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Board Ancestral Diversity and Voluntary Greenhouse Gas Emission Disclosure

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This paper examines the relationship between board diversity and firms' decisions to voluntarily disclose information about their greenhouse gas (GHG) emissions. We focus on board ancestral diversity as a relatively new dimension of (deep-level) board structure and document that it has a positive and statistically significant effect on a firm's scope and quality of voluntary GHG emission disclosure. The effect goes beyond the impact of more common (surface-level) dimensions of board diversity and remains robust after addressing endogeneity concerns. In line with the theoretical conjecture that diversity enhances a board's advising and monitoring capacity, we find that the impact of diverse boards is stronger in more complex firms and in firms with low levels of institutional ownership. Overall, our findings provide evidence for board diversity being a relevant governance factor in corporate environmental decision making.

Introduction

Boards of directors play a vital role in corporate governance. They oversee discretionary management decisions, including those relating to sustainability and environmental issues (Aguilera et al., 2021; Firoozi and Keddie, 2022; Jain and Zaman, 2020; Li, 2018; Li et al., 2017; Walls, Berrone and Phan, 2012), by providing essential advice and monitoring to a firm's management (De Villiers, Naiker and van Staden, 2011; Hillman and Dalziel, 2003). Thereby, the level of board efficacy critically depends on board structure and composition (Johnson, Schnatterly and Hill, 2013). As one crucial characteristic reflecting both the structure and the composition of boards, board diversity has received increasing attention because it is regarded as a driver of social dynamics and collaboration among directors (Baker et al., 2020).

More diverse boards are likely to exhibit higher levels of knowledge and a better understanding of stakeholder needs. In line with resource dependence (Pfeffer and Salancik, 1978) and stakeholder management (Freeman, 1984) theory, they are expected to be better advisors than their more homogeneous counterparts. The discussions within more diverse boards are richer, more informed, and less prone to groupthink, enabling the board to consider a greater variety of aspects and courses of action. Related to the monitoring task, and

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rooted in (stakeholder-)agency theory, board diversity should not only foster board oversight through a better understanding of the firm's operations, challenges and opportunities, but also create greater independence among directors and vis-á-vis management. This makes monitoring less vulnerable to biases and inefficiencies.

Despite the growing interest in board diversity, most of the literature focuses on the role of gender diversity (Baker et al., 2020), and little is known about board diversity in multi-dimensional cultural or ancestral backgrounds (Giannetti and Zhao, 2019). However, the latter concept of board diversity seems particularly relevant when it comes to corporate long-term objectives. Harrison, Price and Bell (1998) document, for instance, that the impact of diversity in deep-level characteristics (i.e., attitude-building director characteristics such as ancestry) increases over time, while the impact of diversity in surface-level characteristics, such as age or gender, decreases over time. This suggests that ancestral diversity as a deep-level characteristic has a more persistent and increasing impact on the board's decision-making process in the long term. As such, board ancestral diversity (BAD) might be particularly relevant in multi-period strategic decision-making processes such as environmental policy decisions, which are typically implemented iteratively and materialize only over longer horizons.

In this regard, a strategically highly relevant environmental decision is the decision to disclose greenhouse gas (GHG) emissions – one of the main drivers of climate change (IPCC, 2023). Various parties are interested in this type of non-financial disclosure, not only because it is perceived as a prerequisite for managing carbon transition risk and as a bedrock on the path to a net-zero emission economy (Bolton et al., 2021). Stakeholders (including customers, employees, investors and policymakers) also consider a firm's carbon footprint when making their consumption, employment, investment and regulatory decisions. In line with these observations, a growing body of research suggests that firms that are conscious of their impact on the environment and voluntarily disclose their emissions can enhance their valuations (Bolton and Kacperczyk, 2021a; Clarkson et al., 2013; Matsumura, Prakash and Vera-Muñoz, 2014; Plumlee et al., 2015).

Given the documented impact of environmental disclosure, it is of particular interest for academics and practitioners to better understand the underlying driving forces of environmental disclosure decisions. Our study provides new insights into the role of board diversity in this decision-making process, focusing on ancestral diversity as a deep-level characteristic of boards that has already been shown to impact various financial firm outcomes (Giannetti and Zhao, 2019). The evidence suggests that BAD improves the board's advising and monitoring capabilities. This supports the notion that BAD also improves corporate environmental decisions and positively impacts voluntary GHG emission disclosure. We explicitly emphasize that our study does not analyse the impact of the accumulation of *certain* environment-friendly values among directors but rather the impact of diversity in *general* perspectives that stimulates the board's monitoring and advising functions.

Constructing a measure of BAD based on the directors' ancestral origin obtained from Ancestry.com and using information on corporate GHG emissions from the Carbon Disclosure Project (CDP), we provide empirical evidence for the hypothesized impact of board diversity on voluntary GHG emission disclosure. Our analysis reveals a positive, statistically and economically significant effect of BAD on disclosure scope and quality. The documented effect goes beyond the impact of more standard (surface-level) dimensions of board diversity and remains robust after addressing endogeneity concerns. In robustness checks, we alleviate endogeneity concerns caused by (i) reverse causality using a two-stage least squares (2SLS) instrumental variable regression, (ii) selection bias using a Heckman (1979) selection correction, and (iii) potentially omitted variables using a variety of additional controls. We further address potential measurement bias by considering alternative dependent and explanatory variables.

