The influence of the board's size, independence and sociodemography on the firm's climate change orientation: evidence from the GALPLACC index

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Abstract

Purpose – *This paper aims to explore the relationship between board composition and a firm's commitment to combatting climate change. Specifically, this study investigates how various characteristics of the board, namely its size and presence of independent directors, and of the directors themselves, including gender diversity, age, educational background and national homogeneity, affect the corporate-level climate change orientation. From a theoretical standpoint, the authors take a cross-fertilizing perspective, bridging upper echelons theory with agency, resource dependence and critical mass theories.*

Design/methodology/approach – *The study uses ordered probit regression models on a hand-collected multi-country and multi-industry sample of 35 listed firms included in the Global Climate Change Liquid Equity Index (GALPLACC) provided by ECPI. This index is particularly relevant as it focuses on firms that have demonstrated a commitment to climate change, providing a robust dataset for the analysis.*

Findings – *The findings underscore the importance of disentangling various characteristics of corporate boards and directors. Specifically, the orientation toward climate change is negatively influenced by both board size and having a higher number of independent directors, while it is positively affected by reaching a critical mass of women on the board. Conversely, factors such as average age, educational background and the level of national homogeneity do not show significant effects.*

Originality/value – *This paper has an exploratory nature and contributes to the ongoing debate on the crucial, yet controversial role played by board-level and directors' sociodemographic characteristics in shaping a firm's environmental stance. Moreover, this study offers potential recommendations for policymakers regarding board composition to enhance firms' climate change orientation.*

Keywords *Climate change, Board diversity, Board composition, ESG rating*

Paper type *Research paper*

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1. Introduction

Acting in harmony with the external environment is a compelling imperative in today's business operations. Accordingly, the social, environmental and ethical dimensions of doing business have gained enormous importance in recent times, as testified by the extensive regulatory efforts in multiple countries to direct the business agenda toward the achievement of virtuous noneconomic objectives. Among these, the 2014/95/EU Directive on non-financial reporting included in the European Union Action Plan for Financing Sustainable Growth and in the United Nations 2030 Agenda on Sustainable Development represents a notable example. Environmental issues (e.g. climate change and water use), social responsibility (e.g. human rights) and corporate governance matters (e.g. corruption

and shareholder protection), usually considered jointly under the abbreviation ESG, are critical indicators of risk management, management competence and nonfinancial performance (Galbreath, 2013). Accordingly, considerable interest has been devoted to the investigation of firms' corporate environmental performance, with several studies focusing on climate change orientation as a fundamental driver of a firm's environmental consciousness and sustainability performance (e.g. Alshahrani *et al.*, 2023; Ben-Amar *et al.*, 2022; De Villiers *et al.*, 2011; Dixon–Fowler *et al.*, 2017; Post *et al.*, 2015; Walls *et al.*, 2012).

In this study, we join these ongoing conversations by delving deeper into the corporate governance factors that may affect a firm's climate change orientation. In particular, we follow a fascinating line of inquiry suggesting that specific and unique board attributes may affect a firm's corporate social responsibility (CSR) orientation in terms of enhancing the internalization of CSR strategically (Ooi *et al.*, 2019). To explain this, several studies take the upper echelons theoretical lens, a perspective that focuses on the influence of directors and top management teams on organizational outcomes, contending that the firm–environment relationship is shaped by the characteristics of the firm's executives (Walls *et al.*, 2012; Gallego-Álvarez and Rodriguez-Dominguez, 2023). As firms' strategic decisions are a reflection of the background attributes of decision-makers (e.g. Gyapong *et al.*, 2021), the board members represent a prominent research domain as a crucial driver of the formulation and implementation of strategic initiatives at various levels (Nadeem *et al.*, 2020). Therefore, we build on prior studies suggesting that the structure and composition of a firm's board of directors (BoD) play a fundamental role in guiding a firm's strategic openness in multiple respects and, in turn, in determining its socially responsible behaviors (Cuadrado-Ballesteros *et al.*, 2017; Forbes and Milliken, 1999; Michelon and Parbonetti, 2012).

In this study, we thus propose a conceptual framework where the extent to which a firm adheres to an ESG approach in terms of prioritizing climate change concerns may be guided by the sociodemographic characteristics of its directors. In doing so, we extend prior studies arguing that sociodemography and diversity may direct climate change efforts because they shape the human capital of board members and, in turn, their individual and collective sensitivity to climate change issues (e.g. Al-Qahtani and Elgharbawy, 2020; Caby *et al.*, 2022; Ciocirlan and Pettersson, 2012; De Abreu *et al.*, 2022; Islam *et al.*, 2022).

Bearing in mind that "CSR exists in a contested space with multiple, apparently irreconcilable, positions" (Mitnick *et al.*, 2021, p. 626), we respond to the recent calls that a cross-fertilizing approach would enrich the debate by bridging equally legitimate points of observation. A cross-fertilizing approach involves integrating multiple theoretical perspectives to generate a more comprehensive understanding of a complex issue. Therefore, rather than relying on separate theoretical perspectives conceived as largely independent, we welcome the ongoing concern that linking multiple theories and impacts may generate positive outcomes for society, while averting negative ones (Mitnick *et al.*, 2021). We develop a conceptual framework combining upper echelons theory as a traditional, interpretive dominant perspective in corporate governance studies with a set of other theoretical approaches that have increasingly, though separately, permeated the academic debate. In particular, we conceptualize the level of a firm's climate change commitment as a function of multiple BoD sociodemographic characteristics, each being associated with diverse theoretical perspectives, namely upper echelons, agency, resource dependence and critical mass theories. Thus, we offer a multi-theoretical, cross-fertilizing approach to examining the complexity and multifaceted nature of this line of inquiry.

From a methodological point of view, we analyze the firms included in the Global Climate Change Liquid Equity Index (GALPLACC), one of the first environmental ratings, with the aim of measuring a firm's ESG position in the specific field of climate change. Specifically, this index captures the level of commitment toward climate change concerns based on a

firm's true allocation of resources to climate-relevant investment projects and develops a ranking that assesses the level of such a commitment.

Our findings indicate that smaller boards may favor a better internal coordination and smoother decision-making mechanisms in favor of a firm's climate change orientation. Moreover, a greater presence of independent directors does not engage an autopilot effect on a firm's corporate environmental and climate change performance. In other words, the mere presence of independent directors does not guarantee an improvement in a firm's environmental and climate change performance, as it requires active engagement and influence from these directors. Finally, our findings suggest that gender diversity positively affects a firm's climate change commitment as long as the female portion of the board reaches a critical mass, a point at which the number of women on the board is sufficient to have a meaningful impact on the board's decision-making process (Post *et al.*, 2011).

Our results are not only academically intriguing but also carry significant practical implications. From a theoretical standpoint, we suggest that board composition plays a critical role in shaping a firm's sustainable choices, challenging some commonly held assumptions and sparking a specific debate on climate change. By dissecting the various sociodemographic characteristics, we illuminate the diverse effects exerted by different attributes of directors. Moreover, our findings demonstrate the complementarity of upper echelons, agency, resource dependence and critical mass theories, supporting the adoption of cross-fertilizing approaches to examine complex issues. From a managerial and policymaking perspective, our study offers valuable insights, highlighting avenues that can foster a greater corporate orientation toward climate change initiatives.

The paper is organized as follows. Section 2 presents a literature review on the topic and the hypotheses to test. Section 3 introduces the sample and variables, along with the methodology used for the econometric estimation. Section 4 shows the main results obtained, while Section 5 offers a discussion of the main findings. Finally, Section 6 provides the conclusions of our study by presenting limitations and possible further research avenues.

