empirical analysis.

3.2.3 Exposure to high-status female peers.

RelFem captures the within-network *composition* of female ties; it treats a connection to a chief executive the same as a connection to a rank-and-file independent

director. To examine whether *absolute exposure* to high-status female peers carries information beyond network composition, we classify each peer director’s board role into a five-tier hierarchy of influence using the associated role title reported by BoardEx.³

We then define $HighStatusFem_{ft}$ as the firm-year mean across directors of the count of Tier-1–2 *female* peers in the director’s external network:

$$HighStatusFem_{ft} = \frac{1}{|B_{ft}|} \sum_{i \in B_{ft}} |\{a \in \mathcal{A}_{i,t-1} : tier_a \in \{1, 2\} \text{ and } female_a = 1\}|, \quad (2)$$

where B_{ft} is the set of directors on firm f ’s board in year t and $\mathcal{A}_{i,t-1}$ is director i ’s peer set. In the analytical panel, $HighStatusFem_{ft}$ has mean 0.82 (SD 1.28) and ranges up to 13.61. It correlates only modestly with $RelFem$ ($r = 0.36$): the two variables capture empirically distinct dimensions of female network exposure — the share of female peers in the focal directors’ networks versus the count of high-status female peers that the firm’s directors can access. We expect the two to retain independent moderating content (Table 6).

3.2.4 Identifying variation: the peer ESG shock.

The peer ESG shock is the source of exogenous variation we use to identify the effect of board network composition on sustainability outcomes. The indicator equals one if any other firm in the focal firm’s GICS sub-industry received any ESG-related regulatory penalty in year t (Equation 3), with the focal firm’s own violations excluded by construction:

$$PeerShock_{ft} = \mathbf{1} \left[\sum_{j \in GICS(f), j \neq f} N_{jt}^{ESG} \geq 1 \right], \quad (3)$$

³Tier 1 contains Chair, CEO, Lead Independent Director and Founder roles; Tier 2 contains President, COO, CFO, Managing Director, Vice Chair and Executive Director roles; Tier 3 contains committee chairs and senior partners; Tier 4 contains standard director and member roles (the default); Tier 5 contains honorary, emeritus and advisory positions. The tier-distribution table is reported in Appendix B.

where N_{jt}^{ESG} is the count of ESG enforcement events with a penalty of at least \$1M recorded against peer j in year t . We use a \$1M materiality threshold to focus on *salient*, economically meaningful peer events that plausibly reach the boardroom agenda. The shock is determined by other firms’ historical conduct and regulatory calendars—neither observable nor controllable by the focal firm—and the focal firm’s own violations are excluded (Gormley and Matsa, 2011). Peer-firm enforcement events of this kind have been shown to generate strong reputational and operational spillovers on otherwise unaffected industry peers (Karpoff, Lott, and Wehrly, 2005); in the environmental domain specifically, sanctions imposed on one firm exert general-deterrence effects that alter the behaviour of other firms in the same sector (Shimshack and Ward, 2005), making peer environmental enforcement a salient, sector-wide signal rather than a firm-idiosyncratic event. By raising the salience of sustainability risk on the boardroom agenda (Ocasio, 1997), such events supply the salience-driven variation that our identification exploits. As robustness, we report estimates across the dollar threshold (any amount, $\geq$ \$10M) and a non-ESG placebo (Table 4), a continuous log peer-penalty coding (Section 4.8), and we decompose the response across ESG outcome dimensions (Table 5).

3.2.5 Controls.

All regressions control for board composition and structure—gender ratio, board size, average director age and tenure, CEO duality, board meetings, and board independence—and for firm size (employees). Variable definitions and sources appear in Table 1; panel-level descriptive statistics in Table 2. In the baseline within-firm specifications, year and firm fixed effects absorb aggregate time trends and time-invariant firm heterogeneity. In the DiD specifications, firm and GICS sub-industry $\times$ year fixed effects absorb both firm and industry-by-time heterogeneity.

3.3 Empirical Strategy

The relationship between board network composition and corporate sustainability outcomes is endogenous on standard accounts. Firms with stronger sustainability orientation may recruit female directors with denser external networks; female directors with particular kinds of relational portfolios may sort into firms already pursuing specific sustainability strategies; and time-varying firm characteristics (CEO turnover, ownership restructurings, ESG-disclosure pressure) may simultaneously affect both board composition and sustainability outcomes. A pure cross-sectional comparison cannot identify the causal effect of network structure on sustainability strategy. We therefore proceed in two steps. We first document the baseline within-firm association between *RelFem* and sustainability performance, then move to a DiD design that exploits peer ESG enforcement penalties as exogenous shocks (Gormley and Matsa, 2011), allowing us to identify how network composition shapes the firm’s strategic response to externally generated sustainability pressure.

Baseline within-firm specification. We estimate

$$y_{ft} = \beta_1 \text{RelFem}_{ft} + \beta_2 \text{RelFem}_{ft}^2 + \beta_3 \text{RelMale}_{ft} + \beta_4 \text{RelMale}_{ft}^2 + \mathbf{X}'_{ft} \boldsymbol{\gamma} + \alpha_f + \mu_t + \varepsilon_{ft}, \quad (4)$$

with firm (α_f) and year (μ_t) fixed effects, firm-clustered standard errors, and turning points recovered as $\text{RelFem}^* = -\hat{\beta}_1 / (2\hat{\beta}_2)$ (delta-method CIs). The within-firm estimates are descriptive; we use them to document the inverted U-shape at the firm level and to benchmark turning points against the DiD optimum.

Difference-in-Differences. The main specification with moderation by *RelFem* is

$$y_{ft} = \delta \text{PeerShock}_{ft} + \theta (\text{PeerShock}_{ft} \times \text{RelFem}_{ft}) + \pi \text{RelFem}_{ft} + \mathbf{X}'_{ft} \boldsymbol{\gamma} + \alpha_f + \lambda_{st} + \varepsilon_{ft}, \quad (5)$$

where α_f are firm fixed effects and λ_{st} are GICS sub-industry $\times$ year fixed effects. The coefficient θ identifies whether the moderation is amplified or attenuated by female-to-female board connectivity. We also estimate the analogous specification with *RelMale* (placebo for the gender channel) and quadratic versions of (5) (*RelFem* and *RelFem*² interactions).⁴

Event study. For dynamic effects we estimate

$$y_{ft} = \sum_{\substack{k=-3 \\ k \neq 0}}^3 \beta_k \mathbf{1}[t - t_0^f = k] + \mathbf{X}_{ft}'\boldsymbol{\gamma} + \alpha_f + \lambda_{st} + \varepsilon_{ft}, \quad (6)$$

with firm (α_f) and GICS sub-industry $\times$ year (λ_{st}) fixed effects and $k = 0$ (the year of the first peer shock) as the omitted reference period. Finally, we apply HonestDiD sensitivity analysis (Rambachan and Roth, 2023).

3.3.1 Identification.

Identification rests on two arguments. First, the peer shock is exogenous to the focal firm’s sustainability strategy: it is determined by other firms’ historical conduct and the regulatory enforcement calendar—neither observable nor controllable by the focal firm—and self-penalised firm-years are excluded by construction. The cross-sectional correlation between *RelFem* and own-sub-industry shock probability is small, so the shock is also approximately orthogonal to the network moderator.⁵ Second, firm and GICS sub-industry $\times$ year fixed effects absorb all time-invariant firm-level confounders and all sub-industry-level time-varying ones, including any

⁴Our design is not a staggered single-treatment rollout but a recurring binary peer shock identified within firm and sub-industry $\times$ year fixed effects, so the negative-weighting problems that the recent heterogeneity-robust difference-in-differences literature highlights for two-way fixed-effects estimators (Goodman-Bacon, 2021; de Chaisemartin and D’Haultfœuille, 2020; Callaway and Sant’Anna, 2021) are of limited concern here; we nonetheless validate the dynamics with the event study in Section 4.3.

⁵A covariate-balance test supports the as-good-as-random assignment of the peer shock with respect to focal-firm characteristics. Regressing the peer shock on lagged focal-firm covariates, neither *RelFem* (the network moderator) nor lagged *EnvScore* (the outcome) predicts treatment (joint $p = 0.79$ and $p = 0.34$, respectively, in the within-firm specification); indeed, no focal-firm characteristic jointly predicts the shock once firm and year fixed effects are included ($F = 0.88$, $p = 0.56$). The shock is thus driven by peers’ conduct rather than the focal firm’s own trajectory.

average industry response to peer penalties. Identification of θ therefore comes from *within-sub-industry variation in network composition at the time of the exogenous shock*—a specification designed to isolate the causal effect of board network structure on sustainability outcomes, holding constant firm-level and industry-by-year heterogeneity. Because the peer shock is assigned at the sub-industry-year level, the sub-industry $\times$ year fixed effects absorb its average effect: the design identifies *heterogeneous* responses to common sub-industry-year ESG shocks—how the firm’s environmental response varies with female-network composition—rather than the average effect of the shock itself. The interaction θ is therefore the object of inference.

This framing also relaxes what exogeneity must deliver: because the sub-industry $\times$ year fixed effects absorb the shock’s average effect, identification requires not that the peer shock be unconditionally exogenous, but only that network composition be unrelated to *which* firms within a sub-industry-year respond—precisely the property our covariate-balance test supports.

The key identifying assumption is parallel trends: absent the peer shock, treated and not-yet-treated firms within the same GICS sub-industry would have followed common environmental trajectories. Two pieces of evidence support it. First, the event study (Section 4.3) shows no differential pre-trends—the three pre-period coefficients ($t = -3, -2, -1$) are small, negative, and jointly insignificant ($F = 0.26$, $p = 0.856$)—so treated firms were not already diverging before the shock. Crucially, the same holds for the moderation itself: in an event study that interacts event time with *RelFem*, the pre-period interaction coefficients are jointly insignificant ($F = 1.99$, $p = 0.14$), so high- and low-*RelFem* firms were not on differing environmental trajectories before the shock—the relevant parallel-trends condition for the heterogeneous response θ . Second, we bound the inference with the HonestDiD sensitivity analysis of Rambachan and Roth (2023), which asks how large a violation of parallel trends would be needed to overturn the result. The post-shock effect is significant under the standard event-study assumption (95% confidence in-

terval $[0.86, 4.77]$); under the Rambachan–Roth relative-magnitude restriction, the robust confidence set widens and admits zero as the permitted pre-trend violation grows (Section 4.8). Finally, three features of the results jointly rule out the alternative that *RelFem* merely proxies for an unobserved “board-quality” factor: the moderation is non-linear with an interior optimum (a quality story would predict a monotone response), the analogous *RelMale* moderation is null, and the effect is absent on financial performance.