In supplementary analyses, we find a stronger effect of BAD on voluntary GHG emission disclosure in complex firms and in firms with a lower percentage of institutional ownership. Using high corporate complexity as a proxy for the firm's advising needs and low institutional ownership as a proxy for monitoring needs, the results confirm that BAD becomes effective through both the advising and the monitoring channel. BAD plays a more prominent role in firms with a greater potential for improvement, that is, in those in special need of advising and in those with weak monitoring.

Our study contributes to the existing literature in three ways. First, we enrich the broader literature on board diversity by outlining that ancestral diversity as a deep-level board characteristic covers aspects of board structure and composition beyond standard surface-level dimensions of diversity. We thereby address criticisms of an often too narrow focus and a lack of cognitive aspects in empirical board diversity research (Baker et al., 2020). Second, we contribute to the literature on the impact of ancestry on strategic corporate decisions in general. Focusing on board members' ancestral roots and transferred values and beliefs, we cover a particularly salient part of individual personality inherited from ancestors. Third, we offer new insights into the drivers of the scope and quality of voluntary GHG emission disclosure. We provide empirical evidence that directors' diversity impacts the board's dynamics and efficacy (Anderson et al., 2011), resulting in superior environmental decisions. Overall, our findings strongly

suggest that board diversity is a relevant governance factor in corporate environmental decision making.

Theoretical background and hypotheses

Boards and ancestral diversity

Boards play a central governance role by monitoring and advising a firm's managers (De Villiers, Naiker and van Staden, 2011; Hillman and Dalziel, 2003). Previous research shows that the actions and efficacy of boards depend on their structure and composition (Adams, Hermalin and Weisbach, 2010; Drobetz et al., 2018; Hermalin and Weisbach, 2003; Johnson, Daily and Ellstrand, 1996; Johnson, Schnatterly and Hill, 2013; Zahra and Pearce, 1989). A growing stream of literature recognizes the social dynamics within boards and focuses on how directors collaborate. Following the identification of boards as small work groups and building on the psychology and sociology literature, a major research theme has emerged: the dynamics and efficacy of a group are affected by the diversity of its members. The more diverse the backgrounds of group members are, the greater the variety of experience, expertise, incentives, networks and perspectives (Anderson et al., 2011; Srinidhi, Gul and Tsui, 2011; Upadhyay and Zeng, 2014). This has substantial implications for how the board can exercise its central functions of advising and monitoring (Anderson et al., 2011).

Building on resource dependence theory (Hillman, Withers and Collins, 2009; Pfeffer and Salancik, 1978), it has been shown that more diverse boards provide firms with better advice and counsel (Anderson et al., 2011; Bear, Rahman and Post, 2010; Carter, Simkins and Simpson, 2003; Giannetti and Zhao, 2019; Harjoto, Laksmana and Lee, 2015; Sun, Xu and Govind, 2022). This is due to the wide variety of experiences, expertise, incentives, networks and perspectives that directors bring to the board. Greater heterogeneity within the board along these dimensions provides more resources for problem solving and strategy formulation, eventually increasing a firm's competitiveness (Anderson et al., 2011; Bear, Rahman and Post, 2010; Hong and Page, 2001, 2004; Robinson and Dechant, 1997). Diverse boards also have richer discussions and more informed deliberations. Together with a reduction in groupthink, this leads to consideration of a greater variety of aspects and courses of action (Abbott, Parker and Presley, 2012).

In light of stakeholder management theory (Freeman, 1984), a diverse board's advising function is strengthened, because the various backgrounds of the directors make the board better able to hear, understand and address the concerns and wishes of multiple stakeholders (D'Acunto, Fuster and Weber, 2021; Harjoto, Laksmana and Lee, 2015; Robinson and Dechant, 1997). In this regard, it is essential to note that the board's support for certain corporate actions does not originate from the accumulation of *certain* beliefs but from the diversity in *general* beliefs, which results in a better ability to identify the overall risks and benefits for the firm.

Considering board diversity from the (stakeholder-) agency theory perspective (Fama and Jensen, 1983; Hill and Jones, 1992; Jensen and Meckling, 1976), one further expects that the board's monitoring function will benefit from higher diversity in the boardroom as well (Abbott, Parker and Presley, 2012; Adams and Ferreira, 2009; Bear, Rahman and Post, 2010; Ben-Amar, Chang and McIlkenny, 2017; Carter, Simkins and Simpson, 2003; Deutsch, 2005; Gul, Srinidhi and Ng, 2011; Srinidhi, Gul and Tsui, 2011; Upadhyay and Zeng, 2014). The increase in knowledge allows diverse boards not only to better advise, but also to maintain a more comprehensive oversight of a firm. This is achieved by a better understanding of the firm's operations, challenges and stakeholder demands, which may also be very diverse. As a result, diverse boards are better able to evaluate firm performance and management actions (Bear, Rahman and Post, 2010; Hillman and Dalziel, 2003). Moreover, reducing groupthink leads to a higher independence of thought among directors. In turn, this increases the probability that the legitimate concerns of individual directors will not be suppressed in an attempt to maintain the harmony of the group (Abbott, Parker and Presley, 2012; Anderson et al., 2011; Carter, Simkins and Simpson, 2003). Board diversity likely also leads to greater personal differences between the board and management. Accordingly, the board may be more efficient in monitoring, because a lower number of personal or business ties improves board independence (Abbott, Parker and Presley, 2012; Carter, Simkins and Simpson, 2003).[1]

Although board diversity encompasses many facets, most studies focus on a small number of diversity attributes (mostly gender), and only a few studies choose to measure board diversity on multiple components (An et al., 2021; Bernile, Bhagwat and Yonker, 2018; Harjoto, Laksmana and Lee, 2015; Katmon et al., 2019).[2] Little is known about the impact of board diversity in multi-dimensional cultural or ancestral backgrounds (Giannetti and Zhao, 2019). However, this recent concept of board diversity seems relevant for at least three reasons. First, ancestry is the starting point of

[1]Despite these positive aspects of board diversity, a few studies mention difficulties arising from diversity through, for example, communication problems and coordination challenges (O'Reilly, Caldwell and Barnett, 1989; Giannetti and Zhao, 2019).