2. Literature review and hypotheses development

The importance of board structure as a critical determinant of the prestige and performance of companies is largely acknowledged in the literature (e.g. Certo, 2003), as, from an agency perspective, the board of directors plays a pivotal role in guiding a firm's strategic directions by both monitoring the managers' initiatives and advising the firm's strategic decision-making process (Brunninge *et al.*, 2007; Deutsch *et al.*, 2007; Hambrick *et al.*, 2005; Mallin, 2004; Zheng and Tsai, 2019). Furthermore, scholars have extensively adopted a resource-dependence approach, suggesting that directors may contribute to facilitating access to external resources (Hillman *et al.*, 2009), thereby ensuring the implementation of strategies and programs (De Villiers *et al.*, 2011; Hillman and Dalziel, 2003).

Within this framework, a long-standing line of inquiry takes the upper echelons perspective to the examination of whether, and if so how, the board of directors' sociodemographic characteristics may affect the firm's strategic avenues. A recent academic debate has emerged on the exploration of how such characteristics may shape a firm's sustainable orientation and the extent to which environmentally responsible actions are prioritized (e.g. Cucari *et al.*, 2018; Lavin and Montecinos-Pearce, 2021; Nadeem *et al.*, 2020; Tijani and Ahmadi, 2022). For instance, Albitar *et al.* (2023) consider a sample of companies listed on the London Stock Exchange from 2014 to 2020 and explore the effects of eco-innovation and climate governance on corporate commitment to climate change, contending that the characteristics of the BoD, e.g. size and independence, may affect the sensitivity to climate change risks and opportunities.

Other studies have underscored the importance of board members' diversity as a driver of the extent to which the firm incorporates a climate change orientation (Albitar *et al.*, 2023; Backman *et al.*, 2017; Marquis and Qian, 2014). For example, by using a sample of US-listed firms for the period 2002–2018, the study of Nadeem *et al.* (2020) examines the relationship between board gender diversity and corporate environmental innovation, suggesting that gender diversity fosters a firm's environmental innovation in terms of both product and process innovation. These findings highlight the inspiring potential of board diversity in driving environmental innovation.

In the same way, we take a well-established approach and unbundle the board's sociodemographic makeup into several attributes, namely board size, board independence, gender diversity, board age, educational background and national homogeneity (e.g. Albitar *et al.*, 2023; Backman *et al.*, 2017; Johnson *et al.*, 2013; Marquis and Qian, 2014). In the next paragraphs, we elaborate on each hypothesis separately.

2.1 Board size

Board size has been explored as a crucial dimension of the board structure and is usually seen as a signal of the board members' heterogeneity level (Guest, 2009). From a resource-dependence perspective, a larger board can be more attractive and hence include more prestigious directors, who may secure the firm access to varying external resources (Certo, 2003; Hillman *et al.*, 2009) that may support the implementation of investment projects (Hillman and Dalziel, 2003; De Villiers *et al.*, 2011). In this respect, prior studies have claimed that by providing access to strategically critical resources, larger board may be helpful in supporting the adoption of climate change initiatives (Ooi *et al.*, 2019).

However, agency theory contends that board size is associated with both advantages and disadvantages, which explains why the literature examining its impact on firm performance and ESG initiatives has provided inconclusive results. Several studies suggest that larger boards are associated with greater collective information and, hence, higher performance at multiple levels (e.g. Lehn *et al.*, 2009), for instance, in terms of positive effects on the voluntary disclosure of executive stock options (Schiehll *et al.*, 2013), governance mechanisms (Allegrini and Greco, 2013) and CSR initiatives (Esa and Ghazali, 2012). In contrast, extensive evidence has been found of a negative association between board size and ESG indicators, as larger boards may be less effective in monitoring and controlling firm governance than smaller boards (Ahmed *et al.*, 2006; De Andres *et al.*, 2005). In particular, Ahmed *et al.* (2006) and Dey (2008) find that directors' commitment is greater in smaller boards, thus reducing agency costs. This occurs because smaller boards may be less affected by free-riding behaviors and better able to elicit communication, coordination and the sharing of ideas (Lipton and Lorsch, 1992) among members. Consistently, a limited number of appointed directors may contribute to streamlining decision-making and avoid potential frictions that may derive from different directors having a heterogeneous sensitivity toward the climate.

Thus, in the specific context of a firm's climate change orientation, we build on an agency theory perspective, suggesting that smaller boards may be better able to prioritize high-order objectives such as environmental initiatives toward climate change and direct resources toward implementing projects to address climate issues. The potential for meaningful change through the influence of smaller boards is indeed inspiring, as it highlights the capacity of smaller boards to lead progress in addressing climate challenges. Based on the above, we therefore expect that board size will be inversely related to a firm's orientation toward climate issues, with smaller boards providing a greater orientation toward climate change commitment. We therefore advance the following hypothesis:

H1. Board size has a negative effect on a firm's climate change orientation.

2.2 Board independence

According to agency theory, board independence is a key corporate governance mechanism that enhances the quality of supervision and, consequently, the overall board effectiveness (Ahmed *et al.*, 2006; Said *et al.*, 2009). Numerous studies have consistently documented a positive relationship between board independence and CSR (Ahmed *et al.*, 2006; Jizi *et al.*, 2014). Firms that engage in CSR initiatives tend to have a higher proportion of independent directors on average (Cucari *et al.*, 2018; Cullinan *et al.*, 2019; Gallego-Álvarez and Pucheta-Martínez, 2020; Hussain *et al.*, 2018). In particular, when it comes to the the social and environmental pillars, prior studies have found that independent directors show more concern about charitable and philanthropic themes compared to inside directors (Haniffa and Cooke, 2005; Ibrahim and Angelidis, 1995; Ibrahim *et al.*, 2003; Jo and Harjoto, 2011). This suggests that independent directors are more sensitive to society's needs and more concerned about ethical matters (Ibrahim and Angelidis, 1995), while also being more interested in complying with laws, regulations and responsible behavior.

Expanding the above, we argue that a higher proportion of independent directors on the board will positively influence a firm's responsiveness to climate change, thereby enhancing shareholders' wealth and the overall firm value. In turn, this suggests that the influence of independent directors, who are typically associated with better reporting quality and transparency, can be harnessed to strengthen accountability toward stakeholders (Rupley *et al.*, 2012; Vafeas, 2005). Therefore, a firm with greater board-level independence is expected to be more inclined to implement honest environmental initiatives due to its enhanced informativeness, thereby contributing to the collective effort to address pressing environmental issues. In light of the above, we hypothesize the following:

H2. The number of independent directors has a positive effect on the firm's climate change orientation.

2.3 Board gender diversity

Under both gender socialization theory and the resource-based view (Backman *et al.*, 2017), the notion of a gender polarization between men's and women's attitudes and behavior is well consolidated in both sociological and management studies.

In the specific context of corporate governance research, the presence of female directors in the boardroom significantly enriches boards' discussions by bringing diverse perspectives and opinions (Chatjuthamard *et al.*, 2021; Srinidhi *et al.*, 2011). This diversity provides a better understanding of the marketplace (Carter *et al.*, 2003), and supports the development of more responsive corporate policies (Pucheta-Martínez *et al.*, 2016), which may improve the board's effectiveness (Groening, 2019) and reduce agency problems (Birindelli *et al.*, 2020; Mathew *et al.*, 2016).

Prior studies indicate that female directors have the potential to significantly enhance companies' awareness of environmental (Baalouch *et al.*, 2019) and social issues and promote the adoption of proactive strategies to respond to corporate stakeholders' social and ethical demands and expectations (Ben-Amar *et al.*, 2017; Hollindale *et al.*, 2019). Thus, most prior literature has advocated that female directors can play a crucial role in increasing a company's environmental consciousness and sustainability performance (Awwad *et al.*, 2023; Cullinan *et al.*, 2019; Ferrero-Ferrero *et al.*, 2015; Glass *et al.*, 2016; Hussain *et al.*, 2018; Post *et al.*, 2011).

