

Assessing board-level determinants of ESG-ERM implementation: A configurational approach¹

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Abstract

Frame of the research: Corporate governance is increasingly shaped by sustainability-related pressures, as Environmental, Social, and Governance (ESG) risks become structurally embedded within the strategic dynamics of manufacturing firms. The transition from voluntary ESG communication to mandatory, risk-oriented disclosure under emerging regulations, such as the CSRD, necessitates a reassessment of how boards integrate ESG-related exposures into formal risk-management systems.

Purpose of the paper: This study examines how specific configurations of board attributes facilitate or hinder the implementation of ESG-oriented Enterprise Risk Management (ESG-ERM). It addresses theoretical fragmentation in prior research by offering a configurational perspective on the role of boards in institutionalising ESG risk governance.

Methodology: The study applies fuzzy-set Qualitative Comparative Analysis (fs/QCA) to a sample of European manufacturing firms listed in the STOXX 600 index to identify equifinal board configurations leading to high and low ESG-ERM implementation. Antecedent conditions include board gender diversity, independence, industry-specific expertise, and the presence of CSR committees.

Findings: The results identify two equifinal board configurations associated with high ESG-ERM implementation: one combining gender diversity, independence, and a CSR committee; the other relying on independence and industry-specific expertise in the absence of a CSR committee. A distinct configuration, marked by the absence of diversity, independence, industry-specific expertise, and a CSR committee, is sufficient for low ESG-ERM implementation.

Research limitations: The measurement of ESG-ERM relies on disclosure-based indicators, which may not fully capture substantive implementation. The sectoral and regional focus limits external generalizability.

Practical implications: The study provides guidance for decision-makers seeking to strengthen ESG-oriented risk governance by identifying board configurations that support the institutionalisation of ESG-ERM.

Originality of the paper: By adopting a configurational approach, the paper advances governance research beyond linear, single-factor explanations. It demonstrates how board-level complementarities shape firms' capacity to embed ESG risks within enterprise risk management.

Key words: ESG-ERM; sustainable corporate governance; board configurations; fs/QCA; sustainability risk governance.

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1. Introduction

As global challenges intersect with industrial operations, companies face mounting expectations to contribute meaningfully to sustainable development. Manufacturing firms, in particular, encounter pressures related to climate transition, resource dependency, and social impacts within complex supply chains (Abbasi and Nilsson, 2012; Christophe and Gaudenzi, 2015; Kohl *et al.*, 2020). In Europe, these expectations have intensified as the regulatory environment shifts from voluntary sustainability communication to mandatory, structured disclosure (Mahmood *et al.*, 2026). The Corporate Sustainability Reporting Directive (CSRD) requires firms to assess and report material Environmental, Social, and Governance (ESG) risks, demonstrating how these risks are embedded in strategy, governance, and risk-management systems (Baumüller and Sopp, 2022). Consequently, attention has shifted from generic sustainability commitments to the critical issue of how organisations govern ESG-related exposures within formal Enterprise Risk Management (ERM) architectures. In this context, integrating ESG-related exposures into formal ERM systems, termed ESG-oriented ERM (ESG-ERM), becomes a central outcome of risk governance.

Risk management is now central to corporate governance amid heightened uncertainty and complexity (Van Asselt and Renn, 2011). Nevertheless, firms vary significantly in their ability to translate sustainability ambitions into robust ESG risk-management practices (Shah *et al.*, 2025).

Existing literature indicates that internal governance mechanisms strongly influence sustainability performance and the institutionalisation of risk-management routines. Boards of directors play a crucial role in defining strategic priorities, overseeing managerial decisions, and ensuring accountability for ESG issues (Beasley *et al.*, 2005; Ingley and van der Walt, 2003). Previous studies show that board characteristics such as independence, expertise, and diversity shape risk oversight and sustainability orientation (Naciti, 2019). However, research has primarily examined their effects on ESG performance and sustainability outcomes, offering fragmented and sometimes contradictory evidence. Less is known about how specific board configurations support the implementation of ESG-oriented ERM systems, despite ERM integration being essential for CSRD compliance. Moreover, studies often rely on linear models that treat governance mechanisms as isolated antecedents (Buchetti *et al.*, 2025), overlooking how board attributes may complement or offset each other in shaping firms' internalisation of ESG risks. Since ESG-ERM implementation likely depends on bundles of governance capacities rather than single attributes, 'net effect' theorising may obscure equifinal governance pathways and the possibility that conditions function as complements or substitutes (Fiss, 2011; Ragin, 2009).

To address this gap, the present study poses the following research question: how do configurations of board-level governance mechanisms shape the implementation of ESG-ERM in European manufacturing firms? Adopting a configurational approach (Ragin, 2008), this study identifies

equifinal combinations of board characteristics associated with high and low ESG-ERM implementation.

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The remainder of the paper is organised as follows. The next section reviews the literature on ERM, ESG risk governance, and board determinants, developing an integrated conceptual framework that links these literatures through a configurational risk-governance lens. The methodological section describes the sample and the fs/QCA design. The results and discussion section presents governance configurations linked to ESG-ERM implementation and their interpretation. The final section discusses implications and avenues for future research.

2. Theoretical background

2.1 Enterprise risk management of ESG risks

Over the past two decades, sustainability challenges and financial disruptions have prompted regulatory and standard-setting bodies to develop corporate governance frameworks that promote institutionalised ERM systems (Subramaniam *et al.*, 2015). Among these, the ERM framework, first introduced in 2004 by the Committee of Sponsoring Organisations of the Treadway Commission (COSO), has emerged as the dominant risk-management standard (Beasley *et al.*, 2015; Hayne and Free, 2014).

ERM is defined by COSO (2013) as a board-directed process applied across the enterprise to identify potential events and manage risks within the organisation's risk appetite, thereby supporting the achievement of strategic objectives. Unlike traditional risk management approaches, which primarily aim to mitigate risks to acceptable levels, ERM adopts a more advanced, strategic perspective, positioning risk as an integral component of value creation (Bromiley *et al.*, 2015; COSO, 2017).

This strategic reorientation of ERM gradually created the conceptual basis for extending its scope beyond conventional financial and operational risks to include ESG concerns (Arena *et al.*, 2010; Perona, 2021; Shad *et al.*, 2019). To this end, COSO, in collaboration with the World Business Council for Sustainable Development (WBCSD), issued the *Guidance on Applying Enterprise Risk Management to Environmental, Social and Governance-related Risks* (COSO-WBCSD, 2018).