[2]See Baker et al. (2020) for a review of the literature on board diversity.

intergenerational culture transmission (Guiso, Sapienza and Zingales, 2006), and culture shapes the values and beliefs that influence an individual's decision making. In line with upper echelons theory, this may have substantial implications for corporate outcomes (Hambrick and Mason, 1984). Second, ancestral diversity covers a unique part of diversity not subsumed by other diversity dimensions and, therefore, adds to a comprehensive understanding of the impact of diversity more broadly (Giannetti and Zhao, 2019). Third, following evidence from sociology, social psychology and organizational behaviour, Harrison, Price and Bell (1998) document that the impact of diversity in deep-level characteristics (i.e., attitude-building director characteristics such as ancestry) increases over time, while the impact of diversity in surface-level characteristics, such as age and gender, decreases over time. Although surface-level characteristics are easily observable and influence collaboration within newly established working groups in the short term, members of the group become accustomed to them in the longer term, and the impact of surface-level diversity decreases over time. In contrast, collaborators discover each other's deep-level traits with some time lag, but the interrelationships between these different traits are long-lasting. Given this more persistent impact of deep-level (ancestral) diversity on the board's decision-making process, it seems particularly relevant for corporate decisions, which are typically implemented iteratively and materialize in the longer term.

Voluntary greenhouse gas emission disclosure

A long-term challenge in current times is the fight against climate change. In the wake of greater public attention, the demand for information about environmental issues – especially GHG emissions as one of the main drivers of climate change (IPCC, 2023) – has steadily risen, and environmental reporting decisions have become of strategic importance for listed firms. Building on the financial disclosure literature (Leuz and Wysocki, 2016), Christensen, Hail and Leuz (2021) argue that equity investors should also care about environmental reporting in general and about GHG emission reporting in particular. They discuss the economic benefits of environmental disclosure and how information transparency can lead to improved liquidity, lower cost of capital, and higher firm value (financial materiality). Confirming the notion that increased transparency assists stakeholders in evaluating the risks and uncertainties arising from GHG emissions, the valuation penalty imposed on polluting firms (Griffin, Lont and Sun, 2017; Hughes, 2000; Matsumura, Prakash and Vera-Muñoz, 2014) is reduced when firms voluntarily disclose their GHG emissions (Clarkson et al., 2013; Matsumura, Prakash and Vera-Muñoz, 2014; Plumlee et al., 2015). This effect is driven by a reduction in the disclosing firm's cost of capital (Bolton and Kacperczyk, 2021a; Jung, Herbohn and Clarkson, 2018; Plumlee et al., 2015).[3]

Furthermore, reducing information asymmetries and adverse selection costs boosts investor, consumer and employee interest (Branco and Rodrigues, 2006; Dhaliwal et al., 2011). Disclosing firms convey a positive signal that they can measure their GHG emissions effectively, which is a prerequisite for managing the associated risks in the first place and helps firms legitimize their operations (Al-Tuwaijiri, Christensen and Hughes, 2004; Matsumura, Prakash and Vera-Muñoz, 2014). Commitment in this as yet unregulated area also potentially allows a firm to shape pending regulation to its standards, leading to lower future adoption costs (Ilhan et al., 2023). From a societal perspective, better disclosure may even induce changes in firms' behaviour (impact materiality) and lead to reductions in GHG emissions (Downar et al., 2021; Jouvenot and Krueger, 2021; Tomar, 2023).

On the downside, the decision to disclose not only incurs direct costs of compiling, preparing and disseminating the disclosed information, but also has indirect costs (Christensen, Hail and Leuz, 2021). These include proprietary costs from potential leakages and revelations of internal business information to consumers, competitors and other stakeholders (Berger and Hann, 2007; Feltham and Xie, 1992; Ilhan et al., 2023), which may lead to an erosion of the firm's competitive advantage. Lower incentives for innovation are particularly harmful in light of GHG emissions because new technologies must be developed to effectively reduce emissions (Breuer, Leuz and Vanhaverbeke, 2022). Voluntary disclosure could also provoke litigation and compliance costs imposed by formerly uninformed competitors, regulators and public interest groups (Healy and Palepu, 2001; Matsumura, Prakash and Vera-Muñoz, 2014). Finally, it may weaken the position of managers vis-à-vis the board (Hermalin and Weisbach, 2003) and give managers incentives to make their activities opaque to protect their private gains and reduce effective external monitoring (Leuz, Lins and Warnock, 2009).

Hypotheses

Building on the board literature, we propose that more diverse boards can better reach and communicate effectively with various and diverse stakeholder groups. They understand that the importance of GHG emis-

[3]For example, firms may recognize that high levels of GHG emissions lead to higher compliance costs, fines, liabilities, litigation, penalties and costs to adopt future regulation and mandatory environmental standards (Sharfman and Fernando, 2008; Matsumura, Prakash and Vera-Muñoz, 2014, ; Griffin, Lont and Sun, 2017; Bolton and Kacperczyk, 2021b).