In the context of climate change, we therefore build on prior studies contending that firms with a higher proportion of female board members tend to engage in more charitable giving (Wang and Coffey, 1992; Williams, 2003), offer better work environments (Bernardi *et al.*, 2006), implement more environmental initiatives (Post *et al.*, 2011) and demonstrate greater concern about climate change (Ciocirlan and Pettersson, 2012). However, there is evidence

indicating that decision-making dynamics are significantly affected by gender stereotypes. Moreover, female directors need to achieve a critical mass to effectively counteract groupthink and tokenism phenomena commonly found in male-dominated environments (Galavotti and D'Este, 2022; Torchia *et al.*, 2011). According to critical mass theory, the underrepresentation of women in BoDs may hinder their ability to fulfill their advisory role (Post *et al.*, 2011; Torchia *et al.*, 2011). Therefore, the heightened sensitivity to climate change observed in female directors compared to their male counterparts (Ciocirlan and Pettersson, 2012) may lead to tangible actions only when a sufficient number of women are appointed to the board. Indeed, reaching a sufficient weight in terms of gender diversity in the board may reduce the possibility that women only act as "grey directors" and may rather sustain their ability to direct decision-making toward the adoption of initiatives favoring the firm's overall climate change orientation. Hence, the following hypothesis is proposed:

H3. The board's gender diversity has a positive effect on the firm's climate change orientation.

2.4 Board age

The age of board members is an important sociodemographic factor that has been traditionally studied from the perspective of the upper echelons as an indicator of potential diversity in the cognitive processes and decision-making preferences of directors (Carpenter *et al.*, 2004). The coexistence of different generations has implications in terms of the heterogeneity of values, motivational goals and experiences influencing the decision-making process. Consistently, prior research investigating the relationship between board age and environmental concerns has underscored that a board of mixed age composition has the potential to improve the integration of environmental, social and governance (ESG) issues into management processes (Ferrero-Ferrero *et al.*, 2015).

At the same time, while age is associated with the development of experience and expertise, cognitive abilities, including learning, memory and reasoning, tend to decrease with age (Burke and Light, 1981). This could lead to age-related effects on individual- and group-level risk-taking, potentially resulting in the rejection of any change threatening the existing social order or questioning the dominant attitude. Studies have also indicated that age is linked to knowledge and sensitivity to environmental issues (Diamantopoulos *et al.*, 2003).

Building on this literature, we suggest that board members' age can affect the board's environmental consciousness and behaviors. In particular, we contend that age is a significant driver of the extent to which climate change issues are perceived as compelling (Diamantopoulos *et al.*, 2003). Young individuals are not only more environmentally conscious (Ciocirlan and Pettersson, 2012) but also more dynamic, open to technological change and proactive in driving business change (Handajani *et al.*, 2014). Therefore, younger directors may be more ideologically ready and motivated to support environmental reform and strategic agility, thus favoring higher environmental attitudes at the firm level. Therefore, we propose the following hypothesis:

H4. The board's age has a negative effect on the firm's climate change orientation.

2.5 Board educational level

The board's educational level is another significant sociodemographic characteristic affecting directors' cognition and decision-making (Johnson *et al.*, 2013) that has been extensively explored from the upper echelons perspective (Carpenter *et al.*, 2004; Prabowo *et al.*, 2017; Wang *et al.*, 2017; Harjoto *et al.*, 2019). Although educational background may potentially capture various aspects and constructs, for instance, in terms of social status

and cognitive similarity, most scholars have examined its impact as a proxy for human capital, knowledge and intellectual competence and, hence, as a potential driver of board excellence (e.g. Datta and Rajagopalan, 1998; Wailerdsak and Suehiro, 2004).

Based on the recognition that a higher educational level is often linked to a more significant knowledge endowment and finer-grained cognitive tools for interpreting decision problems, the extant literature suggests that directors' education influences the quality of their strategic decisions (Fernández-Gago *et al.*, 2018; Tan *et al.*, 2020). A highly educated board is believed to be better equipped to provide more efficient and effective monitoring and guidance (Wang *et al.*, 2017), while also maintaining a comprehensive approach to doing business (United Nations Framework Convention on Climate Change – UNFCC). This association has been observed in several organizational outcomes, including a firm's financial performance (Kim and Lim, 2010), its innovative capability (Wincent *et al.*, 2010) and its CSR disclosure (Issa *et al.*, 2022; Katmon *et al.*, 2019; Prabowo *et al.*, 2017).

Based on the above, we expect that a higher educational level could significantly boost the board's environmental awareness and equip directors with a greater collective sensitivity toward climate change issues. As a result, we propose that a board characterized by a higher average education level will be more inclined to support investment projects aimed at enhancing the overall firm's contribution to highly impactful initiatives:

H5. The board's educational level has a positive effect on the firm's climate change orientation.

2.6 Board nationality

Compared to other sociodemographic dimensions, the impact of racial and ethnic aspects of board demographics on strategic decision-making has received relatively less attention, possibly due to the limited average levels of national heterogeneity in the boardroom (Van der Walt and Ingley, 2003). Nonetheless, from the upper echelons perspective, Nielsen and Nielsen (2013) introduce the concept of nationality diversity as a crucial dimension influencing board decisions and performance. This concept recognizes that different national backgrounds are linked to diverse cultural values and norms, which in turn may influence the norms of conduct and the decision-making priorities in the boardroom.

In line with the general claim that diversity is beneficial to decision-making as a source of ideological heterogeneity that may fruitfully support the sharing of ideas and the enactment of change, several studies have indicated that national diversity positively impacts a firm's sustainability performance (e.g. Harjoto *et al.*, 2019; Naciti, 2019; Rao and Tilt, 2016). For instance, Müller (2014) argues that a more diverse BoD, as reflected by a greater proportion of foreign directors, has a significant and positive impact on firm performance. National diversity has also been found to improve the quality of decision-making for social and environmental actions which, in turn, promotes higher sustainability performance (Harjoto *et al.*, 2019; Naciti, 2019; Rao and Tilt, 2016).

However, when assessing the impact of national diversity on a delicate and complex societal issue like climate change, we argue that potential downsides of national diversity at the board level should be carefully considered as well. In particular, diversity in ethnic origin and the existence of multiple backgrounds may interfere with several group processes, thus negatively affecting group-level decision-making (Souren *et al.*, 2004). Indeed, the variety of cognitive schemata, each contributing to making sense of the decision problem, may potentially hamper communication and coordination, thus resulting in confused brainstorming, difficult compromising among the multiple and potentially conflicting perspectives and potentially decision stasis. From this perspective, Gibson (2004) argues that group members from different cultures are more likely to sense and respond differently to the same event or situation. In line with this, Zhang *et al.* (2007) argue that homogeneous teams share common views and are likely to interpret and evaluate situational events and

management practices in similar ways, i.e. they generally report stronger affinity than heterogeneous teams. When delving into higher-order strategic decisions involving the firm–environment relationship, such as those connected to the efforts that a firm is willing to devote to combatting climate change, we therefore expect that a more culturally homogeneous group of people will foster the achievement of a univocal route to action toward climate investments, favoring a positive group polarization. Therefore, the following hypothesis is proposed:

H6. The board's national homogeneity has a positive effect on the firm's climate change orientation.

3. Methodology

3.1 Sample

The hypotheses of this study were tested on a sample of listed firms included in the Global Climate Change Liquid Equity Index (GALPLACC) developed by ECPI, an independent international company supporting sustainable investments. This index was one of the first to capture corporate-level climate change commitment and is widely used by asset management and institutional investors, keeping them at the forefront of sustainable investment strategies. In terms of eligibility criteria, ECPI establishes an individual ESG rating through a rigorous, undisclosed proprietary screening process based on three criteria. Specifically, each company is assigned a rating scale ranging from F (the worst) to EEE (the best rating obtainable by a company that is particularly committed to tackling climate change), with eight intermediate levels. Firms with the lowest ESG ratings are excluded. The companies passing the initial test must also meet two further criteria, i.e. a minimum market capitalization of €500m and a minimum daily average value of traded stocks of €10m over the previous six months. Only companies meeting all three eligibility criteria are included in the index, which is reviewed every six months, ensuring its credibility and reliability.