4 Results

4.1 Descriptive Statistics and Network Stylized Facts

Table 2 presents descriptive statistics for the S&P 500 panel. Mean Environmental Score is 54.7 (SD 26.0) with broad cross-sectional range, making it the most informative outcome for identifying differential governance responses. Board network homophily displays the expected asymmetry: *RelFem* averages 0.246 (SD 0.117) and *RelMale* averages 0.741 (SD 0.044), the lower mean and higher variance of *RelFem* reflecting the minority position of female directors and supplying a richer source of within-firm variation for identification. Peer ESG regulatory exposure is pervasive, confirming that the shock design captures a systemic feature of S&P 500 regulatory risk rather than outlier firms.⁶

Two descriptive facts about female directors’ external networks are worth flagging. First, a substantial share of female-to-female ties are pre-existing (Panel A of Appendix Table A1), which supports our choice to measure *RelFem* on predetermined, pre-existing connections. Second, female directors’ external connections are substantial and reach senior, high-quality peers: the average female director carries roughly thirteen distinct external ties, a quarter of which go to women, the large majority of those to peers who sit on their own firms’ boards, and about half to firms with above-median environmental performance (Panel B of Appendix Ta-

⁶From Panel E, 51% of firm-years record at least one ESG violation and 21% a violation $\geq \$1\text{M}$; from Panel F, the main peer-shock treatment is active in 47.5% of firm-years.

ble A1). Third, these shares mask a structural asymmetry: because women remain a minority on boards, the average female director reaches roughly three female and ten male peers—and male directors the mirror image—and connects to far fewer high-status own-gender peers (0.8 versus 4.1 Tier-1–2 peers; Panel A). Low *RelFem* therefore reflects the scarcity of available female peers as much as any individual preference, which makes the gender-balanced networks our results identify as optimal comparatively rare. Appendix Figure A1 plots the full *RelFem* and *RelMale* distributions: female directors cluster well below the inverted U-shape optimum ($RelFem^* \approx 0.356$), whereas male directors are tightly concentrated in high own-gender homophily (mean 0.74). Pairwise correlations between the main variables (Table A3) confirm that *RelFem* is correlated with the gender ratio ($r = 0.65$) but far from collinear, and that the peer-shock indicator is positively associated with both ESG performance and high-regulation sub-industries, motivating the inclusion of board controls and firm and year fixed effects throughout. After restricting to boards with at least one woman and dropping observations with missing outcome or controls, the within-firm OLS sample contains $N = 5,932$ firm-years; the DiD specifications further drop firm-years in singleton (sub-industry, year) clusters under the GICS sub-industry $\times$ year fixed-effect structure (yielding $N = 5,430$), as these observations carry no within-cluster identifying variation.

4.2 Baseline Within-Firm Estimates: Network Structure and Sustainability Performance

Before presenting the causal DiD estimates, we establish baseline within-firm evidence on the relationship between board network homophily and ESG performance. Within-firm coefficients are descriptive: omitted time-varying firm characteristics correlated with both network structure and ESG performance could still confound causal inference. The DiD design in Section 4.4 addresses this concern.

Table 3 presents a sequence of two-way fixed-effects estimates for the Environmental Score across four specifications, tracing the explanatory power of board con-

nectivity measures from aggregate gendered connection counts to gender-specific homophily ratios. Column 1 shows that aggregate female and male director connection indices both carry positive and significant within-firm coefficients, with male-dominated connections showing larger effects. Column 2 narrows to same-gender connection indices (*FemFem* and *MaleMale*), which retain positive and significant within-firm coefficients of comparable magnitude. Columns 3–4 introduce the gender-specific homophily ratios (*RelFem* and *RelMale*). In the quadratic specification (Column 4), *RelFem* and *RelFem*² enter with positive and negative signs respectively (both significant at the 1% level), implying an interior maximum at $RelFem^* = 0.386$.⁷ The turning point lies in the interior of the empirical range (*RelFem*: mean 0.246, SD 0.117), supporting H1. Figure 2 plots the predicted Environmental Score contribution as a function of *RelFem*, with the inverted U-shape and optimal value clearly visible.

The inverted U-shape pattern in *RelFem* is not specific to the Environmental Score: applying the same quadratic specification to the Combined ESG Score and the Governance pillar yields the same shape at the 1% level, and to the Social pillar at marginal significance.⁸ This within-firm optimum foreshadows the DiD moderation result, where firms near the same optimal connectivity level show the strongest improvement following peer ESG shocks.

By contrast, the corresponding within-firm regressions of financial performance (*ROA*) on the same network measures do not yield an inverted U-shape: the quadratic terms are not significant, consistent with the null *RelFem* moderation on *ROA* reported in Table 5 (Panel C). Network homophily is therefore associated with the ESG margin of firm performance in the shape predicted by theory, but not with the financial margin.

⁷The interior maximum is recovered as $RelFem^* = -\hat{\beta}_1/(2\hat{\beta}_2) = 39.31/(2 \times 50.93) = 0.386$. The analogous *RelMale* quadratic is not statistically significant in the within-firm specification.

⁸For the Environmental Score the linear and quadratic coefficients on *RelFem* are (39.31***, −50.93***); the analogous *RelMale* quadratic is statistically insignificant, ruling out a generic “board capital” reading.

4.3 Event Study and Parallel Trends Validation

The event study tests parallel trends and the dynamic profile of the firm’s response to peer ESG exposure. For this analysis we use the threshold-restricted variant ($\geq \$1\text{M}$ peer penalty) rather than the no-threshold headline shock: a meaningful event study requires a well-defined “first treatment” year per firm with sufficient pre-period coverage, and the headline definition activates for roughly 62% of firms already in 2010, leaving little cross-cohort timing variation. The $\geq \$1\text{M}$ definition yields a more dispersed treatment-timing distribution and a well-defined never-treated control group. The reading is that the event study validates parallel trends for the threshold-restricted variant; the headline moderation specification (Section 4.4) does not depend on first-event timing because it identifies the effect from cross-firm variation within (sub-industry, year) cells rather than from event-time dynamics.

Figure 3 reports the event-study estimates from Equation (6), with $t = 0$ (the year of the first peer shock) as the omitted reference period. All three pre-period coefficients ($t = -3, -2, -1$) are small, negative, and statistically indistinguishable from zero ($b = -1.52, -1.44, -1.14$; all $p > 0.40$), providing visual support for parallel trends before exposure. The joint Wald test on the full pre-period (all three coefficients $t = -3$ through $t = -1$ jointly zero) is not rejected ($F = 0.26$, $p = 0.856$). The HonestDiD analysis in Section 4.8 bounds the sensitivity of our estimates to any residual pre-trend.

Post-treatment coefficients are positive and rise monotonically from $t = +1$ ($+2.49$, $p < 0.05$) to $t = +3$ ($+9.80$, $p < 0.01$). This escalating pattern is consistent with governance improvement accruing over several years following a peer ESG shock and is hard to reconcile with either reverse causality or a pre-existing differential trend, both of which would imply a non-escalating or pre-treatment pattern.

4.4 Network Composition Shapes Sustainability Response (H1)

The unconditional average effect of the identifying peer ESG shock on *EnvScore* is near zero ($b = -0.376$, SE 0.805, $p = 0.64$). This null is not a substantive claim

about peer ESG events; it is the natural consequence of averaging across firms with very different network compositions, which respond in opposing directions. The interesting variation—the variation that identifies the effect of network composition on the sustainability response—is conditional on *RelFem*.⁹

Table 4, Column (2) reports the primary moderation specification (the headline $\geq \$1\text{M}$ peer shock), which identifies how network composition shapes the firm’s sustainability response. $\text{Shock} \times \text{RelFem}$ is $+42.32$ ($p < 0.01$) and the quadratic interaction $\text{Shock} \times \text{RelFem}^2$ is -59.49 ($p < 0.01$),¹⁰ supporting H1: the gender composition of female directors’ external ties modulates the firm’s *EnvScore* sustainability response, and the moderation follows the same inverted U-shape recovered in the within-firm OLS.¹¹ Figure 4 traces the marginal sustainability response across the empirical range of *RelFem*. The curve is hump-shaped with an interior maximum at $\text{RelFem} \approx 0.356$, consistent with the within-firm OLS turning point ($\text{RelFem}^* = 0.386$). Substantively, moving from the 25th to the 75th percentile of *RelFem* ($0.19 \rightarrow 0.35$) shifts the firm’s sustainability response from contagion-type deterioration (marginal effect ≈ -0.5 *EnvScore* points) to meaningful improvement (marginal effect $\approx +1.2$ points)—a reversal of over one and a half points that takes the firm from negative to positive territory in its response to a peer ESG shock.

At compositional extremes the loss is much larger: firms whose female directors are

⁹Across the four Refinitiv outcomes, only *GovernanceScore* shows a statistically significant unconditional response ($+1.71$, SE 0.77 , $p < 0.05$); *SocialScore* and combined *ESG* are near zero (-0.62 , SE 0.66 ; and $+0.12$, SE 0.52 , respectively). The *Governance* result is consistent with firms tightening governance practices generally in the wake of peer enforcement, even when the environmental response remains heterogeneous across network compositions.

¹⁰Because treatment is assigned at the sub-industry-year level, we verify that firm-clustered inference is not understated: the interaction remains significant under two-way clustering by firm and sub-industry-year ($\text{Shock} \times \text{RelFem}$, $p = 0.001$; $\text{Shock} \times \text{RelFem}^2$, $p = 0.010$) and under clustering by sub-industry-year alone ($p < 0.01$ for both), with firm clustering—which we report throughout—the most conservative of the three (1,699 sub-industry-year and 494 firm clusters).

¹¹Two robustness checks address natural concerns about this interaction. First, because *RelFem* correlates with the gender ratio of the focal board ($r = 0.65$), one might worry that the moderation reflects a mechanical female-headcount channel rather than network composition. The results are qualitatively identical, however, whether we control for the gender ratio or the absolute number of women on the board, indicating that the moderation reflects board composition rather than sheer headcount. Second, because firms typically need time to translate peer-event exposure into observable sustainability adjustments, we also re-estimate the headline moderation with the outcome leaded by one year; the inverted U-shape interaction remains positive and significant, confirming the result is not driven by contemporaneous shock-and-outcome dynamics.

trapped in homophily ($RelFem \rightarrow 0.8$) lose more than ten *EnvScore* points relative to firms at the optimum. Unlike in earlier threshold-restricted specifications, both the linear and the quadratic interaction terms are now individually significant at the 1% level, closing the inverted U-shape case in the DiD design. Figure 5 confirms the moderation dynamically: the balanced series shows post-shock improvements for firms with balanced female networks ($RelFem \in [0.25, 0.45]$), while the extreme series shows no comparable response for firms at compositional extremes ($RelFem < 0.15$ or ≥ 0.6).

Three patterns confirm that what we identify is genuinely a network-composition effect on sustainability strategy, not a generic governance attentiveness story. First, the moderation is robust across shock definitions (Table 4): it is essentially unchanged under the broader no-threshold (any-amount) definition (Column (1), +41.68^{***}) and stays in the same inverted U-shape direction at the larger $\geq \$10M$ threshold (Column (3), +25.46, less precisely estimated as the treated population thins). It also generalizes *across outcome dimensions*—the same headline shock moderated by *RelFem* traces the inverted U-shape on the Social, Governance and combined ESG scores, and within the environmental score it concentrates in the operational Emissions and Resource-Use sub-components (Table 5). Second, the non-ESG placebo (Column (4)) yields a null interaction ($Shock \times RelFem = +21.15, p > 0.10$): the network channel is content-specific to sustainability, not to peer enforcement events in general. Third, the analogous $Shock \times RelMale$ interaction is statistically null. The asymmetry—the gender composition of *female* directors’ external ties shapes the sustainability response while the analogous composition of *male* directors’ ties does not—is consistent with the distinctive relational portfolios literature on female directors (Kim and Starks, 2016; Matsa and Miller, 2013) and rules out a generic “board capital” reading.