Empirical research suggests that ERM frameworks grounded in COSO principles enable organisations to institutionalise ESG risk assessment within strategic planning, thereby supporting transparency and stakeholder confidence (Fraser *et al.*, 2022). Similarly, firms proficient in ERM implementation better align governance and environmental objectives, achieving higher sustainability performance and governance quality (Kuo *et al.*, 2021), while mitigating reputational and financial exposures (Shad *et al.*, 2019; Shah *et al.*, 2025) and fostering ethical practices that extend beyond compliance to proactive risk anticipation (Mukhtar *et al.*, 2025; Sarkis, 2006).

Accordingly, we interpret ESG-ERM implementation as the extent to which ESG-related exposures are translated into formal enterprise-wide governance, assessment, response, and monitoring routines, rather than remaining confined to generic sustainability narratives.

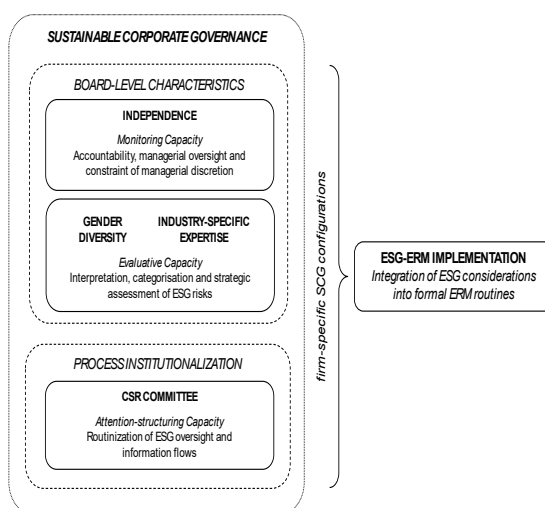
2.2 Conceptual framework: sustainable governance factors and ESG risk oversight

Effective corporate governance is widely recognised as a pillar of prudent risk oversight (Adams *et al.*, 2010; Drew *et al.*, 2006; Hermalin and Weisbach, 2001).

Because risk management constitutes a core component of corporate governance, responsibility for its effective implementation rests with the board of directors (Abdul Rahman *et al.*, 2013; Lang and Jagtiani, 2010). Internal governance mechanisms, particularly the board and its committees, are crucial, as firms frequently face challenges from misaligned managerial and stakeholder interests that external mechanisms address less effectively (Ellul, 2015).

To specify the mechanisms through which board attributes may shape ESG-ERM implementation, we draw on integrative board role perspectives that reconcile monitoring, service, and resource provision (Zahra and Pearce, 1989). In the context of ESG-related risk governance, these roles translate into three governance capacities (Fig. 1). First, *monitoring capacity* reflects the board's ability to constrain managerial discretion and ensure accountability for risk oversight. Second, *evaluative capacity* conveys directors' competence to interpret ambiguous ESG signals, categorise them into risk-relevant categories, and assess implications for strategy and controls. Third, *attention-structuring capacity* involves institutionalising ESG risk oversight through formal forums and routines that stabilise agenda setting, information flows, and follow-up.

Fig. 1: Theoretical framework



Source: Authors' elaboration

Consistent with this logic, the study focuses on four board-level attributes that embody these capacities: gender diversity, independence, industry-specific expertise, and the presence of a CSR committee. As shown in Figure 1, the proposed theoretical framework is configurational: building on set-theoretic reasoning, it treats governance outcomes as products of causal complexity in which conditions matter in combination rather than as isolated antecedents (Ragin, 2009; Schneider and Wagemann, 2012). The contribution of any attribute depends on the presence of other factors, making equifinality plausible and board attributes potential INUS conditions-insufficient by themselves but necessary components of sufficient configurations (Fiss, 2011). Causal asymmetry follows: the configurations associated with weak ESG-ERM are not simply the inverse of those linked to high ESG-ERM. Empirically, the conditions sufficient for low ESG-ERM implementation are not necessarily the logical negations of those sufficient for high implementation but may involve entirely different combinations of conditions. This asymmetry has broader implications. The four conditions provide partly overlapping governance capacities and can compensate for one another in specific configurations. The identified low-implementation pathway emerges when these compensating capacities are jointly absent, reflecting a logic of compound incapacity rather than active obstruction. In organisational systems, resilience depends on overlapping mechanisms, while failure arises when several capacities are lost simultaneously.

2.3 Board-level antecedents of ESG-ERM implementation

Gender diversity, independence, and industry-specific expertise shape board-level capacity by influencing the quality of deliberation, the credibility of scrutiny, and the ability to evaluate ESG-related exposures within a risk-governance framework (Behlau *et al.*, 2024). A CSR committee institutionalises the process by providing a structure for ESG-related risk oversight (Adardour *et al.*, 2026; Velte, 2024). These attributes support ESG-ERM implementation through intermediate governance functions.

Gender diversity activates evaluative capacity by broadening cognitive frames and increasing board sensitivity to emerging sustainability exposures (Byron and Post, 2016; Cordeiro *et al.*, 2020). Gender-diverse boards may incorporate a broader range of stakeholder perspectives into board deliberations, strengthening attention to ESG concerns and increasing the likelihood that they enter strategic and risk-governance assessments (Cambrea *et al.*, 2023; De Masi *et al.*, 2021). Research confirms that ERM can mediate the relationship between board gender diversity and sustainability performance by formalizing ESG risk assessment (Fakir and Jusoh, 2020). However, this influence is not automatic. Evidence on board processes indicates that the contribution of women directors depends not only on their presence but also on whether their representation is sufficient for their views to affect directors' attentiveness and cognitive conflict (De Masi *et al.*, 2022). Broader issue framing requires stable oversight routines for translation into ESG-ERM implementation, indicating that diversity

complements attention-structuring mechanisms rather than serving as a standalone driver (Endrikat *et al.*, 2021).

Board independence, defined as the share of directors without material affiliations to the firm beyond their board role (Coles *et al.*, 2001), enhances monitoring capacity by increasing scrutiny, limiting managerial dominance, and reinforcing accountability for governance choices (Dalton *et al.*, 1998; Hillman and Dalziel, 2003). Independent directors provide an external perspective that sharpens deliberation on environmental and social risks (Neville *et al.*, 2019). From an agency perspective, this monitoring role operates across different governance architectures, making independence a cross-cutting enabling condition rather than a pathway-specific one.

Industry-specific expertise activates evaluative capacity through disciplined risk assessment rather than broadened framing. Directors with prior experience in the firm's industry can leverage sector-specific knowledge to identify ESG issues as material enterprise risks and integrate them into mainstream ERM routines (Della Corte *et al.*, 2025). When evaluative competence is sufficiently strong, expertise may substitute for committee-based institutionalisation, offering an alternative pathway to ESG-ERM implementation that does not depend on a dedicated oversight structure.