Furthermore, ECPI takes a comprehensive approach that also embraces the social dimension of CSR, as it screens corporate documents to assess whether the social pillar is addressed, for instance, regarding employees and human rights, community relationships and respect for shareholders' rights under the "Do Not Do Significant Harm" category. Thus, our sample is not based on companies' voluntary disclosure of some specific sustainability items, but rather relies on a well-established and comprehensive index (e.g. Al-Qahtani and Elgharbawy, 2020).

In terms of composition, at the end of June 2021, the GALPLACC was composed of 40 listed companies from all over the world operating in various sectors identified as crucial in addressing the climate change challenge, including advanced building and materials, energy efficiency, finance, renewable and alternative energy, transport, waste management, water treatment and public services sectors. Thus, our sample has a multi-industry and multi-country nature, making it different from prior studies focusing on specific countries (i.e. Cucari *et al.*, 2018) or industries (i.e. Caby *et al.*, 2022).

We manually collected data on the board composition and gathered sociodemographic information on each director for every company included in the GALPLACC index at the end of June 2021. The data collection process involved reviewing public disclosures, annual reports and other corporate documents. However, due to the reluctance of Asia-Pacific firms to publicly disclose information (see for example the recent Kearney report, 2024), our data collection process was challenging and required additional effort to ensure the accuracy and reliability of the data. This is evident in our final sample, which consists of a unique, hand-collected data set of 35 companies, composed of 16 US firms, three firms from Germany, two firms each from the UK, France, Canada, Switzerland and Sweden and one firm each from Australia, Denmark, Finland, Ireland, Spain and Italy. This composition of the index is more current than ever. In fact, the GALPLACC index as of May 31, 2024, did not contain any Chinese companies and featured only one Japanese-listed firm, consistent

with the recent Amnesty International Report (2023–2024). The report emphasizes that in such contexts, several human rights are not fully respected, which violates one of the fundamental eligibility criteria for inclusion in the GALPLACC index provided by ECPI.

3.2 Variables and sample distribution

Table 1 lists and describes the variables used in this study, while the descriptive statistics of the variables used in the study are provided in Table 2. The Appendix presents the sample composition by firms in alphabetical order.

Dependent variable. The dependent variable, *climate change orientation*, is measured by the rating assigned by ECPI to each company included in the sample and ranges from 1, the lowest level, to 6, the highest rating.

Building the dependent variable of this study based on the GALPLACC index offers several advantages relative to rating scores in several respects. First, the GALPLACC is an investible and replicable index, which implies that it can be replicated by reference to securities of reasonable size and liquidity. Second, the GALPLACC is published daily through various well-known financial services providers. Collectively, these characteristics also contribute to making this index particularly transparent, which cannot be always found as a feature of ESG ratings, as testified by prior studies (see, for instance, Albitar *et al.*, 2023; Al-Qahtani and Elgharbawy, 2020; De Villiers *et al.*, 2011; Walls *et al.*, 2012). In terms of sample distribution on the dependent variable, Table 2 shows that the average ECPI-ESG rating level is high, at 4.4 on a scale from 1 to 6. This high average is not surprising due to the distribution of the index, as 54.28% of the sampled companies fall into the highest levels of the ratings (rating 5 and 6).

Independent variables. As far as the independent variables are concerned, we follow prior studies and measure *board size* as a continuous variable capturing the number of directors sitting on the BoD. The number of directors ranges from 8 to 27, with an average of 13 board members. The *degree of board independence* is operationalized as the ratio of independent directors to the total number of board members. On average, 73% of the directors in the sampled companies were independent. *Board age* is computed as the

Table 1 Variables and measures

Variable	*Description*
Climate change commitment (ECPI-ESG rating)	The rating assigned by ECPI to each company included in the sample. It ranges from 1 (worst level) to 6 (best level)
Board size	Number of directors on the board for each company
Board independence	Percentage of the independent directors on the board for each company
Gender diversity	Binary variable: 1 if women account for at least 30% of board members
Board age	The average age of the directors on the board for each company
Educational level	Percentage of graduate directors on the board for each company
National homogeneity	Binary variable: 1 if the percentage of directors of the same nationality on the board for each company is at least 50%; 0 otherwise
Industry	Binary variable: 1 if the firm belongs to the banking, financial and insurance sector; 0 otherwise
European Union (EU)	Binary variable: 1 if the company is based in the EU; 0 if Extra-EU
Firm size	Log-transformed total assets at the end of 2020
Firm age	Log-transformed number of years since the company's foundation at the end of 2020
Firm performance	Return on Assets (ROA) for each company at the end of 2020
Firm leverage	Level of leverage for each company at the end of 2020

Source: Created by authors'

Table 2 Descriptive statistics

Variable	Mean	SD	Min	Max
ECPI-ESG rating	4.4	1.2649	1	6
Board size	13.11	4.0494	8	27
Board independence	0.73	0.1875	0.27	0.93
Gender diversity	0.69	0.4710	0	1
Board age	59.56	3.7917	52	68
Educational level	0.9274	0.0864	0.73	1
National homogeneity	0.8571	0.3550	0	1
Industry	0.1429	0.3550	0	1
EU	0.6	0.4970	0	1
Firm size	2.820	0.0723	2.7111	3.0318
Firm age	4.2672	0.7741	2.71	5.87
Firm performance	5.9722	5.2483	0.20	20.11
Firm leverage	149.48	84.63	56.74	476.23

Source: Created by authors'

average age of directors on the board; in our sample, the average age is about 60 years, and 52 as the minimum age. *Gender diversity* is measured as a binary variable taking the value of 1 if the number of women on the BoD reaches the minimum threshold of 30% (Noguera, 2020) and 0 otherwise. On this variable, it is worth emphasizing that in 69% of the analyzed companies, the critical mass is reached. *Education level* has been operationalized as the ratio of graduate directors sitting on the board (with the majority of directors, i.e. about 92%, being graduate). Finally, to capture the BoD *national homogeneity*, we built a dichotomous variable taking the value of 1 if at least 50% of board members come from the same country and 0 otherwise.

Moving to the control variables, we include several controls at the context and firm level, in line with prior studies (e.g. De Villiers *et al.*, 2011; McKendall *et al.*, 1999), ensuring that all relevant aspects have been considered in our study.

At the context level, we built a dichotomous variable to capture the industry, which takes the value of 1 if the firm operates in the banking, financial and insurance sectors, and 0 if it operates in any other industry. In our sample, 14 companies belong to the energy and water sector (40% of the sample), seven firms to the manufacturing industry (20% of the sample), five to banking and insurance (14%), four to transport, three to the automotive sector, one to waste and one to the consulting services sector.

Finally, regulations and policies could have an influence on how boards navigate climate-related challenges within regulatory frameworks, as corporate governance rules and the regulatory proactiveness may differ depending on the policy framework. Therefore, we included a binary variable distinguishing between European and non-European companies in our analysis. In terms of distribution, 21 companies are based in European countries (60% of the total sample), while 14 are non-European (40%), thus offering a relatively well-distributed sample in terms of geographical location. Table 3 displays the correlation matrix of our variables.