Economic significance. The headline magnitudes are modest in absolute terms but qualitatively decisive: the moderation flips the sign of the sustainability response from negative (at low *RelFem*) to positive (at the interior optimum) and produces

double-digit declines at the homophily extreme. At the same time, the network channel does not extend to financial performance—the *RelFem* moderation is null on return on assets (Table 5, Panel C)—so these ESG gains do not come at the cost of financial performance and the result cannot be read as a simple resource-diversion story.

4.5 Influence Endowment: High-Status Female Peers (H2)

We test Hypothesis 2 by constructing *HighStatusFem*, the firm-year mean count of Tier-1–2 (Chair / CEO / Lead Independent / senior executive) female peers in each director’s external network (Section 3.2.3). The variable captures the *influence endowment* of female ties: not how many female peers a director has, but how senior in their own firms those peers are.

In a horse race against *RelFem*, both moderators retain independent significance ($S \times \text{RelFem} = +36.91$, $p < 0.01$; $S \times \text{HighStatusFem} = +1.71$, $p < 0.05$), with modest cross-sectional correlation ($r = 0.36$) (Table 6, Column 3). Used on its own (Column 2), *HighStatusFem* traces the same concave moderation, and over the empirical range additional senior female peers monotonically strengthen the peer-shock response—reinforcing rather than qualifying the network-balance effect. Exposure to senior female peers strengthens the peer-shock response beyond what the gender balance of the network alone delivers, consistent with H2. Substantively, this also rules out the reading that *RelFem* is merely a proxy for the general influence or “board capital” that female directors carry into the boardroom: both compositional margins—the *share* of female peers (*RelFem*) and the *count of influential* female peers (*HighStatusFem*)—contribute distinct moderating content.

Crucially, the influence channel is *gender-specific*. Female directors reach far more high-status *male* peers than female ones (on average 4.1 versus 0.8), yet only the senior *female* peers amplify the response—reaching senior male peers does not. As with the null *RelMale* placebo, the channel works through *same-gender* ties.¹²

¹²Formally, the moderation by high-status male peers is jointly insignificant ($\text{Shock} \times \text{HighStatusMale} = +0.34$; quadratic -0.03 ; joint $p = 0.89$), and stays null in a horse race against

4.6 The Social-Capital Channel: Old Ties, Role Models, and What the Mechanism Is *Not*

Section 4.4 establishes *that* the gender composition of female directors’ external networks shapes the firm’s sustainability response. It leaves open *how*: which type of social capital embedded in those networks supplies the operative resource. The candidates are distinct on standard social-capital theory—fresh information acquired through new contacts, trust accumulated through long-standing relationships, role-model exposure to high-quality female peers, or some combination—and generate empirically separable predictions. We discipline the interpretation with three mechanism tests; coefficients appear in Table 6.

We construct two director-year measures, aggregated to firm-year by averaging across the focal firm’s directors. The *recency split* partitions each director’s external peers into NEW ties (formed in the past three years) and OLD ties (formed earlier),¹³ and computes the female share within each set, $\text{Share F (NEW)}_{ft}$ and $\text{Share F (OLD)}_{ft}$. The *role-model exposure* measure, $\text{Mean peer-firm Env (F)}_{ft}$, is the firm-year mean (across directors) of the mean Refinitiv Environmental Score of the S&P 500 firms in which each focal’s female peers serve.

Trust vs. fresh information: the recency split. If the moderation is delivered by *fresh information* acquired through new contacts, it should run through the female-tie share among *newly-formed* ties. If, by contrast, it is delivered by *trust accumulated* through long-standing relationships, it should run through the female-tie share among *long-standing* ties. The two hypotheses generate disjoint predictions on observable coefficients.

The evidence (Table 6, Column (4)) is decisive. Splitting the female-tie share by tie age, only the OLD-tie share carries significant moderating content: $S \times \text{Share F (OLD)} = +9.35$ ($p < 0.05$). The NEW-tie analogue is statistically null

HighStatusFem (male terms joint $p = 0.85$).

¹³Formally, NEW ties have overlap-start within the three-year window $[t - 2, t]$ and OLD ties earlier. The two shares have means 0.29 (NEW) and 0.26 (OLD) in the panel and are correlated only $r = 0.17$, so the split is statistically meaningful rather than a mechanical decomposition.

(+1.17, $p > 0.10$). The moderation channel is trust through long-standing female ties, not fresh information from new contacts. The pattern is the prediction of Krackhardt’s (1992) “strength of strong ties”—the channel operates through ties of meaningful duration that have accumulated the trust capital needed to carry tacit, values-laden content—and matches Uzzi’s (1996, 1997) finding that the informational value of embedded inter-organisational ties grows with relationship duration. It is also the prediction of Reagans and McEvily (2003): when the knowledge to be transferred is tacit (as ESG practice is, relative to codified financial reporting), *cohesion*—a closure property of long-standing ties—dominates structural *range* in explaining transfer success. The result therefore locates the channel on the Coleman closure side of the Coleman–Burt theoretical tension, not on the Burt brokerage side.

Role-model exposure: the ESG quality of female peers. The trust channel raises a natural follow-up: are all long-standing female ties equally informative, or does the channel work *through* female peers who themselves carry high-quality ESG practice from their own boards? We test this directly using *Mean peer-firm Env (F)*, the mean Environmental Score of the firms in which the focal’s *pre-existing* female peers serve, averaged over the board’s female directors.

Column (5) of Table 6 delivers a clean positive result: $S \times \text{Mean peer-firm Env (F)} = +0.065$ ($p < 0.01$). A one-standard-deviation shift in the moderator (about 24 points on the peer-firm *EnvScore* axis) maps to a meaningful amplification of the peer-shock response — non-trivial relative to the unconditional sample SD of 26. The moderation strengthens when female peers serve in better-governed firms, consistent with a *role-model exposure* reading of the channel. This evidence complements the Westphal and Zajac (1997) finding that governance practices diffuse through interlocks via the *example set* by high-quality peer firms, and the Beckman and Haunschild (2002) finding that network learning is increasing in the *experiential quality* of the partners with whom firms are connected. The implication is sharper than “women in networks learn from each other”—the channel runs specifically through female peers who themselves bring high-ESG practice from their boards, identifying *which*

peers are productive rather than treating the network as a uniform conduit.

What the channel is *not*: same-industry female peers. A second natural reading of the moderation — “female peers in the focal firm’s own industry transmit industry-specific governance intelligence” — predicts that the moderation should run through female peers serving in firms in the focal’s GICS sub-industry. This is the prediction of the organisational-learning literature on *industry-bounded* information diffusion (Greve, 2003; Haveman, 1993), and of the literature on industry-specific board expertise (Faleye, Hoitash, and Hoitash, 2018). An industry-information placebo, Column (6) of Table 6, tests this: the interaction is statistically zero (+0.20, $p > 0.10$). The channel is therefore *not* narrowly industry-specific: the information and trust capital that flows through long-standing female peers comes from *any* board they sit on, not just from competitors. This rules out the obvious industry-learning interpretation and strengthens the trust-and-role-model story over an industry-information story—and points to the relational maturity of the peer tie, rather than its industry coordinates, as the binding governance margin.

Taken together, the three tests identify the operative resource as the *accumulated trust* of long-standing female ties, amplified when those ties extend to peers at high-ESG firms—not fresh information from new contacts, and not industry-specific know-how. The strategic implication is that what matters for a board’s sustainability capacity is not just *which* women a board contains, but with how much shared history with high-quality peers their networks have been built.

4.7 Domain Specificity: ESG-Channel Identification (H3)

Hypothesis 3 predicts that the network-balance moderation should be confined to ESG-relevant treatments and ESG-relevant outcomes and remain silent on non-ESG peer events and on financial performance. Two falsifications discipline this claim.

Non-ESG peer enforcement (treatment falsification). Re-estimating the moderation specification with a peer-shock indicator constructed from *non-ESG* en-

forcement events of similar magnitude yields a null interaction ($S \times \text{RelFem} = +21.15$, $p > 0.10$; Table 4). A generic “board-quality” or “board-attention” channel would predict a comparable moderation under any peer shock; we do not see it. The network channel activates only on ESG-relevant treatments.

Financial performance (outcome falsification). Replacing the ESG outcome with return on assets on the same specification, the *RelFem* moderation is statistically null (Table 5, Panel C). Female-network composition does not move firms’ bottom line through this channel; it moves their corporate sustainability strategy. The asymmetry rules out a resource-diversion reading (ESG gains traded against profits) and a generic firm-quality reading (better firms responding more on every margin), and pins the operative channel as ESG-specific governance capability rather than broad strategic alertness.

4.8 Robustness

Several robustness checks discipline the headline result, drawing on the alternative shock definitions in Table 4 and the outcome decomposition in Table 5.

Ruling out a board-quality proxy. A “better firms” channel predicts monotone amplification of the peer-shock response: higher quality, higher response. We observe an inverted U-shape with declining moderation at *both* compositional extremes, an analogous *RelMale* moderation that is null, and a null *RelFem* moderation on financial performance (return on assets; Table 5, Panel C). The asymmetry across *RelFem* and *RelMale* and the financial-margin null jointly rule out unobserved firm quality as the operating channel.

Functional form: the inverted U-shape is not imposed. A natural concern is that the inverted U-shape is an artefact of the quadratic specification rather than a feature of the data. It is not. Estimating the shock effect *flexibly* within *RelFem* bins—a step-function moderation that imposes no parametric shape—recovers the

same hump: the effect rises from negative at low *RelFem* to a peak near the quadratic vertex ($RelFem \approx 0.33$) and declines beyond it (Appendix Figure A3). The same holds under a more flexible specification: replacing the quadratic with a restricted cubic spline, the shock–*RelFem* interaction terms are jointly significant ($p = 0.013$). The curvature is a property of the data, not of the chosen functional form.

Treatment definition, peer group, and ESG dimension. The Shock $\times$ *RelFem* interaction is positive and traces the same inverted U-shape across a wide set of ESG-relevant shock definitions. Sweeping the dollar threshold within sub-industry peers (Table 4), the linear interaction is +41.7*** at any penalty amount and +42.3*** at the $\geq \$1M$ threshold, then fades to +25.5 (n.s.) at $\geq \$10M$ as the treated population thins. The moderation also survives widening the peer group from the GICS sub-industry to the broader GICS *industry* level (+40.2***) and replacing the binary shock with the continuous log peer-penalty amount (+3.1***). Figure 6 summarizes these checks: the Shock $\times$ *RelFem* coefficient is positive and statistically robust across shock definitions, two-way clustered inference, a control for the number of women on the board, and a one-year-leaded outcome, and contains zero only for the non-ESG placebo.