CSR committees contribute to attention-structuring capacity by providing a dedicated forum for channelling, processing, escalating, and monitoring ESG-related information at the board level (Dixon-Fowler *et al.*, 2017; Schiehl *et al.*, 2023). This routinization is crucial when evaluative capacity is limited: in the absence of strong expertise or diversity, a committee stabilises attention and ensures systematic follow-up on ESG risk topics (Velte and Stawinoga, 2020). Conversely, when evaluative capacity is high, industry-expert directors can directly incorporate ESG considerations into existing governance processes, diminishing the marginal contribution of a dedicated committee.

3. Research design

3.1 Sample selection

Case selection in fs/QCA research rests on two core principles: defining a homogeneous analytical context and ensuring outcome heterogeneity within it (Meyer *et al.*, 1993; Rihoux and Ragin, 2009). Accordingly, we restrict the empirical domain to STOXX Europe 600 manufacturing firms as of January 2026, whose primary economic activity is classified within NACE Rev. 2 Section C, divisions 10-33 (Eurostat, 2008). This yields a final sample of 215 companies. The shared production logic of these activities gives the sample a common operating context. Moreover, for the purpose of our study we compare firms based on the institutionalisation of formal ESG-ERM processes and control structures, a governance-level construct distinct from industry-specific ESG themes (Shah *et al.*, 2025). Within this context, firms vary in their degree of ESG-ERM implementation, which provides the outcome heterogeneity that configurational analysis requires.

This sampling choice aligns with prior configurational research, which restricts the scope to manufacturing firms to enhance comparability of operating logic while retaining meaningful within-sector heterogeneity to identify multiple governance configurations (Mardawi *et al.*, 2023; Torres, 2024; Zhu *et al.*, 2025).

The manufacturing sector offers a valuable context for examining how ESG dimensions integrate into ERM. Its resource-intensive production, transnational supply chains, and technologically embedded operations increase vulnerability to environmental, social, and governance disruptions with systemic effects (Abbasi and Nilsson, 2012; Kano *et al.*, 2020; Schneider *et al.*, 2024). Operating within dense regulatory and stakeholder networks (Hu *et al.*, 2019), manufacturers face growing pressure to manage and disclose ESG risks under emerging frameworks, such as the CSRD and ESRS (Hummel and Jobst, 2024; Perona, 2021).

Descriptive statistics are reported in Table 1, while Table 2 summarises the geographical composition of the sample.

Tab. 1: Descriptive statistics

					Percentiles		
	Mean	SD	Min	Max	90 th	50 th	10 th
Independence	64.88	22.88	0.00	100.00	100.00	63.64	37.50
Gender diversity	39.12	9.25	0	70.00	50.00	40.00	28.57
Industry-specific expertise	49.15	25.64	0.64	97.79	84.08	48.81	16.30
CSR Committee	58.60	15.41	0.00	75.92	71.81	61.33	54.23
ESG-ERM Implementation	0.50	0.21	0.00	0.92	0.74	0.53	0.19

Source: Authors' elaboration

Tab. 2: Geographical composition of the sample (N = 215)

Country	N (%)	Country	N (%)
Austria	4 (1.86)	Netherlands	14 (6.51)
Belgium	5 (2.33)	Norway	7 (3.26)
Denmark	13 (6.05)	Spain	4 (1.86)
Finland	12 (5.58)	Sweden	27 (12.56)
France	20 (9.30)	Switzerland	33 (15.35)
Germany	31 (14.42)	United Kingdom	29 (13.49)
Ireland	3 (1.40)	Luxembourg	2 (0.93)
Italy	11 (5.12)		

Source: Authors' elaboration

3.2 Methodology: fuzzy set Qualitative Comparative Analysis (fs/QCA)

An expanding stream of literature views governance mechanisms as interdependent bundles rather than isolated factors (Filatotchev and Wright, 2017; García-Castro *et al.*, 2013; Ward *et al.*, 2009). Empirical studies demonstrate that corporate governance mechanisms operate in tandem, jointly shaping organisational outcomes through patterns of complementarity and substitution (Bell *et al.*, 2014; Misangyi and Acharya,

2014; Oh *et al.*, 2018). Capturing these interactions requires methodological approaches that reveal how different combinations of governance features relate to firm-level results, such as ESG-ERM implementation.

Fuzzy-set Qualitative Comparative Analysis (fs/QCA) offers a suitable methodology for analysing causal complexity and identifying multiple configurations that can produce the same outcome while preserving rich case-level data (Furnari *et al.*, 2021; Ragin, 2009; Schneider and Wagemann, 2012). Capturing these interactions requires methodological approaches that reveal how different combinations of governance features relate to firm-level results, such as ESG-ERM implementation (del Villegas-Periñán *et al.*, 2024; Garcia-Torres *et al.*, 2019; Villalba-Ríos *et al.*, 2023).

We performed fs/QCA using R (Pappas and Woodside, 2021; Thiem and Dusa, 2013). Following the principles of fuzzy-set analysis, we calibrated the original values into fuzzy scores expressing degrees of membership within the [0,1] interval. The calibration process followed Ragin's (2008) procedure, requiring the specification of three qualitative anchors denoting full non-membership, maximum ambiguity, and full membership. For the outcome and board-level antecedent conditions that are not provider-normalised (gender diversity, independence, and industry-specific expertise), we set these anchors at the 10th, 50th, and 90th percentiles of the empirical distribution, a choice commonly adopted in corporate governance fs/QCA applications (del Villegas-Periñán *et al.*, 2024; Torres, 2024). An exception is the CSR Committee Score, a proprietary LSEG indicator already standardised by the data provider. LSEG's ESG scoring framework (2024) maps the underlying score to letter-grade performance tiers: C-grade scores indicate satisfactory relative performance, B-grade scores indicate good relative performance, and A-grade scores indicate leading relative performance within the peer group. To avoid double normalisation and preserve interpretability, we did not apply percentile-based calibration. Instead, we adopted stable, scale-consistent anchors aligned with this architecture, setting 0.417 as full non-membership (lower bound of C+), 0.500 as the crossover point (the C+/B- boundary, with B-grade beginning immediately above 0.500), and 0.750 as full membership (the B+/A- boundary, with A-grade beginning immediately above 0.750).

During calibration, values at 0.5 are excluded from the analysis, as they represent intermediate-set membership, complicating the interpretation of results (Ragin, 2009).