At the firm level, we include a variable capturing *firm size*, measured as the natural logarithm of a firm's total assets at t - 1. Company market capitalization was not considered in our analysis as a size indicator because it is one of the eligibility criteria used by ECPI in the selection of the sampled companies (50 million market cap). To control for the fact that younger firms may be more oriented toward adopting initiatives addressing environmental issues, we include a control on *firm age*, operationalized as the number of years since the firm's establishment as of 2021. On average, firm age is 93 years since foundation. We then included a variable capturing *firm performance*, measured as the firm's return on assets (ROA), to control for the potential effect of poorly performing firms being more encouraged

Table 3 Correlation matrix

	ECPI-ESGrating	*Board size*	*Board independence*	*Gender diversity*	*Board age*	*Educational level*	*National homogeneity50*	*National homogeneity 85*	*Industry*	*EU*	*Firm size*	*Firm age*	*Firm performance*	*Firm leverage*
Dependent variable														
ECPI-ESGrating	1													
Independent variables														
Board size (*H1*)	−0.29	1												
Board independence (*H2*)	−0.31	−0.06	1											
Gender diversity (*H3*)	−0.12	0.67	0.14	1										
Board age (*H4*)	−0.08	0.24	0.11	−0.09	1									
Educational level (*H5*)	−0.05	−0.15	0.31	−0.23	0.06	1								
National homogeneity (*H6*)	−0.13	0.19	−0.11	0.07	0.14	0.10	1							
Control variables														
Industry	0.26	−0.01	−0.02	0.19	−0.04	−0.25	−0.30	−0.19	1					
EU	−0.11	0.21	0.11	−0.04	0.33	0.47	0.33	0.47	0.00	1				
Firm size	0.11	−0.14	0.07	0.14	0.13	−0.26	−0.35	−0.10	0.71	−0.12	1			
Firm age	0.33	0.01	−0.11	0.09	0.08	−0.27	−0.09	−0.14	0.27	−0.08	0.15	1		
Firm performance	0.02	0.17	−0.23	−0.20	−0.12	0.13	0.06	−0.14	−0.42	−0.04	−0.72	−0.06	1	
Firm leverage	0.11	−0.10	0.02	−0.14	0.34	0.10	0.19	0.23	0	0.38	0.37	−0.01	−0.37	1

Notes: *H1* through *H6* are the hypotheses being tested. *H1* is supported; *H2* is rejected; *H3* is supported; *H4* through *H6* are rejected
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to embark on investment projects that may restore desired performance levels. Similarly, we measured *firm leverage* to rule out the effect played by the firm's indebtedness.

At the board level, it is noteworthy that almost all coefficients show a negative correlation with the commitment toward climate change. The negative association between the ECPI rating and board size (−0.29), independent directors (−0.31) and the achievement of a critical mass of women on the board (−0.12) underscores potential areas for improvement in board characteristics to enhance a company's climate change commitment.

At the firm level, the correlation coefficients of firm size (0.11) and Return on Assets – ROA (0.02) suggest that larger and more profitable firms are associated with higher ECPI ratings, as they have access to resources, which they can use to sustain their investments beyond core operations. Additionally, firm age is also positively associated with the ECPI rating (0.33), indicating that older firms may have a greater inclination toward environmental investments, given their experience in a business environment that was historically less focused on environmental issues compared to newer firms. Overall, the low correlation coefficients between the variables indicate that multicollinearity did not bias our results, which is further confirmed by the variance inflation factors (VIFs) being well below the threshold of 3. Furthermore, following an established route in the literature, to ensure proper inference of causality in our cross-sectional model, we used lagged independent and control variables at t - 1. In other words, the rating that a firm can obtain as a measure of its commitment toward climate change initiatives at time t is a function of several board-level predictors and a set of firm-level control variables, all measured at time t - *1*. Thus, we can exclude potential endogeneity effects.

In line with the nature of our dependent variable as an ordinal dependent variable, ordinal regression represented the appropriate estimation method and we therefore adopted ordered probit regressions as the most suitable analytical method. Specifically, the following function was used:

$$\begin{aligned}\text{Climate change orientation} = {} & \beta_1 \text{Board size} + \beta_2 \text{Board independence} \\ & + \beta_3 \text{Gender diversity} + \beta_4 \text{Board age} + \beta_5 \text{Educational level} \\ & + \beta_6 \text{National homogeneity}_i + \beta_7 \text{Industry} + \beta_8 \text{EU} \\ & + \beta_9 \text{Firm size} + \beta_{10} \text{Firm age} + \beta_{11} \text{Firm performance} \\ & + \beta_{12} \text{Firm leverage} + \varepsilon \end{aligned} \tag{1}$$

4. Results

Table 4 presents the results of our equation from Model 0 to Model V. In particular, Model 0 provides the results for a model including only the six board-level variables on which we formulated the study's hypotheses, namely board size, board independence and the socio-demographic dimensions of gender diversity, age, educational level and national homogeneity. Then, from Model I to Model V, we progressively inserted the two context-level control variables, i.e. industry and the belonging to the EU, and the firm-level control variables, namely firm size, firm age, firm performance and leverage. It is worth noting that the inclusion of these control variables leads to a progressive improvement in the explanatory power of the models ($R^2 = 0.14$ in Model I to $R^2 = 0.25$ in Model V), thus supporting the relevance of the selected predictors.

Before delving into the results of the hypotheses, we offer some comments on the effects of the control variables. It is extensively acknowledged that the EU policy is more climate-friendly if compared to many non-European contexts (Global Sustainable Investment Review, 2022). However, contrary to our expectations, the variable capturing the institutional context is not significant in all our models, thus indicating that the level of

Table 4 Ordered probit regression results: main models

Variables	*Model 0*	*Model I*	*Model II*	*Model III*	*Model IV*	*Model V*
Independent variables						
Board size	−0.112* (0.0655)	−0.767** (0.0464)	−0.155*** (0.0594)	−0.156** (0.0625)	−0.161** (0.0632)	−0.142** (0.0670)
Board independence	−2.515*** (0.882)	−2.931*** (0.9091)	−2.577*** (0.914)	−2.659*** (0.991)	−2.520*** (0.963)	−2.559** (1.009)
Gender diversity	0.977 (0.717)	2.274 (2.556)	1.118* (0.618)	1.202** (0.587)	1.250** (0.565)	1.124** (0.552)
Board age	0.0494 (0.0825)	0.029 (0.0837)	0.0856 (0.0762)	0.0729 (0.0672)	0.0737 (0.0656)	0.0654 (0.0635)
Educational level	1.799 (1.923)	1.658 (2.347)	1.697 (2.479)	2.995 (2.741)	2.927 (2.764)	3.144 (2.753)
National homogeneity	−0.643 (0.792)	−0.558 (0.815)	−0.673 (0.802)	−0.718 (0.721)	−0.642 (0.753)	−0.852 (0.776)
Control variables						
Industry		1.353 (1.051)	2.471** (1.063)	2.145* (1.133)	2.086* (1.119)	2.805** (1.275)
EU		0.028 (0.426)	0.0579 (0.382)	0.0946 (0.390)	0.134 (0.378)	−0.303 (0.484)
Firm size			−8.697** (3.609)	−8.056** (3.735)	−6.791 (5.020)	−11.85* (6.425)
Firm age				0.529* (0.275)	0.533* (0.275)	0.515* (0.269)
Firm performance					0.0215 (0.0554)	0.0102 (0.0556)
Firm leverage						0.00452 (0.00290)
Observations	35	35	35	35	35	35
Pseudo R^2	0.1112	0.1411	0.1916	0.2279	0.2291	0.2455

Notes: *Ordered probit regression. Robust std. errors in parentheses. ***indicates statistical significance at the 1% level; **indicates statistical significance at the 5% level; * indicates statistical significance at the 10% level.* This Table shows the ordered probit results. The dependent variable is the ECPI-ESG rating. The predictor variables are board size, board independence, gender diversity (a dichotomous variable which takes value 1 if at least 30% of board members are female, 0 otherwise), board age, educational level, national homogeneity (50% threshold of board members having the same nationality). Industry and EU are context-level control variables. We progressively add the firm-level control variables firm size (in log), firm age (in log), firm performance and firm leverage respectively

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climate change commitment displayed by the firms included in our sample is not solely determined by their geographical location. The lack of statistical significance of this variable, while note entirely surprising, does raise some intriguing considerations. For instance, the average ECPI ratings in the subsample of European and non-European companies are very similar (4.29 for EU companies and 4.57 for non-EU companies), and the t-test indicated that no statistical difference exists between the two groups.