Where does the response show up? Table 5 fixes the headline shock and varies the outcome. The moderation generalizes across the full ESG scorecard—Social, Governance and the combined ESG score all display the same inverted U-shape (Panel A)—so it is not an artefact of the environmental measure. Within the environmental score (Panel B), the response concentrates in the operational, board-actionable sub-components, Emissions (+57.9***) and Resource Use (+41.6**), and is absent for Environmental Innovation, consistent with boards channelling peer-driven ESG salience into near-term operational improvements rather than long-horizon green R&D. In every significant case the quadratic term is negative, preserving the interior-optimum shape.

Finally, the response is to *peer*, not *own*, enforcement. The peer shock excludes the focal firm’s own penalties by construction, but a shocked firm may itself be

penalised the same year (29% are). The moderation is unchanged when we control for the firm’s own contemporaneous ESG penalty ($\text{Shock} \times \text{RelFem} = +42.6$, $p < 0.01$) and, if anything, stronger among firms not themselves penalised that year (+47.1 and -75.5 on the linear and quadratic interactions, both $p < 0.01$). The network channel thus responds to externally observed peer enforcement, not to the firm’s own regulatory experience.¹⁴

HonestDiD sensitivity. The event study assumes parallel trends: absent the shock, treated and not-yet-treated firms would have moved together. To quantify how far this assumption can fail before our conclusions change, we apply the relative-magnitudes sensitivity analysis of Rambachan and Roth (2023). Rather than assuming parallel trends hold exactly, it asks how large a post-period violation—measured as a multiple M of the largest pre-period deviation—would have to be to overturn the result, and reports the resulting “robust” confidence set.

We distinguish two objects. The *average* dynamic response to the shock is significant under the standard event-study assumption (the original 95% confidence interval for the first post-period effect is $[0.86, 4.77]$), but its robust confidence set widens quickly and already contains zero at $M = 0.5$ ($[-1.04, +6.92]$; Figure A2). This pooled response is only moderately robust to pre-trend violations—which is unsurprising, because it averages the opposing reactions of firms at different points of the inverted U-shape and is *not* the object of interest.

Our estimand is the *moderation* (θ)—how the response varies with *RelFem*. It is identified from cross-firm variation in *RelFem* *within* sub-industry $\times$ year cells, not from event-time dynamics, and is therefore insulated from industry-level pre-trends in the level of *EnvScore*. The parallel-trends condition that actually matters for θ —that high- and low-*RelFem* firms were not already on diverging trajectories—holds directly: in an event study that interacts event time with *RelFem*, the pre-period

¹⁴We cannot cleanly partition firms into “never” versus “previously” penalised, because Violation Tracker coverage begins in 2010 and own-penalty histories are left-censored at the start of the panel; we accordingly condition on the firm’s *contemporaneous* own enforcement rather than on its penalty history.

interaction coefficients are jointly insignificant ($F = 1.99$, $p = 0.14$). The network moderation thus rests on an assumption the data corroborate, even though the pooled average effect is, by construction, more fragile.

5 Discussion

5.1 What the Evidence Pins Down

Three regularities organise the discussion. First, the gender composition of female directors’ external networks shapes the firm’s sustainability response non-monotonically. Firms whose female directors carry a gender-balanced mix of external ties (*RelFem* near its optimum of ≈ 0.356) deliver a positive sustainability response to peer pressure; firms whose female directors are isolated in male networks or trapped in female-female homophily deliver contagion-type declines. The OLS turning point (0.386) and the DiD vertex (0.356) lie close together and point to the same conclusion: balance is a strategically relevant margin of board composition for sustainability, over and above headcount.

Second, the operative social-capital resource is accumulated relational history, not fresh information. The recency split provides what is, to our knowledge, the cleanest existing adjudication of the closure-versus-brokerage debate at the board level (Burt, 2004; Coleman, 1988; Krackhardt, 1992; Uzzi, 1997). Long-standing female ties (at least three years of shared service) carry the entire effect; newly-formed ties carry none. The effect strengthens when those long-standing peers serve in high-ESG firms (the role-model channel), and disappears when those peers serve in the focal firm’s own sub-industry (the industry-information placebo). Together, the patterns rule out generic “board attention” or “better firms” readings: an unobserved quality factor would produce symmetric mobilisation across tie ages and peer types. We observe asymmetry along both dimensions.

Third, the channel is content-bounded in a way that disciplines the interpretation against the most common alternative readings. The moderation does not activate

on non-ESG peer enforcement events ($S \times \text{RelFem} = +21.15$, $p > 0.10$), and the same network channel is null on firms' financial performance (return on assets; Table 5, Panel C). Female-network composition mobilises an ESG-specific governance capability rather than generic strategic alertness or board-quality differences that would surface symmetrically across treatments and outcomes.

5.2 Implications for Strategy Theory

Two implications follow for strategic-management research on board governance and corporate sustainability. The first is that gender diversity, far from being a univariate attribute of the board, is a *relational strategic asset* that resists appointment-by-decree. A female director hired from a predominantly female professional circle brings different network capital into the boardroom than one who bridges male and female governance networks; appointments at either compositional extreme fail to deliver the network-balance benefits we document. The relational capital that shapes the firm's sustainability response cannot be manufactured between nominations; it accumulates over years of shared service, and it travels through a specific class of ties. This recasts board gender diversity within the resource-based view of strategic capabilities: it is the structure and history of female directors' external networks, not their count alone, that constitutes the strategically valuable, hard-to-imitate resource.

The second implication is that the operative sustainability-governance resource is more concentrated than the standard literature assumes. Most network-mediated diffusion accounts treat information as flowing through any active tie (Cheng et al., 2014; Davis and Greve, 1997). The evidence here insists that the moving content—sustainability practice, normative cues, and strategic templates for ESG response—is tacit, values-laden, and hard to imitate, and travels only through ties with enough shared history to carry it. The practical corollary for nomination committees, institutional investors, and proxy advisors is that the strategic value of a board candidate—especially for risk and sustainability committees—depends not

only on the composition of her external network but on its *relational maturity*.

A third implication concerns *where* on the scorecard the response lands, positioning our evidence against adjacent literatures. The moderation generalizes across the E, S, and G pillars, which a growing literature shows are measured and priced as distinct constructs rather than a monolith (Christensen, Serafeim, and Sikochi, 2022). Within environmental performance, the response concentrates in the operational, board-actionable margins—emissions and resource use—and is absent for environmental innovation. This maps onto the natural-resource-based distinction between near-term pollution prevention and longer-horizon, innovation-driven stewardship (Christmann, 2000; Hart, 1995). It is also consistent with evidence that governance mechanisms preferentially reward operational prevention (Berrone and Gomez-Mejia, 2009), that external pressure reaches green innovation only under specific conditions (Berrone, Fosfuri, Gelabert, and Gomez-Mejia, 2013), and that external ESG pressure does not, on its own, translate into green patenting (Cohen, Gurun, and Nguyen, 2024): boards channel scarce attention toward proximate, controllable improvements rather than uncertain green R&D. That the same channel is null on financial performance distinguishes it from the long-running debate over whether corporate social performance pays (Margolis and Walsh, 2003; Margolis, Elfenbein, and Walsh, 2009)—the female board network operates as an ESG-specific governance capability, not a generic financial-performance lever.

5.3 Limitations

Three caveats temper the interpretation. First, the design with firm fixed effects absorbs time-invariant confounders but not all time-varying ones; cleaner natural-experimental variation in network position (gender quotas, director-supply shocks) would strengthen the causal claims. Second, the three pre-period event-study coefficients ($t \in \{-3, -2, -1\}$) are modestly negative, though jointly insignificant ($F = 0.26$, $p = 0.856$); the Honest DiD bounds in Section 4.8 contain the null but cannot exclude modest pre-trend violations. Third, Refinitiv ESG scores reward

disclosure effort and can be revised retroactively, so the environmental-performance outcome should be read as the firm’s *revealed and disclosed* sustainability strategy rather than a direct measure of environmental outcomes.

6 Conclusion

This paper has studied how board network structures shape corporate sustainability strategy. The headline result is sharper than the standard board-diversity literature: what governs the firm’s sustainability response is not the number of women on the board alone, but also the compositional structure of the external inter-firm networks those women carry into the boardroom. To identify this effect—given the endogeneity of board composition—we exploit peer ESG enforcement penalties as exogenous variation in the salience of sustainability risk, an identification device rather than the conceptual object of study.

Three results organise the evidence. *First*, gender balance in female directors’ external ties produces an inverted U-shape sustainability response, with an interior optimum at $RelFem \approx 0.356$ and contagion-type declines at both compositional extremes; the average effect is zero precisely because it averages opposing reactions across the distribution of network composition. *Second*, the operative social-capital resource is accumulated relational history, not fresh information. The effect runs entirely through long-standing female ties (at least three years of shared service), amplifies when those ties extend to female peers at high-ESG firms, and is null for industry-specific peers. The recency split adjudicates the Coleman–Burt closure-versus-brokerage debate at the board level on the closure side. *Third*, the channel is domain-specific: the network-balance moderation is absent on non-ESG peer enforcement events and does not extend to firms’ financial performance, ruling out generic “board-quality” readings and confirming that what female-network composition mobilises is an ESG-governance capability.

The contribution is threefold. *To research on board governance and corporate sustainability*, the paper broadens the analytical question from headcount diversity

to network composition, identifying the relational structure through which director-level diversity translates into firm-level sustainability action. *To the social-capital and inter-corporate-network literatures*, it identifies accumulated relational trust—not brokered structural holes—as the active ingredient in board-network influence. *To strategy theory on sustainability capability*, it identifies the precise compositional and relational conditions—gender-balanced networks rich in long-standing ties to high-quality peers—under which board composition operates as a strategic resource for corporate sustainability. It further shows that this resource channels the firm’s response into near-term operational environmental improvements—emissions and resource use—rather than long-horizon innovation.

The practical implication is that board diversity, as a strategic resource, cannot be manufactured by appointment: the relational capital that shapes sustainability outcomes accumulates over years of shared service and travels through ties of meaningful duration. Policy frames that target headcount parity alone may overlook a complementary strategic margin.

The result opens a research agenda: which kinds of board relationships, built over which time horizons, deliver strategic value for which kinds of corporate outcomes. Cleaner natural-experimental variation in network position—through quota mandates, director-supply shocks, or mandatory disclosure regimes outside the United States—would sharpen the causal claims and test the generality of the relational-maturity channel. The present paper is one calibrated point in that agenda.

The headline can be compressed into a single claim: corporate sustainability is shaped by the structure and history of female directors’ external networks. Board gender diversity, on this evidence, is best understood as a relational strategic asset—slowly accumulated, structurally composed, and reaching beyond headcount.