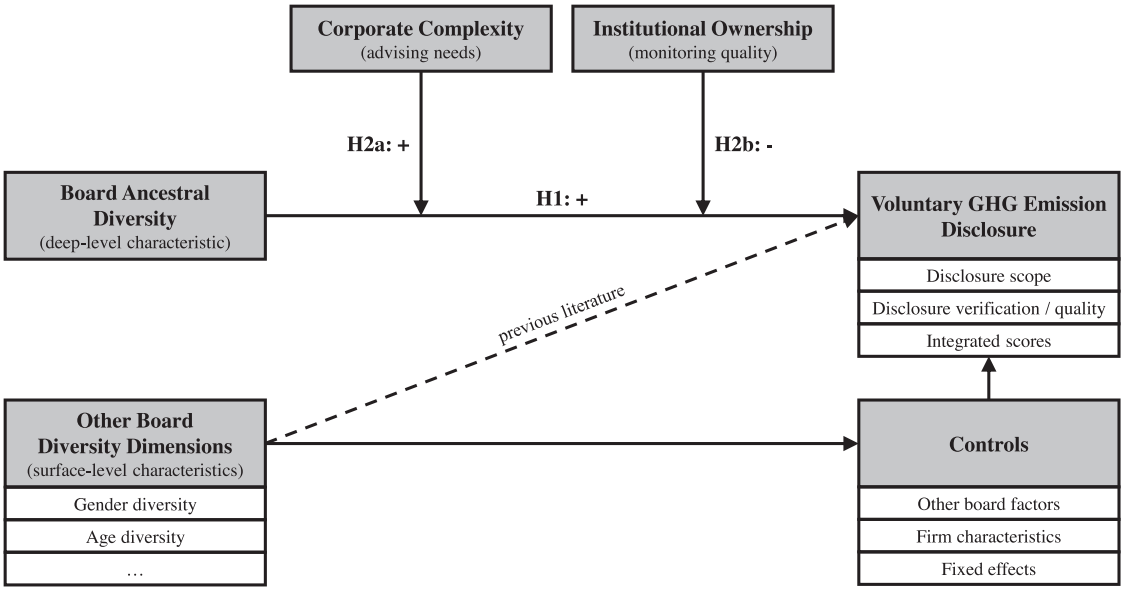

Figure 1. Research model

sion disclosure arises from more than ethical or moral imperatives because GHG emissions impose environmental risks and regulatory uncertainties relevant to a firm's overall assessment. More diverse boards address voluntary GHG emission disclosure during board meetings and subject managers to superior monitoring of the firm's GHG emissions. Raising awareness for arguments favouring voluntary GHG emission disclosure, based on societal preferences and economic benefits, makes firms more likely to engage in voluntary GHG emission disclosure.

Even if most directors had no prior affinity to environment-related practices, a greater diversity of perspectives in the boardroom raises the probability that at least one director will bring up the importance of voluntary GHG emission disclosure. The rest of the board would be forced to consider this idea, increasing the probability that the board recognizes the beneficial effect of voluntary GHG emission disclosure and insists on improvements.

Besides this influence through advising, we also posit that more diverse boards will improve voluntary GHG emission disclosure through better monitoring abilities. The extant literature shows that enhancements in monitoring from greater board diversity improve a firm's information environment by, for example, improving stock price informativeness (Gul, Srinidhi and Ng, 2011) and earnings quality (Srinidhi, Gul and Tsui, 2011) or reducing the likelihood of financial restatements (Abbott, Parker and Presley, 2012) and corporate opacity (Upadhyay and Zeng, 2014). Along the same lines, it is also comprehensible that board diversity promotes the disclosure of environmental information such as GHG emissions.

Overall, we argue that diverse boards, especially those with high levels of BAD, better understand the economic benefits of voluntary GHG emission disclosure. Given that the persistence of BAD is congruent with the long-term and iterative nature of the decision-making process in the context of environmental issues, our hypotheses are as follows:

H1: Higher BAD improves the scope and quality of voluntary GHG emission disclosure.

H2a: The positive impact of BAD on the scope and quality of voluntary GHG emission disclosure is higher in firms with higher advising needs.

H2b: The positive impact of BAD on the scope and quality of voluntary GHG emission disclosure is higher in firms with lower monitoring quality.

By investigating the two board functions individually, we account for Guest's (2019) notion that not all diversity measures might impact advising and monitoring similarly. Figure 1 summarizes our research model and hypotheses.

Data and methodology

Board ancestral diversity

To measure ancestral diversity among the members of a given board, we start our sample construction with annual data on board compositions from the Institutional Shareholder Services (ISS, formerly RiskMetrics). ISS provides detailed board data for S&P 1500 companies, including directors' names, age, board function, employ-

ment status, ethnicity, expertise, gender, independence, and outside directorships.