On the other hand, the industry where the company operates is significantly associated with the climate change score: the banks and insurance sector is positively linked with the climate change score ($\beta = 2.80$, p-value < 0.05 in Table 4, Model V), which confirms that the environmental commitment may be industry-specific.

It is also worth noting that firm age has a statistically significant and positive effect on our dependent variable ($\beta = 0.51$, p-value < 0.1 in Table 4, Model V), indicating that older firms are more responsive to calls for supporting sustainable development. Firm size, in contrast, has a negative effect on the dependent variable ($\beta = -11.85$, p-value < 0.1 in Table 4, Model V), which might suggest that larger firms may suffer from a greater organizational inertia than smaller firms and may hence be less inclined to allocate their slack resources to investment projects that deviate from their core activities.

Moving to the results on our main variables, findings provide evidence that board size has a negative impact on the ECPI-ESG rating ($\beta = -0.14$, p-value < 0.05 in Table 4, Model V), which supports our H1 that a negative relationship exists between the number of BoD members and the firm's climate change orientation (e.g. Ahmed *et al.*, 2006; Dey, 2008). Contrary to our expectations, our empirical evidence indicates that the greater the number of independent directors in the boardroom, the worse the ECPI-ESG rating ($\beta = -2.56$, p-value < 0.05 in Table 4, Model V), so our H2 is rejected.

H3 predicted that the achievement of a critical mass of women on the board would enhance the firm's climate change orientation, with positive implications for the ECPI-ESG rating. This hypothesis is confirmed ($\beta = 1.12$, p-value < 0.05 in Table 4, Model V), thus suggesting that women may support a firm's climate change orientation as long as they do not act as "grey directors" but rather reach a critical mass.

With regard to the role played by age, our fourth hypothesis posited that a higher average age of board members would negatively affect the climate change orientation, as we expect the younger generations to be more sensitive to sustainable development. Our results, however, do not support the intended effects and rather show that the average age of board members has no influence on a firm's climate change commitment; therefore, our H4 is not confirmed. This result, however, is not particularly surprising given the relatively high average age of board members in our sample (60 years). The number of graduate directors sitting on the board has no significant impact on the ECPI-ESG rating; thus, our H5 that a greater educational level would encourage greater climate change commitment is not supported. Again, this result should also be considered in the light of the fact that 92% of the sampled directors have a degree. It is also worth noting that, despite not having any statistical significance, the coefficient of this variable has the expected positive sign, consistently with our hypothesized relationship. Table 4 does not show any statistical evidence for the impact of nationality homogeneity among board members; for this reason, our H6 is not confirmed.

Robustness tests

To further test the robustness of our results, we ran alternative models with a sensitivity analysis on two independent variables, namely national homogeneity (Table 5, Models from VI to IX) and women on the BoD (Table 6). In particular, we developed a more restrictive measure of national homogeneity, operationalized as a binary variable equal to 1 if the board includes at least 85% of directors from the same country, whose results are shown in

Table 5 Robustness test: sensitivity analysis on national homogeneity and logit model

Variables	*Model VI*	*Model VII*	*Model VIII*	*Model IX*	*Model X (logit model)*
Independent variables					
Board size	−0.162*** (0.0624)	−0.162** (0.0658)	−0.175** (0.0681)	−0.162** (0.0714)	−0.7230*** (0.2455)
Board independence	−2.319** (1.039)	−2.411** (1.050)	−2.150** (1.089)	−2.061* (1.103)	0.4657** (0.2078)
Gender diversity	1.009* (0.593)	1.087* (0.578)	1.188** (0.561)	1.080* (0.558)	−11.7296** (5.1168)
Board age	0.0829 (0.0744)	0.0702 (0.0658)	0.0708 (0.0633)	0.0645 (0.0613)	6.2652*** (2.3136)
Educational level	1.386 (2.534)	2.686 (2.974)	2.319 (3.168)	2.419 (3.218)	18.9808* (11.1553)
National homogeneity85	0.325 (0.421)	0.346 (0.423)	0.448 (0.451)	0.506 (0.478)	2.0101 (1.2442)
Control variables					
Industry	2.746*** (0.988)	2.405** (1.018)	2.291** (1.017)	2.971** (1.307)	9.2196* (4.7571)
EU	−0.275 (0.452)	−0.263 (0.420)	−0.163 (0.416)	−0.609 (0.560)	−1.5498 (2.0782)
Firm size	−8.626** (3.537)	−7.931** (3.718)	−5.127 (4.692)	−9.215 (6.191)	−56.0790* (28.7102)
Firm age		0.526** (0.267)	0.541** (0.268)	0.528** (0.262)	1.8022 (0.7357)
Firm performance			0.0517 (0.0574)	0.0486 (0.0557)	−0.0256 (0.2009)
Firm leverage				0.00401 (0.00283)	0.0169 (0.0119)
Observations	35	35	35	35	35
Pseudo R^2	0.1865	0.2223	0.2293	0.2427	0.4499

Notes: *Ordered probit regression results. Robust std. errors in parentheses. ***indicates statistical significance at the 1% level; ** indicates statistical significance at the 5% level; * indicates statistical significance at the 10% level.* This Table shows a robustness test results. The dependent variable is the ECPI-ESG rating. The predictor variables are board size, board independence, gender diversity (a dichotomous variable which takes value 1 if at least 30% of board members are female, 0 otherwise), board age, educational level, national homogeneity (85% threshold of board members having the same nationality). Industry and EU are context-level control variables. We progressively add the firm-level control variables firm size (in log), firm age (in log), firm performance and firm leverage respectively. In this way we test the robustness of our analysis. In Model IX, we report a logistic regression based on a dichotomous dependent variable

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Table 5. Furthermore, we built a continuous measure capturing the number of women sitting on the BoD, as reported in Table 6.

The results shown in Table 5 converge and confirm the patterns of findings presented in Table 4. Specifically, the effects associated with board size ($\beta = -0.16$, p-value < 0.05, Table 5 Model IX), the presence of independent directors ($\beta = -2.06$, p-value < 0.1, Table 5 Model IX), and the critical mass of women ($\beta = 1.08$, p-value < 0.1, Table 5 Model IX) offer statistical support to our main model. Consistently, the results of the average age of board members, their educational level and the variable capturing national homogeneity confirm the nonsignificance. However, it is interesting to note that with a more restrictive measure of national homogeneity (85% instead of 50%), the coefficient of this variable reflects the relationship hypothesized in H6.

In Table 5, Model X, we also ran an additional analysis based on a different operationalization of our dependent variable. In particular, we created a new DV as a binary measure taking value 0 for the lower levels of the ECPI rating (from 0 to 4) and 1 for the higher levels of the rating (5 and 6). The results of the logit regression model are fully in line with our main model and the other robustness analyses.

Finally, in Table 6, we present the results of a sensitivity analysis, where we included the percentage of women directors on the board for each company. In terms of distribution, the percentage of women on boards is 31% on average, ranging from 7% to a maximum of 50%. The results confirm our main models, thus further underscoring the importance of attaining a critical mass for women to play a significant role in the boardroom.