Tables

Table 1: Description of Variables

Variable	Definition	Source
<i>Panel A: ESG variables (Refinitiv pillar scores; 0–100, higher = better)</i>		
EnvScore	Environmental pillar score: aggregate environmental management performance.	Refinitiv
SocialScore	Social pillar score: workforce, human rights, community, product responsibility.	Refinitiv
GovernanceScore	Governance pillar score: management, shareholders, CSR strategy.	Refinitiv
ESG (Combined)	Overall Refinitiv ESG combined score (weighted average of the three pillars net of controversy adjustment).	Refinitiv
Emissions	Environmental sub-component (of EnvScore): emissions reduction, waste, and biodiversity management.	Refinitiv
Resource Use	Environmental sub-component (of EnvScore): water, energy, and materials efficiency and supply-chain management.	Refinitiv
Env. Innovation	Environmental sub-component (of EnvScore): eco-product design and green R&D / environmental innovation capacity.	Refinitiv
<i>Panel B: Governance variables (board network homophily and board controls)</i>		
RelFem	Mean share of female directors’ pre-existing (>1 yr) external connections to other female directors (Eq. 1); bounded [0, 1].	BoardEx
RelMale	Analogous mean share of male directors’ pre-existing (>1 yr) external connections to other male directors; bounded [0, 1].	BoardEx
FemFem Conn. Index	Average count of female-to-female external connections among the firm’s female directors.	BoardEx
MaleMale Conn. Index	Average count of male-to-male external connections among the firm’s male directors.	BoardEx
HighStatusFem	Mean across directors of the count of high-status (Tier-1–2) female peers in the director’s external network (Eq. 2; see Section 3.2.3 for tier definitions and Appendix B for the tier-distribution table).	BoardEx
Share F (NEW)	Mean across female directors of the female share of <i>newly-formed</i> ties: peer overlap-start within the past 3 years (Section 4.6).	BoardEx
Share F (OLD)	Mean across female directors of the female share of <i>long-standing</i> ties: peer overlap-start more than 2 years before t (tie age ≥ 3).	BoardEx
Mean peer-firm Env (F)	Mean across directors of the mean Refinitiv Environmental Score of the S&P 500 firms in which each focal’s female peers serve in year t ; role-model exposure measure (Section 4.6).	Refinitiv
# same-sub-ind F peers	Mean across directors of the count of female peers serving in firms in the focal firm’s GICS sub-industry; industry-information placebo.	BoardEx
Gender Ratio	Number of female directors divided by total board size.	BoardEx
Board Size	Total number of directors on the focal board.	BoardEx
Avg. Director Age	Mean age (years) of directors on the focal board.	BoardEx
Avg. Director Tenure	Mean tenure (years) of directors on the focal board.	BoardEx
CEO Duality	=1 if the CEO is also Chair of the Board; 0 otherwise.	BoardEx
Board Meetings	Number of board meetings held in the year.	BoardEx
Board Independence	Percentage of independent (non-executive) directors on the board, as reported by the firm.	BoardEx

Notes: Sample: 494 S&P 500 firms, 2010–2023; 6,567 firm-year observations. All means, shares and counts in the table are firm-year aggregates of director-level quantities. “Outside-own-board” connections exclude director ties via fellow directors of the focal board. Violation Tracker matched to S&P 500 firms via SEC CIK; all penalties in 2023 USD. Main identification variable: Peer-Shock $\geq$ \$1M (sub-industry). See Section 3 for details of the identification strategy.

Table 1: Description of Variables (continued)

Variable	Definition	Source
<i>Panel C: Firm characteristics and financial performance</i>		
Firm Size	Number of employees (thousands).	Compustat
ROA (%)	Return on assets, winsorized at the 1st and 99th percentiles and expressed in percentage points.	Compustat
GICS Sub-industry	8-digit GICS sub-industry classification (used to define the peer group).	Compustat
GICS Industry	6-digit GICS industry classification.	Compustat
<i>Panel D: Treatment variables (peer ESG penalty shocks; firm-year indicators)</i>		
Penalty $\geq$ \$1M (<i>main</i>)	=1 if any other S&P 500 firm in the same GICS sub-industry received an ESG-related regulatory penalty $\geq$ \$1M in year t (main treatment; Eq. 3).	Violation Tracker
Penalty amount) (any)	Same, with no dollar threshold (robustness).	Violation Tracker
Penalty $\geq$ \$10M	Same, with $\geq$ \$10M threshold (robustness).	Violation Tracker
Social penalty $\geq$ \$1M	=1 if any sub-industry peer received a <i>social</i> -pillar penalty $\geq$ \$1M (ESG-dimension robustness).	Violation Tracker
Governance penalty $\geq$ \$1M	=1 if any sub-industry peer received a <i>governance</i> -pillar penalty $\geq$ \$1M (ESG-dimension robustness).	Violation Tracker
Env. penalty $\geq$ \$1M	=1 if any sub-industry peer received an <i>environmental</i> -only penalty $\geq$ \$1M.	Violation Tracker
Non-ESG (placebo)	Indicator =1 for peer non-ESG regulatory penalty $\geq$ \$1M, GICS sub-industry (placebo).	Violation Tracker
log Peer Penalty \$	Log of total peer-firm ESG penalty dollars in the sub-industry-year (dose-response).	Violation Tracker
Shock $\times$ RelFem	Interaction term identifying the moderation effect (Eq. 5).	Constructed
Shock $\times$ RelFem ²	Quadratic interaction term testing the inverted U-shape prediction.	Constructed

Notes: Sample: 494 S&P 500 firms, 2010–2023; 6,567 firm-year observations. Refinitiv ESG scores cover 6,356 firm-years (97%); Compustat financial variables cover 6,046 firm-years (92%). “Outside-own-board” connections exclude director ties via fellow directors of the focal board. Violation Tracker matched to S&P 500 firms via SEC CIK; all penalties in 2023 USD. Main identification variable: PeerShock $\geq$ \$1M (sub-industry). See Section 3 for details of the identification strategy.

Table 2: Descriptive Statistics

	Mean	SD	Min	Max
<i>Panel A: ESG Performance (Refinitiv, 0–100; higher = better)</i>				
Environmental Score	54.664	25.998	0.00	98.55
Social Score	61.992	19.552	0.26	98.14
Governance Score	61.006	20.023	0.91	99.49
ESG Combined Score	59.600	17.326	5.87	95.16
Emissions	58.567	30.663	0.00	99.93
Resource Use	60.329	31.708	0.00	99.92
Env. Innovation	35.532	32.829	0.00	99.90
<i>Panel B: Board Network Homophily and Gender Composition</i>				
RelFem (F→F connectivity share)	0.246	0.117	0.00	0.91
RelMale (M→M connectivity share)	0.741	0.044	0.48	0.91
HighStatusFem (# Tier-1–2 F peers)	0.816	1.281	0.00	13.61
Gender Ratio (women / board size)	0.245	0.107	0.05	1.00
Board Size (directors)	11.098	2.206	4.00	30.00
Share F (NEW ties, < 3y)	0.293	0.162	0.00	0.89
Share F (OLD ties, ≥ 3y)	0.256	0.130	0.00	0.92
Mean peer-firm Env (F)	57.216	23.912	0.00	97.74
<i>Panel C: Board Governance Characteristics</i>				
Avg. Director Age (yrs)	64.007	3.430	41.00	78.30
Avg. Director Tenure (yrs)	8.113	3.387	0.10	25.27
CEO Duality (=1 if CEO = Chair)	0.682	0.466	0	1
Board Meetings per Year	8.126	3.680	1.00	43.00
Board Independence (%)	84.106	8.959	37.50	100.00
<i>Panel D: Financial Performance and Firm Size</i>				
ROA (%)	8.334	6.599	-6.19	30.15
Firm Size (employees, 000s)	53.889	134.020	0.01	2300.00
<i>Panel E: Own-Firm ESG Violations (Violation Tracker)</i>				
Number of violations in year (count)	3.755	12.884	0	279.00
Any ESG violation (=1)	0.510	0.500	0	1
Any ESG violation ≥ \$1M (=1)	0.207	0.405	0	1
<i>Panel F: Peer ESG Shock Indicators (binary; main and robustness alternatives)</i>				
Peer ESG Shock ≥ \$1M, sub-ind. (<i>main</i>)	0.475	0.499	0	1
Peer ESG Shock ≥ \$10M, sub-ind.	0.288	0.453	0	1
Peer ESG Shock (any amount), sub-ind.	0.754	0.431	0	1
Peer Environmental Penalty ≥ \$1M, sub-ind.	0.145	0.352	0	1
Peer Social Penalty ≥ \$1M, sub-ind.	0.322	0.467	0	1
Peer Governance Penalty ≥ \$1M, sub-ind.	0.252	0.434	0	1
Peer Non-ESG Penalty ≥ \$1M, sub-ind. (<i>placebo</i>)	0.344	0.475	0	1

Estimation sample: 494 S&P 500 firms, 2010–2023; $N = 6,036$ firm-year observations (boards with at least one female director and at most 30 directors). ESG pillar and combined scores from Refinitiv (0–100, higher = better). *RelFem* (*RelMale*) is the mean share of *pre-existing* (older-than-one-year) same-gender inter-corporate connections among female (male) directors. Firm Size shown in thousands of employees. Peer-shock indicators from Good Jobs First Violation Tracker; “Sub-ind.” = GICS sub-industry peer group. Main identification variable: Panel F, row 1.

Table 3: Female-Network Composition and Environmental Performance: Within-Firm OLS Estimates

	(1)	(2)	(3)	(4)
Female Conn. Index	0.003** (0.002)			
Male Conn. Index	0.015*** (0.003)			
FemFem Conn. Index		0.011** (0.005)		
MaleMale Conn. Index		0.020*** (0.003)		
RelFem			10.926*** (3.625)	39.305*** (9.106)
RelFem ²				-50.929*** (15.029)
RelMale			-13.479 (15.675)	89.299 (168.612)
RelMale ²				-69.201 (114.452)
Board Size	0.971*** (0.238)	0.985*** (0.239)	0.985*** (0.245)	0.979*** (0.245)
Gender Ratio	16.305*** (4.802)	16.243*** (4.774)	11.335** (4.802)	10.436** (4.719)
Avg. Director Age	0.520** (0.223)	0.516** (0.222)	0.511** (0.228)	0.480** (0.228)
Avg. Director Tenure	0.287 (0.185)	0.283 (0.185)	0.268 (0.190)	0.230 (0.189)
CEO Duality	0.083 (1.170)	0.107 (1.171)	0.067 (1.216)	0.072 (1.196)
Board Meetings	-0.093 (0.083)	-0.093 (0.083)	-0.104 (0.085)	-0.099 (0.084)
Board Independence	0.080 (0.056)	0.079 (0.056)	0.074 (0.059)	0.075 (0.058)
Firm Size ($\times 10^{-5}$)	2.86*** (0.88)	2.87*** (0.89)	2.78*** (0.79)	2.95*** (0.80)
Observations	5932	5932	5932	5932
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R ²	0.781	0.781	0.775	0.777

Notes: Within-firm OLS estimates of Refinitiv *EnvScore* on female-network composition; all columns include firm and year fixed effects and the full board and firm control set. Columns (1)–(2) use raw same-gender connection counts; columns (3)–(4) use *RelFem* (the female share of directors' pre-existing female ties), with column (4) adding its quadratic (turning point $RelFem^* = 0.386$). The sample is held fixed across columns at boards with at least one woman and at most 30 directors and non-missing *RelFem*; standard errors clustered at the firm level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Network Composition Moderates the Environmental Response to Peer ESG Enforcement: Difference-in-Differences Across Shock Definitions