Subsequently, a truth table was generated to enumerate all possible configurations of causal conditions (Greckhamer *et al.*, 2018). The table was then sorted by frequency and consistency, applying a minimum frequency threshold of three cases and a raw consistency cutoff of 0.78. This retained empirically meaningful configurations while remaining above the recommended minimum of 0.75 for samples exceeding 150 observations (Ragin, 2008; Rihoux and Ragin, 2009).

3.3.1 Outcome condition: ESG-ERM implementation

ESG-ERM implementation is measured using the index developed by Shah *et al.* (2025), which extends earlier approaches by the same authors and assesses a firm's implementation of an ESG-ERM system using information from annual reports. These reports provide a solid basis for evaluation because ESG-ERM implementation typically materialises in formal governance and risk-management arrangements, which are reflected in official reporting. As a primary channel for firms to disclose their risk-oversight architecture and control systems to external audiences, annual reporting makes these arrangements observable and comparable. Furthermore, its public and stakeholder-facing nature carries significant accountability; disclosed structures and processes can be scrutinised and challenged if unsupported, strengthening the credibility of an index based on documented evidence.

The measure is based on the COSO-WBCSD (2018) guidelines, the leading framework for integrating ESG factors into ERM systems, and evaluates the extent to which firms embed ESG considerations across the five dimensions of ERM identified by the COSO-WBCSD guidelines: (i) governance and culture; (ii) strategy and objective-setting; (iii) risk identification and assessment; (iv) risk response; and (v) communication and reporting.

Following Shah *et al.* (2025), a manual content analysis of firms' annual reports was conducted to dichotomously code 38 ESG-ERM items across these dimensions. A score of 1 was assigned when a firm explicitly disclosed an ESG-related ERM practice, and 0 when no such evidence was found. The full coding protocol and item definitions are reported in Appendix A.

Since each element carries equal weight, the level of ESG-ERM implementation is calculated by summing all positive scores and dividing by the total number of assessed items, resulting in a continuous index ranging from 0 (no implementation) to 1 (full implementation):

$$\text{ESG-ERM Index} = \frac{1}{38} \sum_{i=1}^{38} x_i$$

where $x_i \in \{0,1\}$ denotes item i for $i=1,\dots,38$.

3.3.2 Antecedent conditions

Four antecedent conditions are examined: three reflect board composition - gender diversity, independence, and industry - specific expertise-while the fourth represents a structural governance mechanism, namely the establishment of a CSR committee. All data were retrieved from LSEG.

Board gender diversity, measured as the proportion of women directors (Grosvold and Brammer, 2011; Terjesen and Singh, 2008), introduces heterogeneity of values and cognitive frames, enhancing sensitivity to sustainability-related risks and opportunities.

Board independence, defined as the share of independent directors (Yatim, 2010), reflects the board's capacity for impartial oversight and objective judgment in ESG-related decision-making. Industry-specific expertise, operationalised as the proportion of directors with prior experience in the firm's industry (Pucheta-Martínez *et al.*, 2020; Ramón-Llorens *et al.*, 2019), captures the domain-specific knowledge that allows for the contextualization of ESG risks within sectoral dynamics.

The CSR Committee Score represents a governance dimension that indicates the extent to which ESG oversight is embedded within the board's formal architecture (Endrikat *et al.*, 2021). According to LSEG (2024), raw ESG indicators are industry-normalised and percentile-scaled, producing continuous, cross-firm comparable measures of governance features. Thus, the CSR Committee Score serves as an appropriate indicator of the governance institutionalisation of ESG responsibilities (Bifulco *et al.*, 2023; Moisello *et al.*, 2026).

4. Results and discussion

4.1 Analysis of necessary conditions

Consistent with standard set-theoretic protocol, a necessity analysis was performed to evaluate whether any single governance condition represents a superset of the outcome (Ragin, 2009; Schneider and Wagemann, 2012), as illustrated in Table 3. In fs/QCA, necessity captures deterministic relationships in which the outcome cannot occur without the condition, as assessed by the consistency and coverage parameters. Following Ragin (2009), a minimum consistency threshold of 0.90 was adopted to mitigate the risk of logical contradictions and ensure that the empirical relationship approximates set-theoretic inclusion.

Tab. 3: Analysis of necessary conditions for high and low ESG-ERM implementation

Conditions	High ESG-ERM implementation		Low ESG-ERM implementation	
	Consistency	Coverage	Consistency	Coverage
Independence	0.606	0.572	0.544	0.534
~ Independence	0.506	0.516	0.565	0.599
Gender diversity	0.584	0.581	0.512	0.539
~ Gender diversity	0.527	0.509	0.595	0.598
Industry-specific expertise	0.555	0.551	0.547	0.565
~ Industry-specific expertise	0.562	0.544	0.565	0.569
CSR Committee	0.654	0.578	0.635	0.584
~ CSR Committee	0.530	0.583	0.542	0.619

Source: Authors' elaboration

All governance attributes fall below the 0.90 consistency threshold, indicating that no single structural feature of the board constitutes a genuinely necessary condition for the effective ESG-ERM implementation (or absence). Therefore, it is reasonable to infer that ESG-ERM implementation results from specific configurations of governance

attributes rather than from any single, indispensable mechanism, justifying the application of fs/QCA to this inquiry.

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4.2 Configurational pathways to high and low ESG-ERM implementation

The sufficiency analysis yields $2^4 = 16$ logically possible configurations, all of which are observed in the truth table, leaving no logical remainders for counterfactual reasoning. The absence of remainders ensures that the complex, intermediate, and parsimonious solutions coincide for both the outcome and its negation (Duşa, 2022; Haesebrouck, 2023; Thomann and Maggetti, 2020). Therefore, we report a single solution, as results do not depend on solution type.

The truth tables (Tables 4 and 5) clarify the empirical basis of the solutions. With an inclusion cut-off of 0.78, a PRI threshold of 0.50, and a frequency threshold of three cases per configuration, two configurations qualify as sufficient for high ESG-ERM implementation, and one for low ESG-ERM implementation.

The overall coverage of 35.8% for high ESG-ERM and 14.8% for low ESG-ERM illustrates the set-theoretic logic of sufficiency: the identified configurations are reliable rather than exhaustive, isolating governance arrangements that consistently produce the outcome.