Next, we add the directors' ancestries from Ancestry.com. This database provides information on the country of origin of immigrants who arrived in New York via ship between 1820 and 1957. We aggregate this information to the level of last names. We match the most common ancestry of each last name to the directors' last names in our ISS sample (Bae et al., 2023; Giannetti and Zhao, 2019; Liu, 2016; Merkley, Michaely and Pacelli, 2020; Pan, Siegel and Wang, 2017, 2020).[4] Then, we calculate the ancestral diversity within a specific board in a given year using Blau's (1977, p. 78) measure of heterogeneity:

$$\textit{Board ancestral diversity} = 1 - \sum_{a \in A} P_a^2, \qquad (1)$$

where P_a is the percentage of directors with ancestry a, and A is the entirety of all ancestries present on the board. This index measures the probability that two randomly selected directors from the same board do not have the same ancestry.[5] In particular, it ranges between 0 (lower diversity) and 1 (higher diversity).[6]

Greenhouse gas emission disclosure

We obtain voluntary GHG emission disclosure data over the 2010–2017 period from the CDP.[7] The CDP sends standardized questionnaires annually to the portfolio firms of its participating institutional investors, requesting environmental information such as actual GHG emissions and their external verification. According to the Greenhouse Gas Protocol (2004), this information is classified into three scopes: scope 1 includes all direct GHG emissions of the firm; scope 2 incorporates all indirect GHG emissions for the generation of purchased energy; and scope 3 subsumes all other indirect GHG emissions that are produced in association with a firm's business operations (e.g., production of purchased materials, outsourced services, employee business travel, and product use). Firm reactions to the CDP questionnaire are tracked in the CDP Climate Change dataset. Provide information include the general response status (responded/not responded) on an annual basis as well as the detailed answers to the questionnaire from those firms who decided to voluntarily disclose their environmental impact.

We extract four measures from the CDP data to account for different aspects of voluntary GHG emission disclosure. Our first measure, *disclosure scope*, indicates to what extent a firm discloses its GHG emissions. It takes the value of 0 if no emissions are disclosed, 1 if only scope 1 is disclosed, 2 if scopes 1 and 2 are disclosed, and 3 if all three scopes are disclosed. As in Döring et al. (2023) and Ilhan et al. (2023), we construct a second measure, *disclosure verification*, as a proxy of GHG emission disclosure quality. Specifically, we account for the extent to which a firm's GHG emission disclosure is externally verified. This ordinal variable takes the value of 0 if no emission disclosure is externally verified, 1 if only scope 1 is externally verified, 2 if scopes 1 and 2 are externally verified, and 3 if all three scopes are externally verified. The construction of *disclosure scope* and *disclosure verification*, based on available transparent information, circumvents apparent inconsistencies and intertemporal changes within measures that are calculated (often opaquely) by different sustainability data providers (Berg, Fabisik and Sautner, 2021; Busch, Johnson and Pioch, 2020; Kishan, 2022).

We further use the provided *CDP score*, a composite score that evaluates the information disclosed in CDP's questionnaire and awards points for the availability and comprehensiveness of information. The CDP ranks firms from A (best) to E (worst), which we translate to numerical values from 4 (best) to 0 (worst).

As the CDP score also considers some performance-related questions beyond emission information disclosure, we also include the now-ceased *integrated disclosure score* (Döring et al., 2023). This score assesses the detailedness and comprehensiveness of the disclosure.[8]

[4]Online Appendix Table B1 shows the distribution of the top 20 ancestries in our sample. Given that the 'age of mass migration' into the United States was driven to a great extent by UK settlers, it is not surprising that the UK is the most common director ancestry. To alleviate concerns that our results are driven by an overrepresentation of the UK, we control for the impact of directors with UK ancestry by adding the fraction that these directors constitute in a board to our main regression. The results (not reported) remain qualitatively unchanged.

[5]Although this interpretation relies on either an infinite sample size or sampling with replacement, Blau's (1977) index has proved useful in a variety of empirical studies on board diversity (Andrevski *et al.*, 2014; Bear *et al.*, 2010; Ben-Amar *et al.*, 2017; Campbell and Mínguez-Vera, 2008; Giannetti and Zhao, 2019; Harjoto *et al.*, 2015; Miller and del Carmen Triana, 2009; Pandey *et al.*, 2023; Sun *et al.*, 2022; Tuggle *et al.*, 2010; among others).

[6]In a robustness test, we also examine the effect of an alternative measure of diversity. The results do not change qualitatively (shown in Online Appendix D4).

[7]Online Appendix Table B2 provides details on the annual summary statistics. Other recent papers that use data on environmental disclosure from the CDP include Ben-Amar and McIlkenny (2015), Ben-Amar *et al.* (2017), Döring *et al.* (2023), Elijido-Ten and Clarkson (2019), Flammer *et al.* (2021), Griffin *et al.* (2017), Huang *et al.* (2022), Ilhan *et al.* (2023), Jung *et al.* (2018), Lewis *et al.* (2014), Liao *et al.* (2015), Matsumura *et al.* (2014), Prado-Lorenzo and Garcia-Sanchez (2010) and Stanny (2013).

[8]Although the CDP reported data for its integrated disclosure score only until 2015, we observe a strong correlation of this score with our other three variables: disclosure scope, disclosure verification, and CDP score. We thus extrapolate the missing values of 2016 and 2017 based on a first-stage OLS regression

In line with the CDP score, we transform the integrated disclosure score's scale from 0 (worst) to 100 (best) into a score with numerical values from 1 to 4 based on empirical quartiles. Firms with an original disclosure score of 0 also receive a score of 0 after the transformation. We assign non-disclosing firms to the lowest-scoring category for the CDP and integrated disclosure score.[9]

Controls

We include several control variables that may affect GHG emission disclosure. Detailed definitions and sources of all variables are provided in Online Appendix Table A1. First, to avoid our results being driven by other diversity effects within the board, we follow Harjoto, Laksmana and Lee (2015) and include additional board diversity measures from ISS. These measures include board diversity in gender, race, age, outside directorships, tenure, co-option (i.e. appointments to the board after the current CEO), and expertise. We repeat Blau's (1977) measure of heterogeneity for each dimension (see Equation 1) and standardize the results within industry-years between 0 and 1. The sum of these seven standardized diversity measures is our overall diversity control, labelled *board diversity*. Second, we control for other board characteristics, including average age and tenure of directors, board size, CEO–chairman duality, whether the CEO is the only company insider on the board, and the percentage of independent directors. We capture the information content of these variables in one aggregate variable, *board factor*. It is the first principal component of all board variables.[10] Third, based on Compustat data, we include standard firm controls (Döring et al., 2023) comprising firm size,[11] payout ratio, leverage, profitability, capital expenditures, and book-to-market ratio.