	(1) ESG (any)	(2) ESG $\geq$ \$1M	(3) ESG $\geq$ \$10M	(4) Non-ESG
Peer Shock	-4.759* (2.538)	-6.370*** (1.947)	-3.454 (2.477)	-4.439** (2.192)
Shock $\times$ RelFem	41.680*** (15.773)	42.321*** (13.422)	25.460 (16.032)	21.146 (13.303)
Shock $\times$ RelFem ²	-70.004*** (25.248)	-59.491*** (22.850)	-39.978 (27.107)	-26.154 (21.839)
RelFem	7.926 (14.752)	19.883* (11.281)	32.953*** (9.817)	30.555*** (11.079)
RelFem ²	-3.313 (22.749)	-28.140 (19.318)	-44.685*** (16.720)	-42.759** (19.141)
Observations	5430	5430	5430	5430
Firm FE	Yes	Yes	Yes	Yes
GICS Sub-ind. $\times$ Year FE	Yes	Yes	Yes	Yes
Adj. R ²	0.809	0.809	0.808	0.809

Standard errors clustered at the firm level in parentheses. All columns include firm and GICS sub-industry $\times$ year fixed effects, the full board and firm control set, and *RelMale* (linear and quadratic). Columns sweep the ESG peer-penalty dollar threshold—(1) any amount, (2) $\geq$ \$1M (headline), (3) $\geq$ \$10M—and (4) a non-ESG enforcement placebo. The *RelFem* and *RelFem*² *level* terms capture the baseline (no-shock) relationship between network composition and *EnvScore*; this curvature loads on the Shock interaction when the peer shock is common and strongly moderating (columns 1–2) and on the level terms when the shock is rare (column 3) or a placebo (column 4). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Network-Conditional Sustainability Response Across Outcome Dimensions

Outcome	Peer Shock	Shock $\times$ RelFem	Shock $\times$ RelFem ²	<i>N</i>
<i>Panel A. Across ESG performance scores (Refinitiv, 0–100)</i>				
Environmental Score	-6.370*** (1.947)	42.321*** (13.422)	-59.491*** (22.850)	5430
Social Score	-2.256 (1.603)	21.416* (11.771)	-46.663** (20.837)	5430
Governance Score	-1.033 (1.993)	20.896 (13.271)	-36.036* (21.725)	5430
ESG (combined)	-2.623** (1.306)	24.854** (9.621)	-44.791*** (16.978)	5430
<i>Panel B. Within the Environmental score: Refinitiv sub-components</i>				
Emissions	-7.706*** (2.473)	57.895*** (16.653)	-93.551*** (28.735)	5430
Resource Use	-4.226 (2.743)	41.597** (19.392)	-73.769** (33.450)	5430
Environmental Innovation	-4.084 (2.826)	13.201 (19.100)	3.194 (33.125)	5430
<i>Panel C. Financial-performance falsification (percentage points)</i>				
Return on Assets	0.031 (0.546)	3.637 (3.481)	-9.095 (5.823)	5196

Notes: Each row is a separate regression of the indicated outcome on the headline peer ESG shock (any same-sub-industry peer ESG penalty $\geq \$1\text{M}$) interacted linearly and quadratically with *RelFem*, plus *RelFem*, *RelMale* (linear and quadratic), the full board and firm control set, firm fixed effects and GICS sub-industry $\times$ Year fixed effects; SE (in parentheses) clustered at the firm level. Sample: boards with at least one woman and at most 30 directors, 2010–2023. Panel A shows the moderation generalizes across the full ESG scorecard; Panel B decomposes the environmental score into its Refinitiv sub-components, showing the response concentrates in the operational Emissions and Resource-Use dimensions and is absent for Environmental Innovation; Panel C is a financial-performance falsification (return on assets, winsorized at 1/99 and expressed in percentage points), on which the moderation is statistically null—confirming the channel is specific to sustainability rather than generic firm performance. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Decomposing the Network Channel: Status, Vintage, and Role-Model Mechanisms

	(1) Baseline	(2) HighStatus Fem	(3) Horse race	(4) Old vs New	(5) Role model	(6) Industry placebo
Peer ESG Shock	-6.370*** (1.947)	-1.429 (0.922)	-6.494*** (1.957)	-3.051* (1.612)	-4.376*** (1.512)	-1.478 (1.225)
Shock $\times$ RelFem	42.321*** (13.422)		36.909*** (13.836)			
Shock $\times$ RelFem ²	-59.491*** (22.850)		-52.224** (24.274)			
Shock $\times$ HighStatusFem		2.074*** (0.793)	1.710** (0.795)			
Shock $\times$ HighStatusFem ²		-0.247** (0.110)	-0.224** (0.106)			
Shock $\times$ Share F (OLD)				9.352** (4.623)		
Shock $\times$ Share F (NEW)				1.167 (3.387)		
Shock $\times$ Role-Model (F)					0.065*** (0.023)	
Shock $\times$ Same-Ind. F peers						0.202 (0.155)
Observations	5430	5430	5430	5430	5182	5445
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
GICS Sub-ind. $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R ²	0.809	0.807	0.810	0.808	0.942	0.806

Notes: DiD moderation of the identifying peer ESG shock ($\geq \$1M$, sub-industry) on Refinitiv EnvScore; the *Peer ESG Shock* row reports the main treatment effect. Column (1) is the baseline *RelFem* quadratic moderation; (2) replaces *RelFem* with *HighStatusFem* (mean count of Tier-1–2 female peers in directors’ external networks); (3) is a horse race in which both moderators enter jointly and both survive; (4) decomposes the female-tie moderation into long-standing (OLD, tie age ≥ 3) and newly-formed (NEW, < 3 years) components, showing it loads on long-standing ties; (5) uses role-model exposure (mean EnvScore of the firms where the focal’s pre-existing female peers serve, excluding the focal firm); (6) is an industry-information placebo, Shock $\times$ the count of same-sub-industry female peers, which is null. All specifications include firm and GICS sub-industry $\times$ year fixed effects; SE clustered at the firm level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figures

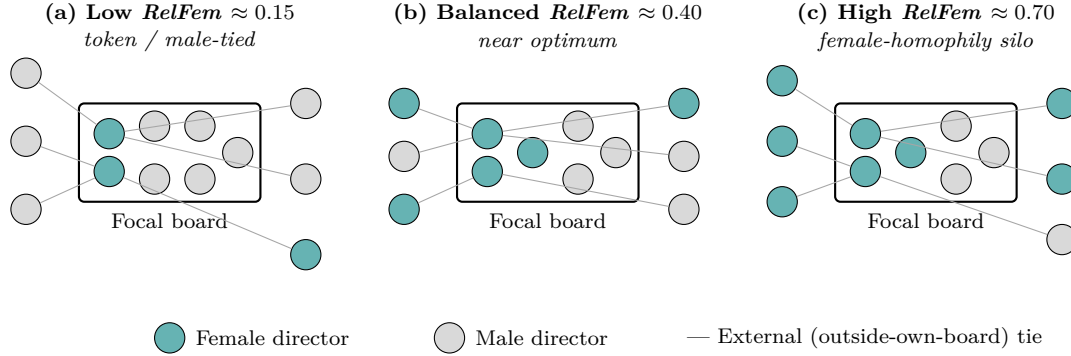


Figure 1: **Stylized representation of *RelFem*.** Each panel shows a focal board and the external ties of its female directors; the share of those ties landing on female peers defines *RelFem*—low (≈ 0.15 , token), balanced (≈ 0.40 , near the empirical optimum), and high (≈ 0.70 , female-homophily silo). The empirical inverted U-shape implies the sustainability response is strongest at the balanced level.

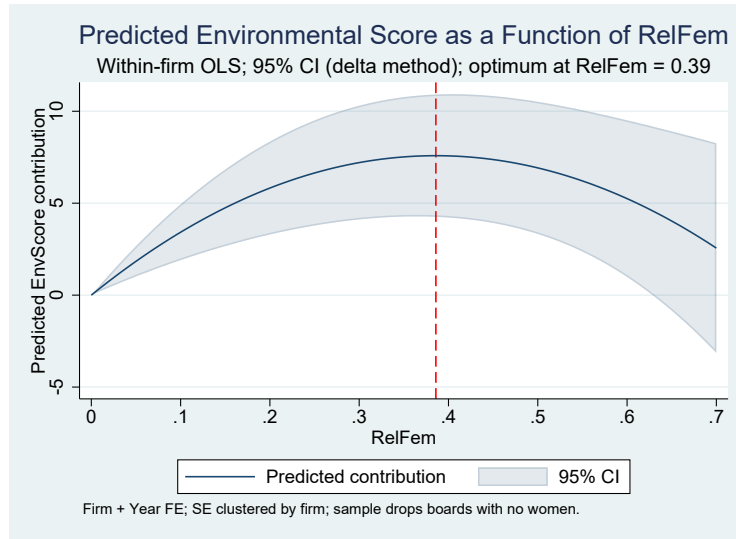


Figure 2: **Predicted Environmental Score as a function of *RelFem*.** Within-firm OLS quadratic fit (Table 3, Column (4)); firm and year fixed effects, SE clustered by firm; shaded band is the 95% CI (delta method). The contribution is inverted U-shape with an interior maximum at $RelFem^* = 0.386$ (dashed line).

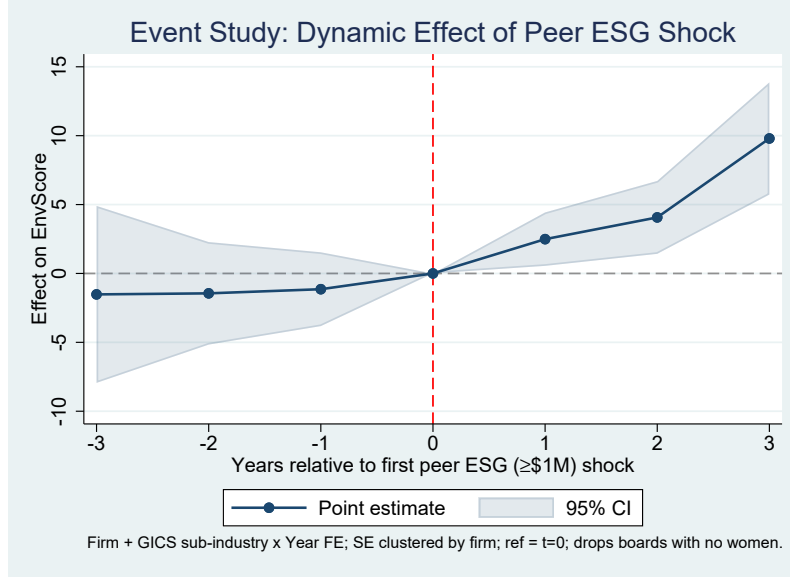


Figure 3: **Event study: dynamic effect of the peer ESG shock.** Coefficients β_k from Equation (6) relative to $t = 0$ (omitted reference; dashed red line). Firm and GICS sub-industry $\times$ year fixed effects; SE clustered by firm; capped lines are 95% CIs. The pre-period coefficients ($t = -3, -2, -1$) are jointly zero ($F = 0.26$, $p = 0.856$).