Tab. 4: High ESG-ERM Implementation: Truth table

Gender diversity	Independence	Industry-specific expertise	CSR committee	High ESG-ERM	n	Cons.	PRI
0	1	1	0	1	8	0.802	0.672
1	1	0	1	1	26	0.780	0.664
1	1	0	0	0	10	0.755	0.605
0	0	1	0	0	7	0.744	0.566
1	0	1	1	0	15	0.724	0.540
1	0	0	1	0	11	0.718	0.554
1	1	1	0	0	17	0.714	0.553
1	1	1	1	0	14	0.698	0.482
0	0	0	1	0	16	0.669	0.457
1	0	1	0	0	18	0.669	0.469
0	1	1	1	0	11	0.667	0.441
1	0	0	0	0	10	0.660	0.470
0	0	1	1	0	18	0.656	0.452
0	1	0	0	0	8	0.652	0.400
0	1	0	1	0	16	0.648	0.436
0	0	0	0	0	10	0.585	0.334

Source: Authors' elaboration

Tab. 5: Low ESG-ERM Implementation - Truth table

Gender diversity	Independence	Industry-specific expertise	CSR committee	Low ESG-ERM	n	Cons.	PRI
0	0	0	0	1	10	0.781	0.648
0	1	0	0	0	8	0.730	0.535
0	1	1	1	0	11	0.730	0.546
1	1	1	1	0	14	0.719	0.518
0	1	0	1	0	16	0.709	0.533
0	0	0	1	0	16	0.705	0.517
1	0	1	0	0	18	0.704	0.525
0	0	1	1	0	18	0.698	0.520
1	0	0	0	0	10	0.695	0.524
0	0	1	0	0	7	0.663	0.428
1	0	1	1	0	15	0.660	0.432
1	0	0	1	0	11	0.644	0.438
1	1	1	0	0	17	0.640	0.437
1	1	0	0	0	10	0.623	0.393
0	1	1	0	0	8	0.589	0.318
1	1	0	1	0	26	0.556	0.322

Source: Authors' elaboration

Table 6 illustrates the results of the sufficiency analysis. Each configuration embodies a distinct governance logic, revealing alternative structural and cognitive routes through which boards internalise sustainability considerations into ERM systems.

Tab. 6: Sufficiency analysis for high and low ESG-ERM implementation

	High ESG-ERM implementation		Low ESG-ERM implementation
Configurations	1	2	3
Independence	•	•	⊗
Gender diversity	•	⊗	⊗
Industry-specific expertise	⊗	•	⊗
CSR Committee	•	⊗	⊗
Raw Coverage	0.234	0.171	0.148
Unique Coverage	0.189	0.124	-
Consistency	0.780	0.802	0.781
Overall Coverage	0.358		0.148
Overall Consistency	0.784		0.781

Source: Authors' elaboration

The two configurations associated with high ESG-ERM implementation share board independence as a core enabling condition but differ in how evaluative and attention-structuring capacities are activated: through complementarity in the first pathway and through substitution in the second.

The first configuration describes a governance setup in which gender-diverse, independent boards, despite limited expertise, achieve higher ESG-ERM implementation when supported by a well-established CSR committee. This pattern reflects complementarity between board diversity and formal governance structures (Zaccone, 2023). Gender diversity strengthens evaluative capacity by broadening perspectives on ESG exposures as enterprise-level risks (Behlau *et al.*, 2024). Independence fosters autonomous discussion, limits managerial dominance, and allows these perspectives to shape board agendas. The CSR committee enhances attention-structuring capacity by integrating ESG issues into regular monitoring, structured information flows, and recurring oversight. Formal substructures, therefore, do more than signal commitment; they compensate for limited evaluative competence by ensuring systematic follow-up (Schnatterly *et al.*, 2021). This mechanism is especially relevant in manufacturing, where operational complexity and regulatory exposure require boards to process heterogeneous risk inputs and embed them into formal risk architectures.

The second configuration reveals an alternative logic. Independent boards with strong industry expertise achieve high ESG-ERM implementation even without gender diversity or a dedicated CSR committee. In this case, evaluative capacity substitutes for attention-structuring capacity. Skilled and independent directors incorporate sustainability issues directly into risk-assessment routines by extending traditional risk categories to include ESG dimensions. Their expertise is sufficient to embed ESG oversight into formal ERM processes without the need for committee support. Sustainability oversight is absorbed into core governance processes rather than channelled through a specialised committee (Annesi *et al.*, 2025). This configuration exemplifies technical assimilation, in which ESG risk management is embedded within established financial and operational controls (Amiraslani *et al.*, 2025). In manufacturing firms, where technical knowledge and familiarity with sector-specific exposures are critical, such expertise-based integration may be particularly effective.

The contrast between the two configurations clarifies that diversity and expertise are not universally additive; under certain structural conditions, they can operate as alternative enablers of ESG-ERM.

Across both pathways, independence is a foundational enabling condition; its monitoring contribution takes different forms: in the first, it creates deliberative space for diversity-activated evaluative capacity, while in the second, it safeguards analytical objectivity against managerial preferences (Younas *et al.*, 2019). This cross-cutting role reconciles agency-theoretic and resource-dependence arguments: independence constrains managerial discretion, while diversity and expertise provide the evaluative capacity needed to process ESG risk information, mechanisms that operate as complements or substitutes depending on context.

The analysis was extended to the negated outcome, as recommended by Schneider and Wagemann (2012). The configuration associated with low levels of ESG-ERM implementation reveals a governance pattern defined by the joint absence of all included sustainable governance variables (see Table

6). Here, boards are homogeneous, internally dependent, and technically underqualified, operating without organisational infrastructure to support the inclusion of sustainability considerations into ERM.

This configuration reflects a simultaneous failure of all three governance capacities. Limited diversity narrows the range of perspectives considered by the board, reducing its ability to evaluate ESG issues and likely relegating them to peripheral rather than material risks. The absence of independence weakens the board's ability to challenge managerial framing, undermining monitoring capacity and allowing executives to contain ESG topics within selective narratives. Limited expertise further depresses evaluative capacity, reducing the board's ability to convert ambiguous sustainability issues into concrete risk exposures, control requirements, and lines of responsibility (Villiers, 2022).

Finally, the absence of a CSR committee removes attention-structuring capacity: no mechanism stabilises attention over time, generates follow-up, or produces auditable outputs. The combined effect is not merely weaker monitoring but a failure of internal coupling, in which ESG issues lack ownership, enter no standardised assessment routines, and trigger none of the documentation and review cycles that characterise implemented ERM. Independence's role within this configuration is particularly informative. As a cross-cutting enabling condition, even its partial presence can preserve a baseline level of monitoring that supports ESG oversight across different governance architectures. Its complete absence matters because, combined with the lack of other enabling conditions, it removes this compensating capacity entirely.