Summary statistics

We require all firm-year observations in the CDP database to have non-missing data for the dependent and control variables. We further exclude firms in the finance industry (SIC codes between 6000 and 6999) because this industry is heavily regulated. All continuous variables are corrected for outliers by winsorizing at the 1% and 99% levels. Owing to varying data availability, our final datasets consist of 3670 firm-year observations for disclosure scope and verification, 3228 for the integrated disclosure score, and 2830 for the CDP score between 2010 and 2017 in the United States. Table 1 presents the summary statistics in detail.

Analysing the correlations between our main variables in Table 2, it is notable that *BAD* correlates only 14.9% with *board diversity*, aggregating the diversity dimensions commonly analysed in the literature. We find a similar picture when considering the correlations between *BAD* and the individual components of *board diversity* (not reported). They range from as low as −0.2% (*co-option diversity*) to only 17.3% (*race diversity*). These weak correlations are consistent with Giannetti and Zhao (2019), who also find that BAD covers a unique part of board diversity not subsumed by other dimensions. Weak correlations emphasize that our analysis of ancestral diversity and other commonly used diversity dimensions will lead to a more comprehensive understanding of the broad concept of diversity.

Research design

Given the ordinal structure of our dependent variables, we use an ordered logit model to estimate the coefficients of the following baseline regression:

$$Disclosure_{i,j,t} = \beta_1 \times Board\ ancestral\ diversity_{i,t} + \sum_{c \in C} \beta_c \times Control_{c,i,t} + \mu_j + \tau_t + \varepsilon_{i,j,t}, \quad (2)$$

where i, j, and t index firms, industries, and years, respectively. *Disclosure* represents disclosure scope, disclosure verification, integrated disclosure score, or CDP score; *board ancestral diversity* is as defined above; and *control* denotes control c out of the full set of controls C.[12] Industry fixed effect (μ_j) and year fixed effect (τ_t) control for unobserved industry characteristics and temporal shocks. $\varepsilon_{i,j,t}$ is the error term.

of the integrated disclosure score on disclosure scope, disclosure verification, and CDP score during the years of available data.

[9]As a robustness test, and to enable comparison with other studies, we also transform our four ordinal disclosure variables to binary dummy variables (see Online Appendix D4). The results do not change qualitatively.

[10]Our baseline results remain qualitatively unchanged (not reported) when we include all individual diversity measures and board characteristics.

[11]Recognizing the prevalent discussion in the literature dealing with the adequate choice of firm size measures and the corresponding disentangling of "measurement effects" and actual "size effects", we follow Dang, Li and Yang (2018) and re-estimate our main analysis with total sales and market value of equity as alternative firm size measures. Compared with our baseline model (see Table 3), the results remain qualitatively unchanged in both cases (not reported).

[12]Acknowledging a potential issue of multicollinearity between the independent variables, we calculate the variables' respective variance inflation factors (VIFs, not reported). Given the average VIFs between 1.601 and 1.648 for the regressions in columns (1) to (4) in Table 3, which presents our main results, multicollinearity should not be an issue in our analysis. The variables' individual VIFs range between 1.159 and 2.481.

Table 1. Descriptive statistics

	N	Mean	P25	Median	P75	SD
GHG emission reporting						
Disclosure scope	3670	1.320	0	0	3	1.400
Disclosure verification	3670	0.630	0	0	1	1.100
Integrated disclosure score	3228	1.293	0	1	3	1.460
CDP score	2830	1.210	0	0	2	1.415
Board diversity						
Board ancestral diversity	3670	0.694	0.640	0.720	0.778	0.115
County ancestral diversity	2884	0.874	0.851	0.885	0.922	0.061
Peers' board ancestral diversity	3661	0.693	0.663	0.698	0.729	0.051
Cultural distance	3668	1.892	1.382	1.848	2.336	0.691
Board diversity	3670	4.102	3.554	4.123	4.650	0.820
Board characteristics						
Board factor	3670	0.007	−0.715	0.279	0.961	1.230
Firm characteristics						
Firm size	3670	9.189	8.329	9.040	10.006	1.228
Payout ratio	3670	0.330	0.000	0.267	0.497	0.541
Leverage	3670	0.277	0.162	0.268	0.373	0.165
Profitability	3670	0.150	0.098	0.139	0.187	0.073
Capex	3670	0.051	0.020	0.036	0.066	0.047
Book-to-market ratio	3670	0.405	0.203	0.341	0.552	0.290

Note: This table reports the number of observations, mean, 25th percentile, median, 75th percentile, and standard deviation of each variable used in our models. Detailed variable descriptions are in Online Appendix Table A1.