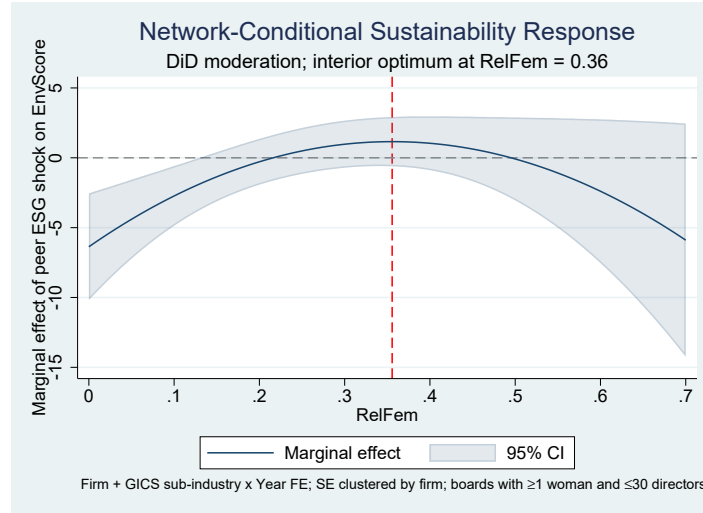


Figure 4: **Network-conditional sustainability response.** Marginal effect of the peer ESG shock on Environmental Score across the observed *RelFem* range (quadratic-interaction DiD). Firm and GICS sub-industry $\times$ year fixed effects; SE clustered by firm; shaded band is the 95% CI (delta method). The effect is inverted U-shape with an interior maximum at $RelFem \approx 0.356$, consistent with the OLS turning point.

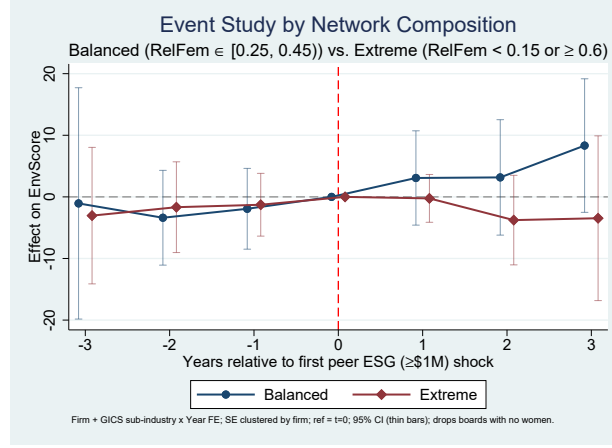


Figure 5: **Event study by network composition.** Coefficients β_k (Equation (6), $\geq \$1M$ peer shock) for balanced-network firms (navy circles, $RelFem \in [0.25, 0.45]$) and firms at compositional extremes (maroon diamonds, $RelFem < 0.15$ or ≥ 0.6), relative to $t = 0$ (omitted reference; dashed red line). Firm and GICS sub-industry $\times$ year fixed effects; SE clustered by firm; capped lines are 95% CIs. The post-shock response concentrates in balanced networks.

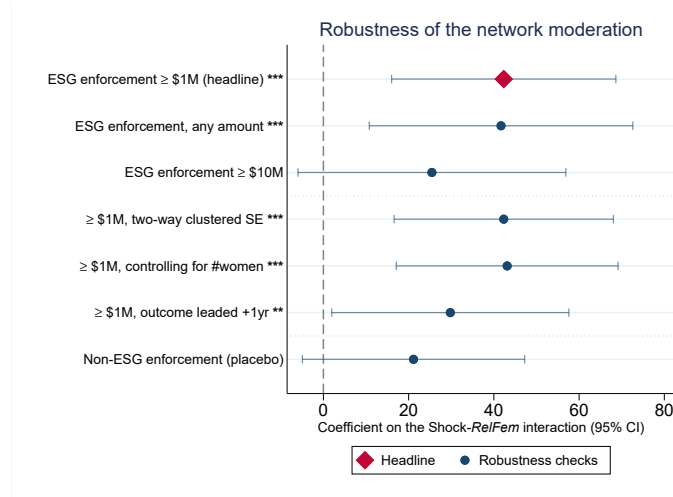


Figure 6: **Robustness of the network moderation.** Each row reports the linear Shock $\times RelFem$ coefficient (with its 95% confidence interval) from the quadratic difference-in-differences specification, re-estimated under alternative shock definitions, inference methods, and controls. The headline specification (peer ESG enforcement $\geq \$1M$; red diamond) is reproduced at the any-amount and $\geq \$10M$ thresholds; under two-way clustering by firm and sub-industry-year; controlling for the absolute number of women on the board; and with the outcome lead one year.

Appendix

A. Supporting tables and figures

Table A1: Structure and Composition of Directors' External Networks, by Gender

	Female	Male	Diff. (F–M)
<i>Panel A: Network size and reach (counts of distinct external peers)</i>			
Average degree (distinct external ties)	13.20 (5.21)	12.88 (5.16)	+0.32***
Own-gender peers	3.47 (2.26)	9.35 (3.71)	–5.88***
Cross-gender peers	9.73 (3.69)	3.53 (2.21)	+6.20***
High-status (Tier-1–2) own-gender peers	0.83 (1.27)	4.10 (2.29)	–3.27***
<i>Panel B: Network composition (shares of own-gender ties)</i>			
Share of ties to own gender (<i>RelFem</i> / <i>RelMale</i>)	0.250 (0.115)	0.738 (0.117)	–0.488***
Share to senior (board) peers	0.829 (0.214)	0.881 (0.133)	–0.052***
Share to high-ESG firms	0.519 (0.459)	0.515 (0.471)	+0.003***
<i>Panel C: Tie vintage</i>			
Old ties (formed >3 years earlier)	0.181 (0.164)	0.204 (0.174)	–0.023***
New ties (formed within last 3 years)	0.819 (0.164)	0.796 (0.174)	+0.023***
Pre-existing share (>1 year)	0.429 (0.268)	0.474 (0.240)	–0.045***
Mean tie age (years)	1.89 (1.03)	2.05 (1.12)	–0.16***

Board-year means over a board's female (male) directors' distinct external Listed-Org connections; S&P 500 boards with at least one woman, 2010–2023 ($\approx 6,040$ board-years). Cell entries are means with standard deviations in parentheses; “own gender” denotes female-to-female ties for female directors and male-to-male ties for male directors. In Panel A, peer counts are numbers of distinct external directors reached; high-status peers are those holding Tier-1–2 board roles (chair, CEO, lead independent, or senior executive). The final column reports the female–male difference and its significance from a paired t -test across board-years. The own- versus cross-gender asymmetry—female directors reach about three female and ten male peers, male directors the reverse—reflects the minority position of women on boards: female directors are mechanically less able to form own-gender ties, yet still hold slightly broader and more recently formed networks. High-ESG = peer firm above-median Refinitiv EnvScore in that year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

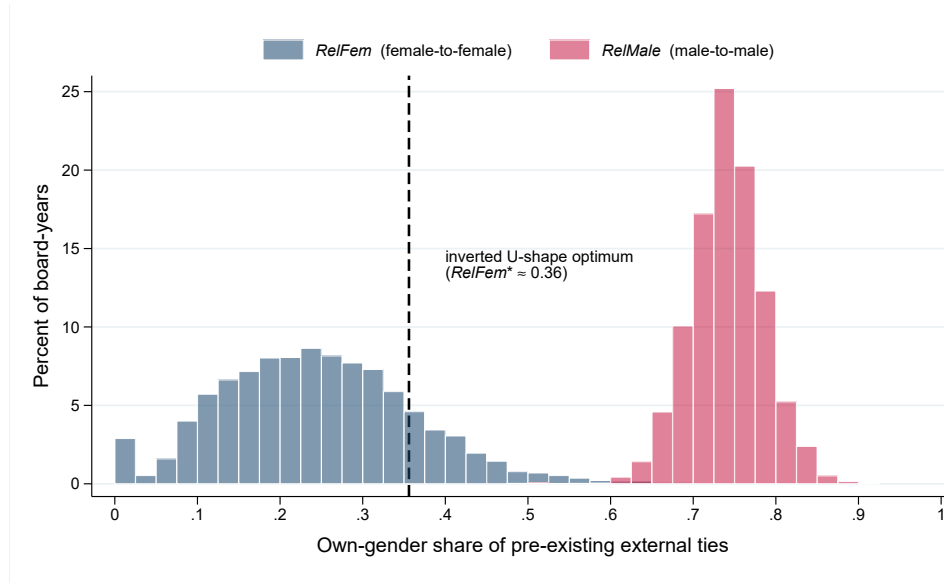


Figure A1: **Distribution of own-gender network homophily, by director gender.** Histogram of *RelFem* (female directors’ female-to-female pre-existing tie share) and *RelMale* (male directors’ male-to-male share) over the analytic sample of S&P 500 board-years, 2010–2023. The dashed line marks the sustainability-optimal balance (the DiD turning point, $RelFem^* \approx 0.356$). Male directors are far more own-gender homophilous (mean 0.74) than female directors (mean 0.25), and most board-years fall below the optimum—underscoring that the balanced configurations our results identify as most effective are comparatively rare.

Table A2: ESG Regulatory Penalties: Characteristics of the Peer Shock Variable

<i>Panel A: S&P 500 firm regulatory penalties by ESG category (2010–2023)</i>				
	Penalty events	Firms penalized	Avg. (\$M)	Total (\$B)
Environmental	3,863	263	20.2	77.94
Social	15,121	390	3.9	59.70
Governance	1,081	190	56.6	61.17
<i>Memo: Non-ESG (placebo)</i>	3,251	275	47.6	154.75
<i>Total ESG</i>	20,065	417	9.9	198.81
<i>Panel B: ESG penalty events by threshold</i>				
	Penalty events	S&P 500 firms	Sub-industries	Total (\$B)
Any amount	20,065	417	116	198.81
$\geq \$1M$ (<i>main shock</i>)	1,870	291	98	198.04
$\geq \$10M$	792	193	76	193.92
$\geq \$100M$	210	74	39	176.19
<i>Panel C: Industry distribution of ESG penalty events ($\geq \\$1M$), top 10</i>				
GICS sub-industry	Events	% events	Firms	% \$
Diversified Banks	380	20.3%	8	41.9%
Investment Banking & Brokerage	95	5.1%	4	8.0%
Electric Utilities	90	4.8%	14	11.9%
Aerospace & Defense	72	3.9%	10	2.9%
Integrated Oil & Gas	65	3.5%	3	0.8%
Pharmaceuticals	61	3.3%	5	8.8%
Consumer Staples Merch. Retail	60	3.2%	5	0.5%
Asset Mgmt. & Custody Banks	49	2.6%	10	1.5%
Air Freight & Logistics	46	2.5%	3	0.4%
Managed Health Care	40	2.1%	5	0.7%
Top 10 sub-industries (subtotal)	958	51.2%	67	77.2%
All other (88 sub-industries)	912	48.8%	224	22.8%

Source: Good Jobs First Violation Tracker, matched to the S&P 500 panel via CIK; all penalties in 2023 USD. *ESG categories:* Environmental = EPA, Clean Air/Water Act, hazardous waste; Social = labor relations, OSHA, discrimination; Governance = SEC enforcement, financial fraud, bribery; Non-ESG = all other violations (used as placebo). *Main shock:* Panel B, row 2 ($\geq \$1M$ threshold, GICS sub-industry peer group). A firm-year receives a peer-shock indicator if any *other* S&P 500 firm in the same sub-industry was penalized in that year.