Although this configuration involves fewer firms, it remains both practically and analytically relevant. These firms operate in similar sectors and regulatory environments as firms with stronger ESG-ERM arrangements. Their weaker implementation is unlikely to stem from shared external pressures alone and points to differences in board governance. The joint absence of the four conditions may reflect either a persistent governance gap or a transitional stage under CSRD implementation pressure. In the first case, the missing attributes reinforce one another, making regulatory pressure alone insufficient for ESG-ERM implementation. Meaningful progress would therefore require changes in board composition or governance structures. In the second case, firms may still be developing the attributes needed to comply with the CSRD. Even under this interpretation, a stronger implementation would require acquiring the governance capacities currently absent. The distinction concerns whether the gap is stable or temporary, rather than whether board governance remains central.

The negated-outcome analysis also supports causal asymmetry. Low ESG-ERM implementation does not mirror high-implementation pathways but reflects a distinct causal structure, consistent with set-theoretic expectations (Ragin, 2008) and supporting the findings' internal validity and robustness. Additional evidence that the results are not driven by national institutional heterogeneity is provided by the logit robustness checks with country fixed effects reported in Appendix B.

A final interpretive qualification concerns the scope of the findings on both high and low ESG-ERM implementation. The configurational findings identify board-level antecedents of formal ESG-ERM arrangements. Their interpretation must remain bound to the institutionalisation of ESG risk governance, including oversight, assessment, escalation, and review routines, rather than their enactment in everyday risk management. Institutional theory suggests that formal structures may partially decouple from organisational practice under external pressure to conform (Bromley and Powell, 2012; Vollero and Siano, 2024). This possibility is particularly relevant under the CSRD, which may prompt firms to formalise and report ESG risk-management arrangements before they are fully embedded in operational processes. The identified configurations should be viewed as pathways to stronger or weaker formal ESG-ERM institutionalisation. Whether the documented arrangements, where present, achieve substantive operational depth remains an open question for future process-level research.

5. Conclusions, limitations and avenues for future research

This study demonstrates that ESG-ERM integration does not rely on a single governance attribute but on how multiple features converge within the board. ERM gains traction when directors frame risk as a strategic concern (Beasley *et al.*, 2015) and when governance structures provide the institutional continuity necessary for risk practices to stabilise over time (Dabari and Saidin, 2016). The configurational patterns show that ESG-ERM emerges when monitoring capacity is combined with evaluative capacity, either reinforced by attention-structuring capacity or strong enough to compensate for its absence. The findings reconcile agency-theoretic and resource-dependence arguments: independence constrains managerial discretion, while diversity and expertise provide the cognitive and evaluative capacity needed to process ESG-related risk information, with these mechanisms functioning as complements or substitutes, depending on the broader governance context. From a managerial perspective, boards lacking strong industry-specific expertise may benefit from combining gender diversity, independent directors, and a well-functioning CSR committee; however, boards with high industry-specific expertise may achieve comparable formal ESG-ERM institutionalisation without a CSR committee, provided independence is maintained. A key practical implication is that effective ESG risk governance may benefit from targeting configurations of governance capacities rather than optimising individual board attributes in isolation. This consideration is relevant for firms redesigning board composition and governance arrangements in light of the risk-management and accountability expectations introduced by the CSRD.

The findings carry specific implications for the Italian governance context. Italian manufacturing firms are disproportionately exposed to CSRD-related pressures due to their integration into transnational supply chains and reliance on stakeholder legitimacy (Cucari *et al.*, 2018;

Naciti, 2019). Robustness checks for institutional variation indicate a higher propensity for ESG-ERM membership among Italian firms. This pattern may reflect regulatory anticipation and stakeholder pressure in addition to board composition. More broadly, it suggests that board-level configurations are more likely to lead to formal ESG-ERM institutionalisation when operating within institutional environments that reinforce ESG accountability (Bifulco *et al.*, 2023; Gennari and Salvioni, 2019).

Overall coverage results indicate that a significant share of firms is not explained by the identified governance bundles. This residual is theoretically informative, suggesting that ESG-ERM implementation in many firms may stem from factors outside board composition, such as ownership concentration, firm size, institutional investor pressure, or regulatory history. Future research should examine how firm-level and institutional antecedents interact with board attributes in multi-level configurational designs.

Some limitations should be acknowledged. The ESG-ERM index relies on annual report evidence, which may not fully capture the depth of internal implementation (Bromley and Powell, 2012). While the CSRD may improve reporting comparability, it may also lead firms to formalise and report practices before they are fully embedded. Furthermore, the content analysis was conducted by a single coder, preventing the assessment of intercoder reliability, despite the use of predefined rules and item-level evidence records. The focus on STOXX 600 manufacturing firms also limits generalizability. Future research could explore other sectors and institutional settings, track ESG-ERM development over time, and triangulate annual-report evidence with assurance statements, internal audit records, or interviews. Qualitative studies could further elucidate how boards translate ESG risks and regulatory expectations into established risk-management routines.

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Appendix A: ESG-ERM implementation index and coding protocol

The ESG-ERM implementation index follows Shah *et al.* (2025) and comprises 38 binary items mapped to the COSO-WBCSD framework. Each item was coded at the firm level as present (1) or absent (0) and aggregated into a continuous index. The instrument was applied without modification.

The unit of analysis is the firm, with one observation for each company. A single researcher coded formal, publicly available annual reports, in PDF format.

Coding followed a conservative approach. A score of 1 required explicit, practice-level evidence of ESG-ERM implementation, such as a designated governance body or role, a defined process or review cycle, an assessment or escalation procedure, a specified ESG-risk scope, or a formal oversight mechanism. Generic statements about sustainability or risk management were coded 0 unless both the ESG linkage and the underlying practice were clearly described. Ambiguous, aspirational, and exclusively forward-looking disclosures were also coded 0.

Documents were screened using item-specific keywords reported in Table A1, and all candidate passages were assessed in context. Coding consistency and traceability were supported by predefined decision rules and item-level evidence memos that recorded the document type, page, or section, along with a brief description of the disclosed practice. Ambiguous cases were reassessed during a second coding pass. Firms without eligible documents were excluded from index construction and recorded in the retrieval log.

Table A1: Coding protocol, adapted from Shah et al. (2025).