5. Discussion and implications

Our analysis supports the upper echelons perspective that the board-level characteristics and the sociodemographic dimensions of its members may drive a firm's strategic decision-

Table 6 Robustness test: panel sensitivity analysis

	Panel A						Panel B	
Variables	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*	*Model 8*
Independent variables								
Board size	−0.105** (0.0419)	−0.100** (0.0465)	−0.104** (0.0470)	−0.0896* (0.0532)	−0.118** (0.0471)	−0.114** (0.0513)	−0.124** (0.0532)	−0.117** (0.0583)
Board independence	−2.906*** (0.968)	−2.938*** (1.010)	−2.840*** (0.963)	−2.911*** (0.975)	−2.574** (1.087)	−2.609** (1.087)	−2.424** (1.135)	−2.343** (1.126)
Female involvement	3.357 (2.494)	3.179 (2.248)	3.465 (2.448)	3.694 (2.249)	2.794 (2.268)	2.562 (2.079)	3.317 (2.252)	3.610* (2.061)
Board age	0.0755 (0.0748)	0.0570 (0.0646)	0.0593 (0.0646)	0.0597 (0.0626)	0.0708 (0.0728)	0.0517 (0.0629)	0.0574 (0.0609)	0.0606 (0.0589)
Educational level	1.191 (2.440)	2.242 (2.742)	2.167 (2.711)	2.594 (2.694)	0.756 (2.433)	1.799 (2.900)	1.406 (2.995)	1.674 (3.088)
National homogeneity50	−0.700 (0.817)	−0.736 (0.749)	−0.670 (0.762)	−0.936 (0.787)	0.415 (0.437)	0.447 (0.431)	0.550 (0.466)	0.610 (0.494)
Control variables								
Industry	2.377** (1.071)	2.090* (1.125)	2.030* (1.114)	2.964** (1.257)	2.726*** (1.019)	2.419** (1.029)	2.291** (1.026)	3.201** (1.309)
EU	−0.0465 (0.431)	−0.0236 (0.435)	0.0141 (0.429)	−0.518 (0.490)	−0.413 (0.523)	−0.415 (0.490)	−0.311 (0.480)	−0.865 (0.584)
Firm size	−7.609** (3.279)	−6.814** (3.143)	−5.634 (4.692)	−12.37** (5.875)	−7.691** (3.345)	−6.829** (3.297)	−3.949 (4.622)	−9.569 (5.888)
Firm age		0.472* (0.280)	0.472* (0.279)	0.453* (0.270)		0.475* (0.273)	0.481* (0.271)	0.466* (0.261)
Firm performance			0.0207 (0.0610)	0.0119 (0.0589)			0.0549 (0.0622)	0.0560 (0.0577)
Firm leverage				0.00590** (0.00268)				0.00534** (0.00264)
Observations	35	35	35	35	35	35	35	35
Pseudo R^2	0.1711	0.2003	0.2013	0.2301	0.1683	0.1977	0.2052	0.2294

Notes: Ordered probit regression. Robust std. errors in parentheses. ***indicates statistical significance at the 1% level, **indicates statistical significance at the 5% level; *indicates statistical significance at the 10% level. This Table shows the ordered probit results. The dependent variable is ECPI-ESG rating. The predictor variables are Board size, Board age, independent, women, Educational level, nationality50 (under "Panel A") and nationality85 (under "Panel B"), Industry, EU as explained in Table 1. We progressively add the control variables firm size (in log), firm age (in log), firm performance and firm leverage respectively in columns named Model 1, Model 2, Model 3, Model 4, Model 5, Model 6, Model 7 and Model 8. In this way we test the robustness of our analysis

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making. In particular, our study indicates that the board composition impacts the corporate-level climate change orientation and emphasize the importance of examining multiple board characteristics, as they may have various effects on the sustainable orientation of companies in terms of pursuing a climate change agenda. Specifically, companies with smaller boards are rewarded in terms of ECPI-ESG ratings thanks to their greater effectiveness in monitoring (Ahmed *et al.*, 2006; De Andres *et al.*, 2005). This result confirms agency theory tenets and suggests that because smaller boards may potentially be characterized by a lower heterogeneity among directors, the board members may be more aligned in terms of environmental consciousness. This alignment may lead to a shared attentiveness to climate change concerns, fostering a more optimistic view of the potential impact of board composition on climate change commitment. Accordingly, a smaller number of appointed directors may facilitate the fruitful sharing of attitudes and intentions, thus harmonizing decision-making dynamics toward the achievement of higher-order, virtuous objectives such as environmental initiatives (Ahmed *et al.*, 2006; Dey, 2008).

With a plethora of studies highlighting the importance of board independence as a crucial element in enhancing the effectiveness of supervision and monitoring (Ahmed *et al.*, 2006; Hillman and Dalziel, 2003; Said *et al.*, 2009), it is fascinating that the number of independent directors negatively influences a company's level of commitment to climate change. Indeed, though specific laws and regulations in many countries worldwide have encouraged the inclusion of independent directors on boards, our study indicates that when a minority, albeit well-represented, becomes a majority (even relative), it may lose its effectiveness in a group context. In fact, in contrast to the traditional agency theory underpinnings indicating that outside directors may minimize the opportunistic behaviors of managers, our findings suggest that independence does not automatically confer better advising at the board level and this may be for several reasons. First, independent directors often sit on multiple boards, meaning they potentially suffer from professional distractions in terms of busy schedules that negatively impact their meeting attendance and necessitate a selective allocation of time and attention (Masulis and Zhang, 2019). In addition, this finding also raises interesting implications in terms of the qualitative aspect of the independence attribute (Crespí-Cladera and Pascual-Fuster, 2014). For instance, co-opted independent directors, i.e. directors appointed after the CEO, may be less independent, thus indicating that not all independent directors are effective monitors (Coles *et al.*, 2014). This condition, in turn, may indicate that independent directors are not necessarily able to assess environmental opportunities or are too busy to detect them. Furthermore, our finding may be interpreted as a signal of independent directors being more profit-oriented than internal board members, which may hence discourage navigating uncertain investment projects prioritizing long-term environmental quality over short-term economic wealth. Thus, reducing the board size to achieve climate change benefits may occur by reducing the number of independent directors or better controlling their selection to appoint a smaller number of environmentally sensitive board members.

Moving to the gender diversity sphere, our analysis confirms that a critical mass should be reached to ensure a positive impact of women on the adoption of sustainability initiatives (e.g. Fernandez-Feijoo *et al.*, 2012, 2014; Konrad *et al.*, 2008; Manita *et al.*, 2018). While gender diversity acts as a catalyst of environmental commitment (Awwad *et al.*, 2023; Baalouch *et al.*, 2019; Ben-Amar *et al.*, 2017; Cullinan *et al.*, 2019; Glass *et al.*, 2016; Hollindale *et al.*, 2019), giving an effective voice to female directors requires them to achieve a critical mass in the boardroom (Galavotti and D'Este, 2022; Guest, 2009; Torchia *et al.*, 2011). Therefore, the greater sensitivity toward climate change characterizing female directors relative to male counterparts (Ciocirlan and Pettersson, 2012) may translate into concrete actions as long as appointed women reach a critical mass in the overall board composition. In our study, 30% of gender quotas are associated with a significantly higher climate change orientation, emphasizing the urgency of achieving gender diversity for a positive impact on sustainability initiatives.

This consideration, while confirming the important role of the multiple regulations of the last decades in increasing gender quotas, also reminds that the perceived legitimacy of women occupying directorship positions is still challenged in the common thinking. Connected to the above, from a policymaking perspective, regulators play a relevant role in guiding the composition of boards as a crucial way to sustain the orientation toward climate change initiatives. Indeed, as long as climate change is a priority on policymakers' agenda, our findings confirm the effectiveness of a 30% gender quota policy. In light of the potential negative effects associated with a large board size and independent directors, gender quotas should be reached by reducing the number of male directors, especially if they are independent, to appoint a significant number of women, stressing the need for strategic board composition.

Interestingly, neither the average age nor the educational level of board members appears to be a significant driver of a firm's climate change commitment. This evidence suggests that, while ecological movements and environmental consciousness have gained strong support, especially from younger people (Diamantopoulos *et al.*, 2003; Handajani *et al.*, 2014), older directors are also concerned about the prospects for future generations. Similarly, while the education level of board members and the extent of national homogeneity have significant effects in other areas, such as financial risk perception (e.g. Lippi and Rossi, 2020), insurance literacy (e.g. Cucinelli *et al.*, 2021) and financial literacy (e.g. Lusardi and Tufano, 2015), their effects are flattened in a climate change context, which further confirms the crucial role that environmental concerns play within and across society. At the same time, however, we believe that caution should be adopted in the interpretation of such evidence, given the relatively limited number of observations.