Table A3: Pairwise Correlations Among Key Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(1) EnvScore	1																		
(2) Social	0.71***	1																	
(3) Governance	0.36***	0.31***	1																
(4) ESG (Combined)	0.85***	0.87***	0.66***	1															
(5) Emissions	0.86***	0.68***	0.35***	0.78***	1														
(6) Resource Use	0.86***	0.74***	0.35***	0.82***	0.79***	1													
(7) Env. Innovation	0.64***	0.34***	0.21***	0.48***	0.36***	0.39***	1												
(8) RelFem	0.32***	0.30***	0.19***	0.34***	0.32***	0.34***	0.16***	1											
(9) RelMale	-0.20***	-0.25***	-0.08***	-0.23***	-0.21***	-0.25***	0.00	-0.39***	1										
(10) Gender Ratio	0.32***	0.34***	0.27***	0.39***	0.32***	0.33***	0.14***	0.65***	-0.39***	1									
(11) Board Size	0.28***	0.20***	0.01	0.19***	0.23***	0.21***	0.14***	0.09***	-0.14***	-0.02	1								
(12) Avg. Age	0.09***	0.06***	0.11***	0.09***	0.09***	0.04***	-0.01	-0.06***	0.06***	-0.06***	0.13***	1							
(13) Avg. Tenure	-0.08***	-0.10***	-0.03***	-0.09***	-0.10***	-0.12***	-0.05***	-0.12***	0.09***	-0.21***	0.07***	0.37***	1						
(14) CEO Duality	0.04***	0.05***	-0.16***	-0.03***	0.02***	0.02***	0.05***	0.00	0.03***	-0.03***	0.10***	0.13***	0.18***	1					
(15) Board Meetings	0.13***	0.10***	0.06***	0.11***	0.11***	0.11***	0.04***	0.07***	-0.05***	0.11***	0.14***	0.01	-0.16***	-0.06***	1				
(16) Board Indep.	0.21***	0.23***	0.40***	0.35***	0.20***	0.20***	0.12***	0.10***	-0.13***	0.26***	0.07***	0.07***	-0.11***	-0.05***	0.10***	1			
(17) Peer Shock ($\geq \$1M$)	0.11***	0.09***	0.07***	0.10***	0.09***	0.10***	-0.01	0.07***	-0.10***	0.08***	0.17***	0.06***	-0.08***	0.06***	0.13***	0.12***	1		
(18) ROA (%)	-0.10***	0.04***	-0.05***	-0.02***	-0.06***	0.00	-0.07***	0.04***	-0.07***	0.01	-0.20***	-0.12***	0.04***	-0.02	-0.23***	-0.03***	-0.10***	1	
(19) HighStatusFem	0.24***	0.24***	0.08***	0.23***	0.24***	0.25***	0.14***	0.36***	-0.20***	0.18***	0.18***	-0.07***	-0.06***	0.07***	0.07***	0.02	0.06***	0.04***	1

Lower-triangular Pearson correlation matrix for the S&P 500 panel, 2010–2023, restricted to boards with at least one woman (N up to 6,000 firm-year observations; sample size for each pair from jointly non-missing observations). Variables (5)–(7), indented, are the Refinitiv environmental sub-components of EnvScore. *RelFem* is the pre-existing-ties female-homophily measure; *RelMale* the male analogue; *HighStatusFem* the mean count of Tier-1–2 female peers; *ROA* is winsorized at 1/99 and in percentage points. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Variable definitions in Table 1.

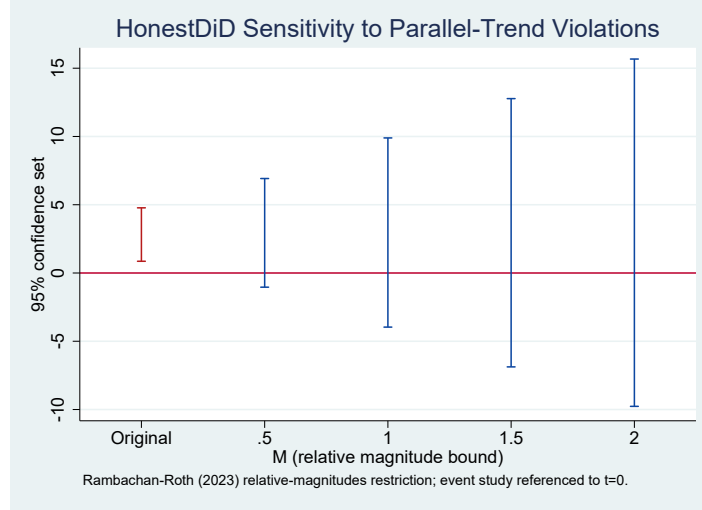


Figure A2: **HonestDiD sensitivity analysis** (Rambachan and Roth, 2023) for the event study referenced to $t = 0$. First interval: original 95% CI for the first post-period effect $([0.86, 4.77], \text{excludes zero})$. Subsequent intervals: 95% confidence sets under the relative-magnitudes restriction $\Delta^{RM}(M)$, $M \in \{0.5, 1, 1.5, 2\}$; the set admits zero for all $M \geq 0.5$. Firm and GICS sub-industry $\times$ year fixed effects; SE clustered by firm.

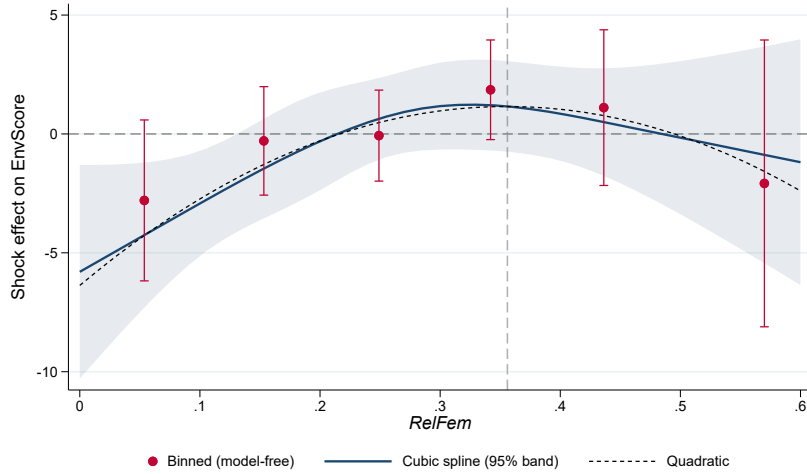


Figure A3: **The inverted U-shape is not an imposed functional form.** The figure overlays three estimates of how the peer ESG shock's marginal effect on *EnvScore* varies with *RelFem*: a model-free step function within equal-width (0.1-wide) *RelFem* bins (red points, 95% CIs); a flexible restricted cubic spline (navy line, shaded 95% band); and the quadratic of the headline model (black dashed line). All three trace the same inverted U. The model-free bins rise from negative at low *RelFem* to a peak near the quadratic vertex ($RelFem^* \approx 0.356$, vertical dashed line) and turn negative again in the top bin ($RelFem \geq 0.5$), so the decline at high *RelFem* is present in the data, not an extrapolation of the quadratic. The spline—free to take any smooth shape—selects the same hump, and its shock–*RelFem* interaction terms are jointly significant ($p = 0.013$). The band widens at the extremes, where *RelFem* is sparse (the top bin pools $RelFem \geq 0.5$). Firm and GICS sub-industry $\times$ year fixed effects; SE clustered by firm.

B. Definition and construction of the network measures

The board-network measures are built from BoardEx director-affiliation data, which record, for each pair of directors, the listed companies they are jointly affiliated with and the calendar window over which the affiliation overlaps. We treat two directors as *connected* in year t if they share a Listed-Org affiliation active in t ; a director’s *external network* in year t is the set of other directors to whom she is connected through boards *other* than the focal firm’s own, with self-ties excluded. Director gender is taken from BoardEx director profiles. A tie’s *age* in year t is t minus its overlap-start year, and a tie is *pre-existing* if it was established more than one year before t (age > 1); restricting to pre-existing ties makes the network predetermined with respect to the contemporaneous peer shock.

Homophily shares (*RelFem*, *RelMale*). For each female director we compute the share of her pre-existing external connections that run to other women, and average this share across the firm’s female directors to obtain $RelFem_{ft}$ (Equation 1); $RelMale_{ft}$ is the analogous male-to-male share over male directors, both bounded $[0, 1]$. The *FemFem* and *MaleMale* connectivity indices used in the within-firm robustness columns are the corresponding *counts* (average number of female-to-female and male-to-male external connections), not shares.

Tie vintage (*Share F (NEW)*, *Share F (OLD)*). We split each female director’s external peers by tie age into newly-formed ties (established within the past three years) and long-standing ties (established earlier) and compute the female share within each set; $Share F (NEW)_{ft}$ and $Share F (OLD)_{ft}$ are the board-level means of these director-level shares.

Role-model exposure and the industry placebo. The role-model measure takes, for each female director, the mean Refinitiv Environmental Score of the firms in which her pre-existing *female* peers serve—*excluding the focal firm itself*—averaged across the board’s female directors. The industry-information placebo

counts each director’s female peers serving in firms in the focal firm’s own GICS sub-industry, again averaged across directors.

Tier classification of peer board roles. Tier assignment for the *HighStatusFem* variable (Section 3.2.3) draws on each peer’s reported board role title, board-position indicator, and executive-director flag in BoardEx, applying priority-ordered string matching against the five tiers defined in the footnote to Section 3.2.3. Applied to the 6.43 million listed-org peer–board overlaps that intersect the 2008–2024 window, the classifier yields:

Tier	Overlaps	%
T1 Top (Chair / CEO / Lead Independent)	1,139,887	17.7%
T2 Senior executive	706,795	11.0%
T3 Committee chair / senior partner	75,254	1.2%
T4 Standard director / member	4,357,163	67.6%
T5 Honorary / emeritus / advisory	151,852	2.4%
Total	6,430,951	100.0%
T1–2 (“high-status” subset used in <i>HighStatusFem</i>)	1,846,682	28.7%

HighStatusFem_{ft} counts the Tier-1–2 peers in each director’s external network who are also flagged female in the BoardEx director profiles, and averages this count across the firm’s directors. Of the 1.85 million high-status peer-board overlaps in the universe, approximately 12% have a female peer (consistent with the 11–16% female share of high-status board roles documented in the broader executive-suite literature).

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