Domain	Item	Unit of confirmation	Standard exclusion boundary	Keyword search strings
D1	ERM-1 Board charter for ESG-related risks	Explicit attribution of ESG-relevant risk oversight to board/committee (remit responsibility statement).	Values/commitment with no oversight attribution.	"board responsibility" AND "ESG"; "board oversight" AND "ESG"; "risk oversight" AND "sustainability"; "ESG oversight"; "committee remit" AND "risk"
D1	ERM-2 Board approval of ESG risk integration into mission/vision	Board attribution linking ESG risk integration to strategic direction (endorsement/oversight language).	Mission/vision with no governance attribution.	"mission" AND "board approved"; "vision" AND "board oversight"; "strategy approved by the board"; "ESG risk integration" AND "strategy"
D1	ERM-3 Board training on ESG-related risks	Board training content explicitly includes ESG-relevant risk topics.	Generic "training" with no topic content.	"board training" AND "ESG"; "director training" AND "climate"; "induction" AND "sustainability risk"; "ESG training"; "climate training"
D1	ERM-4 Board committee for ESG-related risks	Committee exists with remit covering ESG-related risk oversight (stand-alone or embedded in risk/audit).	Committee only for CSR/ESG performance without risk oversight.	"risk committee" AND "ESG"; "sustainability committee" AND "risk"; "ESG committee" AND "risk"; "audit committee" AND "ESG risk"; "sustainability risk oversight"
D1	ERM-5 Communication between board committees on ESG risks	Described coordination routine across committees on ESG risk oversight (reporting lines, joint reviews).	Generic "committees collaborate" with no routine.	"coordination" AND "ESG risk"; "joint meeting" AND "risk"; "cross-committee" AND "ESG"; "reporting line" AND "risk"; "committee reports to" AND "board"
D1	ERM-6 Management awareness sessions on ESG risks	Management capability building linked to ESG risk domains and risk/control responsibilities.	Culture narratives not linked to risk responsibilities.	"management training" AND "ESG risk"; "awareness session" AND "sustainability risk"; "risk training" AND "ESG"; "sustainability risk workshop"; "ESG risk awareness"
D1	ERM-7 Reporting of ESG-related risks	ESG topics appear in formal risk reporting as risks/uncertainties/principal risks.	ESG topics only as impacts/KPIs.	"principal risks" AND "ESG"; "risk factors" AND "sustainability"; "uncertainties" AND "climate"; "sustainability risks"; "ESG risks"; "climate-related risks"
D2	ERM-8 Business model for ESG risks	ESG issues linked to business model exposure/resilience framed as risk to objectives.	ESG positioning without risk-objective linkage.	"business model" AND "risk" OR "resilience"; "value chain risk"; "license to operate" AND "risk"
D2	ERM-9 SWOT of ESG-related risks	Strategic scanning / scenario analysis / SWOT (or other equivalent tools) that explicitly include ESG risks.	Materiality list without scanning/strategy function.	"SWOT" AND "ESG" OR "sustainability" OR "climate"; "strategic analysis" AND "ESG risk"; "scenario analysis" AND "climate risk"; "risks and opportunities"
D2	ERM-10 Risk appetite for ESG risks	Risk appetite/tolerance framework applied to ESG categories.	"low tolerance" phrasing without a framework.	"risk appetite" AND ("ESG" OR "climate" OR "sustainability"); "risk tolerance" AND ("ESG" OR "climate"); "appetite statement"
D2	ERM-11 Link ESG risks to stakeholder value creation	Stakeholder expectations linked to risk prioritization and/or value creation objectives.	Stakeholder engagement with no implications for risk/objectives.	"stakeholder" AND ("risk prioritization" OR "value creation"); "material risks for stakeholders"; "material risks to stakeholders"
D3	ERM-12 Climate/carbon-related risk info	Climate framed as risk/uncertainty affecting objectives (transition/physical/regulatory/cost).	Emissions inventory/targets only.	"climate risk"; "transition risk"; "physical risk"; "carbon pricing"; "GHG regulation"
D3	ERM-13 Biodiversity risk info	Biodiversity/nature dependencies framed as operational/compliance risk.	Biodiversity initiatives only.	"biodiversity risk"; "nature-related risks"; "TNFD"; "ecosystem services"; "deforestation risk"
D3	ERM-14 Toxic emissions and waste material risk info	Waste/toxic emissions framed as liability/compliance disruption risk.	Compliance claims without risk articulation.	"hazardous"; "toxic"; "emissions risk"; "waste risk"; "contamination"; "pollution incident"
D3	ERM-15 Compliance risk info	Compliance/regulatory treated as a risk category in ERM framing.	"we comply" assurances only.	"compliance risk"; "regulatory risk"; "legal risk"; "non-compliance"
D3	ERM-16 Health and safety risk info	Occupational H&S framed as risk category in risk reporting.	H&S KPIs only.	"health and safety risk"; "H&S risk"; "occupational safety risk"; "incident risk"
D3	ERM-17 Reputational risk info	Reputation framed as risk category.	Reputation only as asset/strength.	"reputational risk"; "brand risk"; "social license"; "stakeholder backlash"
D3	ERM-18 Cybersecurity risk info	Cyber/data security framed as a risk category.	IT modernization with no risk framing.	"cyber risk"; "cyber security risk"; "cybersecurity risk"; "information security risk"; "data breach"; "security incident"
D3	ERM-19 Financial risk info	Financial risks disclosed as risks within risk reporting.	Financial performance narrative only.	"liquidity risk"; "credit risk"; "market risk"; "FX risk"; "interest rate risk"
D3	ERM-20 Assessment of carbon footprint risk	Evaluation signal: ranking/materiality/likelihood impact/scenario/stress.	Measurement without evaluation.	"climate risk assessment"; "climate scenario analysis"; "stress test" AND "climate"; "likelihood" AND "impact" AND "climate"
D3	ERM-21 Assessment of governance code compliance	Monitoring/review process for governance code compliance.	Binary "complies" only.	"comply or explain"; "comply-and-explain"; "governance code" AND ("review" OR "assessment"); "compliance review"
D3	ERM-22 Assessment of product quality risk	Prioritization/monitoring system/control effectiveness beyond policy.	Certifications/policy only.	"quality risk"; "product safety risk"; "recall"; "quality management risk"
D3	ERM-23 Assessment of H&S risks	Risk assessment activity described (audit/assessments in risk framing).	Outcomes without process.	"risk assessment" AND ("safety" OR "H&S"); "safety audit"; "hazard identification"
D3	ERM-24 Assessment of fraud risk	Fraud risk assessed/monitored within internal control/audit.	Code of ethics only.	"fraud risk"; "anti-fraud"; "internal audit" AND "fraud"; "fraud risk assessment"; "whistleblowing"
D3	ERM-25 Assessment of reputational risk	Reputational risk evaluated/prioritized/monitored.	Mere mention of reputational sensitivity.	"reputational risk"; "reputation assessment"; "reputation monitoring"
D3	ERM-26 Response to credit risk	Concrete mitigation/limits for ESG-linked credit or counterparty risk.	Generic credit risk management with no ESG linkage.	"ESG credit risk"; "climate credit risk"; "counterparty ESG risk"; "credit risk management" AND "ESG"
D3	ERM-27 Response to market risk	Concrete controls for ESG/climate-linked market, energy or carbon-price risk.	Generic market risk or hedging with no ESG linkage.	"carbon price risk"; "energy price risk"; "transition risk mitigation"; "market risk" AND "climate"; "hedging" AND "carbon"
D3	ERM-28 Response to liquidity risk	Concrete mitigation for ESG-linked liquidity, financing or covenant risk (buffers/facilities/monitoring/contingency).	Generic liquidity management with no ESG linkage.	"ESG liquidity risk"; "sustainability-linked financing"; "ESG covenant"; "financing risk" AND "ESG"; "transition financing risk"
D3	ERM-29 Response to FX risk	Concrete mitigation for ESG/climate-linked currency exposure.	Generic FX hedging or exposure only.	"ESG FX risk"; "climate currency risk"; "foreign exchange risk management" AND "sustainability"; "currency risk" AND "transition"
D3	ERM-30 Response to data security risk	Controls/routines for cyber or data security risk.	Privacy policy only.	"information security controls"; "incident response"; "security governance"; "ISO 27001"; "cybersecurity controls"
D4	ERM-31 Changes in environment affecting risk profile	Monitoring of external/emerging ESG risks linked to risk profile updates.	Outlook with no ERM update linkage.	"risk profile update"; "updated risk assessment"; "emerging ESG risks"; "emerging climate risks"; "external environment" AND "risk profile"
D4	ERM-32 Revision of strategies related to ESG risks	Strategy revised in response to ESG risk considerations.	ESG strategy description with no revision logic.	"revised strategy" AND ("ESG risk" OR "climate risk"); "strategy update" AND "climate risk"; "strategic response" AND "transition risk"
D4	ERM-33 Due diligence of ESG-ERM process	Review/audit/assurance refers to risk management process incl. ESG risks.	Due diligence only for suppliers/operations.	"ERM review"; "risk management audit"; "risk management assurance"; "effectiveness review" AND "risk management"; "ESG risk review"
D4	ERM-34 Revision of RM processes/capabilities	Enhancement of ERM processes addressing ESG risks.	Generic references to "continuous improvement" only.	"enhanced risk management"; "ERM framework update"; "new risk methodology"; "risk system upgrade"; "ESG risk process"
D5	ERM-35 Reporting of ESG risk to board/management	Internal reporting routine to board/management on ESG risks.	External reporting only.	"report to the board" AND ("ESG risk" OR "climate risk"); "risk dashboard"; "risk reporting cadence"; "ESG risk report"
D5	ERM-36 ESG risks communicated to shareholders in AGM	ESG risks communicated via AGM/annual reporting in risk framing.	Sustainability highlights only.	"AGM" AND ("ESG risk" OR "climate risk"); "annual general meeting" AND "risk"; "shareholder ESG risk"; "investor risk disclosure"
D5	ERM-37 Disclosure of ESG risks to all stakeholders	ESG risks disclosed externally with stakeholder orientation beyond investors.	Engagement narrative without risk disclosure.	"stakeholders" AND "risk disclosure"; "community risk"; "supply chain risk"; "human rights risk"; "affected stakeholders"
D5	ERM-38 Board approval disclosed on ESG risk data	Board linked to risk disclosures including ESG risks.	Management sign-off only.	"board approved" AND ("risk disclosures" OR "ESG risk"); "board risk report"; "on behalf of the board" AND "risk disclosures"