Finally, as regards the firm operating contexts, interestingly, although the EU has a more environmentally oriented policy relative to other legal systems (Global Sustainable Investment Review, 2022), belonging to an institutional system providing a well-developed environmental policy does not appear to be a significant driver of a firm's climate change orientation. In contrast, the industry seems to play a significant role. However, the fact that the banking and insurance industry displays significantly greater levels of climate change commitment than other industries, including manufacturing, indicates that the extent to which firms actively incorporate an environmental stance may be driven by the ease with which they adapt their production processes. In this sense, policymakers and industry-level lobbying institutions may consider the importance of streamlining the conversion of internal processes as much as possible to make climate change investments less industry-sensitive. In turn, this may also drive virtuous changes at the business model level in terms of reducing the environmental impact of those industries that mostly contribute to the climate problem.

6. Concluding remarks

The role played by the board of directors' characteristics in informing and guiding strategic decision-making processes within companies is well established in the literature (Coles *et al.*, 2008; Pathan, 2009). We promote a conceptually focused approach and join an emerging and promising conversation advocating that an in-depth perspective should be adopted by assessing specific ESG dimensions. Indeed, although most literature adopts an aggregate perspective through composite ESG ratings, our study suggests that the intrinsic heterogeneity in the composition of such ratings calls for a more targeted perspective. This nuanced perspective is crucial in joining the academic debate on the factors affecting firms' environmental sensitivity in terms of climate change orientation (e.g. Cucari *et al.*, 2018; De Abreu *et al.*, 2022; Islam *et al.*, 2022).

From a theoretical perspective, we respond to the recent calls that the interpretive complexity of CSR matters requires the adoption of a cross-fertilizing approach (Mitnick *et al.*, 2021). Accordingly, we elaborate a conceptual framework bridging multiple

theoretical perspectives to the examination of how varying sociodemographic characteristics of the board of directors impact a firm's climate change orientation. In particular, the board dimensions examined in this study lie at the intersection of different theories, namely upper echelons, agency, resource dependence and critical mass theories. Collectively, our results demonstrate and reinforce their complementarity by underlying their mutually supportive explanatory power when addressing contested issues like CSR (Mitnick *et al.*, 2021).

This paper has some limitations that may pave the way for some intriguing future lines of inquiry. First and most notably, our study is based on a small sample size that, while reflecting the stringent criteria used by ECPI to build the GALPLACC index, invites a prudent approach in the interpretation of the empirical results, especially regarding the lack of significance of some variables, namely board age, educational level and national homogeneity. Accordingly, we were cautious in offering generalizable prescriptions as the study takes an exploratory nature. It is also worth noting that, because the index used in this study does not include nonlisted companies, there may be some underrepresented firm categories, such as small and medium-sized enterprises. Thus, future studies may extend our analysis by focusing on more populated indexes.

The multi-country and multi-industry perspective offered in this study deviates from the conventional approach of focusing on specific countries (e.g. Cucari *et al.*, 2018) or industries (e.g. Caby *et al.*, 2022). At the same time, we encourage future research to adopt a contingency perspective in terms of analyzing whether, and to what extent, the effect played by some sociodemographic characteristics may be country-specific. In this respect, the existence of multiple and often contrasting regulations on gender quotas may represent a fertile research ground for assessing possible country-specificities in the identification of the relevant critical mass.

Second, we follow an established approach in the corporate governance literature to the operationalization of our main predictors. However, future studies might advance some traditional concepts and measurements to accommodate emerging social concerns. For instance, the increasing gender fluidity, which refers to the recognition and acceptance of a spectrum of gender identities beyond the traditional binary of male and female, that is surfacing in the sociological and policymaking landscapes may encourage more fine-grained and nuanced perspectives to the use of gender polarity views. This shift in understanding gender could influence future research on corporate governance and sustainability by prompting a more inclusive and diverse approach to gender-related issues.

Finally, while most existing studies adopt a quantitative approach to the examination of corporate environmental performance, future research may embrace a qualitative approach to better capture the motivations driving the directors' commitment toward climate change initiatives or, more broadly, their sustainable sensitivity.

To conclude, the extent to which the composition of the board can influence a firm's climate change orientation represents a fertile area for further research and we thus encourage additional studies on this highly relevant topic. In particular, taking a multi-country perspective may significantly enhance global awareness of the corporate governance mechanisms enabling an environmental consciousness.

Overall, we contribute to the recently flourishing debate on the value added generated by examining complex and contested matters like CSR through the cross-fertilizing combination of mutually informing theoretical perspectives (Mitnick *et al.*, 2021). While our study does not aim to reconcile these theoretical frameworks, it is positioned at their intersection and acknowledges the importance of calibrating their interpretive dominance when addressing intricate issues.

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Appendix: Sample composition by firms in alphabetical order

Table A1 This table presents the sample composition used in this analysis by firms in alphabetical order

Firm	*Country*	*Sector*	*Board size*	*Board independence*	*Gender diversity*	*Board age*	*Educational level*	*National homogeneity50*
ABB ltd	Switzerland	Energy	11	0.91	0	59.45	1	0
Allianz SE	Germany	Banking and insurance	22	0.90	1	55.73	0.77	0
Applied Materials Inc	USA	Energy	20	0.79	1	58.5	0.95	1
Atlas Copco AB a	Sweden	Industry	12	0.80	0	58.09	0.73	1
Bank of Nova Scotia Halifax	Canada	Banking and insurance	27	0.85	1	58.92	0.92	0
Bayer Motoren werke AG (BMW)	Germany	Automotive	11	0.92	0	56.85	0.74	1
Canadian National Railways	Canada	Transport	18	0.50	1	63.62	1	1
CSX Corporation	USA	Transport	13	0.37	1	61.27	1	1
Cummins Inc	USA	Industrial	12	0.73	1	53	1	1
Danaher Corp	USA	Industrial	11	0.50	1	64.54	0.85	1
Ecolab Inc	USA	Energy	9	0.58	1	58.83	1	1
Emerson Electric Co	USA	Industrial	10	0.91	0	61.82	1	1
Enel SpA	Italy	Energy	12	0.90	1	54.33	1	1
Fortum Oyj	Finland	Energy	11	0.67	1	56.3	0.9	1
Geberit AG reg	Switzerland	Industrial	14	0.64	1	52.5	1	1
General Electric Co	USA	Energy	12	0.93	0	58.91	0.91	1
Iberdrola SA	Spain	Energy	20	0.38	1	59.29	0.93	0
Johnson Controls International plc	Ireland	Industrial	10	0.79	0	58.92	1	1
Munich re AG	Germany	Banking and insurance	12	0.69	0	59.4	0.75	1
National Australia Bank Ltd	Australia	Banking and insurance	13	0.89	1	60.4	1	1
National Grid PLC	UK	Energy	13	0.91	1	60	0.92	1
NextEra Energy Inc	USA	Energy	9	0.86	1	63.31	1	1
Norfolk Southern Corp	USA	Transport	8	0.75	0	61.31	1	1
Orsted	Denmark	Energy	10	0.62	0	58.33	0.89	1
Republic Services Inc	USA	Energy	14	0.67	1	53	1	1
Roper Technologies, Inc	USA	Industrial	13	0.88	1	64	0.9	1
Saint-Gobain, Cie de	France	Industrial	14	0.42	0	60.71	0.79	1
Schneider Electric SE	France	Energy	14	0.73	1	58.08	0.91	0
Southern Co	USA	Energy	10	0.69	1	67.64	1	1
Standard Chartered	UK	Banking and insurance	12	0.27	1	61.57	0.93	1
Tesla, Inc	USA	Automotive	11	0.92	1	53.2	0.90	1
Union Pacific Corp	USA	Transport	16	0.50	0	66.42	0.83	1
Volvo AB B	Sweden	Automotive	8	0.70	1	58.69	0.94	1
Waste Management Inc	USA	Energy	14	0.90	1	64.25	1	1
Xcel Energy Inc	USA	Energy	13	0.92	1	63.57	1	1

Source: Created by authors'

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