Appendix B.

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Assessing board-level
determinants of ESG-
ERM implementation: A
configurational approach

Logit robustness checks for institutional variation

We estimate logit models with a binary dependent variable derived from the calibrated fuzzy-set outcome. This variable equals 1 when a firm exhibits a high degree of membership in the outcome set (i.e., its calibrated ESG-ERM score places it on the ‘more in than out’ side) and 0 otherwise. For the high-outcome models, the indicator identifies firms with comparatively high ESG-ERM implementation; for the low-outcome models, it identifies firms with comparatively low ESG-ERM implementation. Two alternative institutional controls are used: (i) a specification with country fixed effects to account for country-level governance and regulatory differences, and (ii) a parsimonious board-regime proxy that distinguishes one-tier, optional, and two-tier systems without country fixed effects.

Table B1 reports results for High ESG-ERM, and Table B2 for Low ESG-ERM. We focus on the direction and relative strength of associations, and on whether institutional heterogeneity is better captured by country fixed effects or the board-regime proxy.

Table B1: High ESG-ERM

Model	Institutional heterogeneity	Key coefficients	Model fit
POS-A	Country fixed effects	Independence: 0.014* Italy FE: 3.090**	AIC = 291.87
POS-B	Board-regime proxy	No governance predictor statistically different from zero	AIC = 303.98

p < 0.10; ** p < 0.05; *** p < 0.01.

In the specification absorbing cross-country institutional differences (POS-A), board independence is positively associated with the probability of being classified as high ESG-ERM (marginal significance). The set of country fixed effects is non-trivial, with the Italy indicator being positive and statistically significant, confirming meaningful between-country heterogeneity in the propensity to reach high ESG-ERM membership. Conversely, when institutional variation is proxied only through the board-regime category (POS-B), neither the regime proxy nor governance predictors exhibit statistically distinguishable effects, and overall fit deteriorates relative to POS-A (higher AIC).

Table B2: Low ESG-ERM

Model	Institutional heterogeneity	Key coefficients (selected)	Model fit
NEG-A	Country fixed effects	Independence: -0.017** Italy FE: -3.035**	AIC = 290.32
NEG-B	Board-regime proxy	No governance predictor statistically different from zero	AIC = 301.16

p < 0.10; ** p < 0.05; *** p < 0.01.

Results for the low-outcome models mirror those of the high-outcome models. Under country fixed effects (NEG-A), board independence is negatively associated with the probability of being classified as low ESG-ERM (marginal significance), consistent with POS-A. Country heterogeneity again emerges, with the Italy indicator being negative and statistically significant, indicating a lower likelihood of low ESG-ERM membership relative to the reference country. When institutional heterogeneity is approximated solely by the board-regime proxy (NEG-B), coefficients are not statistically distinguishable from zero, and model fit is weaker (higher AIC). Overall, these logit checks support the conclusion that country-level institutional differences significantly influence classification into high/low ESG-ERM membership, while a regime proxy alone is insufficient to capture that variation.

Notes: These models serve as robustness checks to assess whether the main configurational conclusions are sensitive to institutional heterogeneity. They are not intended to replicate set-theoretic logic in a linear-additive form but rather to confirm that (i) the direction of association for key governance attributes is broadly coherent across specifications and (ii) institutional heterogeneity is more effectively captured by country fixed effects than by a coarse board-regime proxy.