Although non-linear ordered logit models account for the ordinal structure of our data, we acknowledge two important differences relative to the standard linear regression model. First, although they have the correct sign and significance level, the coefficients of non-linear regression models cannot be interpreted as the marginal effect that a one-unit increase in the explanatory variable will have on the dependent variable (Beck, Demirgüç-Kunt and Levine, 2006). Therefore, we cannot directly compare the magnitudes of our estimates across subsamples. To enable comparability and better interpretation, we introduce an additional panel that shows the elasticities of our model, namely the effect of a 1% increase in BAD on the probability that an average firm will have a certain disclosure scope, disclosure verification, integrated disclosure score, or CDP score.[13]

Second, adding interaction terms of the explanatory variable with a moderating variable may result in a misleading coefficient for ordered logit models. Norton, Wang and Ai (2004, p. 154) find that "the marginal effect of a change in both interacted variables is not equal to the marginal effect of changing just the interaction term. More surprisingly, the sign may be different for different observations". Therefore, we introduce sample split tests as an appropriate alternative to analyse heterogeneities in the effect of BAD on voluntary GHG emission disclosure.

[13]As is common for elasticities, we define the average firm as at the means of the model's independent variables.

Results

Main analysis

Table 3 presents the results of our baseline model. As shown in Panel A, both aggregated surface-level diversity and BAD have a positive and statistically as well as economically significant effect on the scope and quality of GHG emission disclosure. The documented impact of these board diversity variables supports the notion that diversity matters for voluntary GHG emission disclosure decisions. In particular, the large coefficient of BAD suggests that BAD covers a dimension of diversity not captured by other previously used diversity measures.

Panel B indicates how a 1% increase in BAD changes the average firm's probability of having a given GHG emission disclosure level. In line with our argument that BAD enhances voluntary GHG emission disclosure, we see a decrease in the probability of having the lowest GHG emission disclosure levels. At the same time, the likelihood of having higher GHG disclosure levels increases. We find that the average firm's probability of having the highest disclosure scope, disclosure verification, integrated disclosure score or CDP score increases by 1.32%, 1.43%, 1.43% or 1.36%, respectively, in response to a 1% change in BAD. Considering standardized coefficient estimates, we find that a one-standard-deviation increase in BAD increases the average firm's probability of having the highest disclosure scope, disclosure verification, integrated disclosure score or CDP score by 21.92%, 23.76%, 23.76% and 22.60%, respec-

Table 2. Correlation table

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
GHG emission reporting																
(1) Disclosure scope	1.000															
(2) Disclosure verification	**0.646***	1.000														
(3) Integrated disclosure score	**0.862***	**0.774***	1.000													
(4) CDP score	**0.848***	**0.784***	**0.931***	1.000												
Board diversity																
(5) Board ancestral diversity	0.158*	0.109*	0.136*	0.130*	1.000											
(6) County ancestral diversity	0.079*	0.071*	0.095*	0.098*	0.156*	1.000										
(7) Peers' board ancestral diversity	0.161*	0.127*	0.151*	0.164*	0.376*	0.149*	1.000									
(8) Cultural distance	0.126*	0.072*	0.100*	0.099*	**0.651***	0.205*	0.262*	1.000								
(9) Board diversity	0.231*	0.178*	0.253*	0.258*	0.148*	−0.022	0.086*	0.112*	1.000							
Board characteristics																
(10) Board factor	0.159*	0.122*	0.157*	0.152*	0.035*	−0.003	−0.034*	−0.007	0.148*	1.000						
Firm characteristics																
(11) Firm size	0.391*	0.380*	0.434*	0.458*	0.059*	−0.052*	0.138*	−0.024	0.253*	0.170*	1.000					
(12) Payout ratio	0.117*	0.118*	0.158*	0.169*	−0.015	−0.015	−0.009	−0.015	0.071*	0.075*	0.166*	1.000				
(13) Leverage	0.048*	0.092*	0.086*	0.080*	0.008	−0.107*	0.019	−0.022	0.081*	0.161*	0.180*	0.145*	1.000			
(14) Profitability	0.028*	0.050*	0.035*	0.048*	0.052*	0.024	0.048*	0.069*	0.005	−0.109*	−0.192*	0.005	−0.072*	1.000		
(15) Capex	−0.096*	−0.043*	−0.091*	−0.103*	−0.126*	−0.151*	−0.236*	−0.183*	−0.106*	0.004	0.011	−0.030*	0.023	0.100*	1.000	
(16) Book-to-market ratio	−0.108*	−0.100*	−0.143*	−0.146*	−0.044*	−0.031*	−0.143*	−0.077*	−0.066*	0.022	0.106*	−0.055*	−0.149*	**−0.510***	0.179*	1.000

Note: This table presents the pairwise correlations between the main variables used in our analyses. Absolute correlation coefficients larger than 0.5 are in bold. Detailed variable descriptions are in Online Appendix Table A1.

* Indicates significance at the 10% level.

Table 3. Board ancestral diversity and GHG emission disclosure

Dependent variable	(1) Disclosure scope	(2) Disclosure verification	(3) Integrated disclosure score	(4) CDP score
Panel A: Regression estimates				
Board ancestral diversity	2.323***	2.127**	2.127***	1.995***
	(0.001)	(0.011)	(0.002)	(0.006)
Board diversity	0.401***	0.293**	0.415***	0.387***
	(0.000)	(0.022)	(0.001)	(0.004)
Board factor	0.169***	0.164**	0.137**	0.132**
	(0.008)	(0.022)	(0.039)	(0.041)
Firm size	0.783***	0.882***	0.877***	0.954***
	(0.000)	(0.000)	(0.000)	(0.000)
Payout ratio	0.136	0.135	0.235**	0.209**
	(0.210)	(0.158)	(0.020)	(0.045)
Leverage	−0.610	0.117	−0.652	−0.789
	(0.293)	(0.843)	(0.161)	(0.106)
Profitability	0.148	0.800	1.212	1.266
	(0.908)	(0.534)	(0.300)	(0.348)
Capex	−2.858	−0.219	−3.373	−1.859
	(0.160)	(0.927)	(0.100)	(0.398)
Book-to-market ratio	−0.537	−0.162	−0.544	−0.425
	(0.120)	(0.695)	(0.112)	(0.304)
Panel B: Magnitude of the effects – a 1% increase in board ancestral diversity				
0	−0.522	−0.135	−0.594	−0.420
1	0.594	1.249	0.596	0.704
2	0.828	1.342	1.056	1.023
3	1.323	1.434	1.300	1.263
4			1.434	1.364
N	3670	3670	3228	2830
Pseudo R^2	0.213	0.206	0.197	0.208
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes

Note: This table presents the estimation results for an ordered logit regression of disclosure scope, disclosure verification, integrated disclosure score and CDP score on board ancestral diversity and other control variables. Detailed variable descriptions are in Online Appendix Table A1. Panel A presents the regressions' coefficient estimates. Panel B reports the magnitude of the effect of a 1% increase in ancestral diversity. Column (1) (Column (2)) gives the percentage changes in the probability that an average firm discloses (verifies) its GHG emission for no, one, two or three scopes. Column (3) (Column (4)) gives the percentage changes in the probability that an average firm has an integrated disclosure (CDP) score of 0, 1, 2, 3 or 4. Standard errors are clustered at the firm and year level. *p*-values are in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

tively.[14] The corresponding figures for our composite board diversity variable are 27.01%, 23.31%, 33.02% and 31.36%.

Given that the board diversity variable is a composite index capturing seven diversity dimensions, the standalone effect of BAD on voluntary GHG emission disclosure is economically large in absolute and relative terms, that is, even when it is compared with the impact of all other diversity dimensions taken together. Based on these results, we conclude that Hypothesis 1 is confirmed. Higher BAD improves the scope and quality of voluntary GHG emission disclosure.

Supplementary analysis

To better understand the channels through which board diversity affects GHG disclosure, we analyse the board's central functions of advising and monitoring separately. Specifically, we split our sample according to a firm's need for advice and the prevailing monitoring quality. As more diverse boards offer better advising and monitoring capabilities, our main effect should be more pronounced among firms with more room for

[14]To obtain these figures, we first determine the percentage change in BAD that results from a one standard deviation increase in BAD for the average firm (i.e. we calculate the ratio of BAD's standard deviation to its mean). We then multiply this percentage value by the impact that comes from only a 1% increase in BAD on the average firm's voluntary GHG emission disclosure [e.g. 21.92% ≈ 21.923 % ≈ ((0.155 / 0.694) × 100) × 1.323 %].

improvement, that is, among firms with higher advising needs and a lower monitoring quality.

Advising needs. We first consider the board's advisory function, through which it provides managers with advice and counsel to promote the interests of shareholders. Firms that face high operational complexity benefit from high-quality advice because it is more challenging for their managers to maintain sufficiently high expertise in many substantially different businesses, industries, markets and product lines (Rose and Shepard, 1997). Evidence suggests that more complex firms are more likely to benefit from the advice of larger boards (Coles, Daniel and Naveen, 2008) and more heterogeneous boards (Anderson et al., 2011). Their better advice builds on a much broader set of experiences and knowledge, which is more likely to cope with the firm's complexity. Building on these studies, we use a proxy for firm complexity and investigate how BAD impacts voluntary GHG emission disclosure in the different complexity subgroups.

In particular, we determine a firm's complexity (*structural complexity*) following Coles, Daniel and Naveen (2008) as the first principal component of firm size, leverage and the number of segments.[15] To prepare for the sample split tests, we classify firms with values equal to or above the median value of *structural complexity* as firms with high complexity and stronger needs for advice (high subsamples). Those with values below the median value are firms with less complexity and weaker needs for advice (low subsamples).

Table 4 presents the regression results of ordered logit regressions for disclosure scope, disclosure verification, integrated disclosure score and CDP score separately for the high and low subsamples. Panel A shows that the estimated coefficients on BAD are positive and statistically significant for the high subsamples and insignificant for the low subsamples. These results confirm Hypothesis 2a, namely that the positive impact of BAD on the scope and quality of voluntary GHG emission disclosure is higher in firms with higher advising needs.[16]

Monitoring quality. To analyse the impact of board diversity on the board's monitoring function, we first determine the current state of monitoring by building on the notion that institutional investors are the most sophisticated participants in financial markets (Bushee, 1998; Hand, 1990; Walther, 1997). In this role, they should implement efficient corporate governance through monitoring and intervention (Shleifer and Vishny, 1986), and they also manifest their environmental concerns through their investment and management processes (Döring et al., 2023; Ilhan et al., 2023).

We obtain firms' *total institutional ownership* based on institutional investors' equity holdings of common stock from the Thomson Reuters 13F database. This variable is the percentage of common shares owned by institutional owners. We expect firms with values equal to or above the median value of *total institutional ownership* (high subsamples) to implement stronger monitoring standards, and those with values below the median (low subsamples) to have weaker monitoring standards.

Table 5 shows the corresponding regression results separately for the high and low subsamples. Considering the coefficient estimates presented in Panel A, we observe a positive and highly significant effect of BAD on emission disclosure across all measures of voluntary GHG emission disclosure for the low subsample. In contrast, the effect is consistently insignificant for the high subsample. These results provide empirical evidence for Hypothesis 2b, suggesting that the positive impact of BAD on the scope and quality of voluntary GHG emission disclosure is higher in firms with lower prevailing monitoring quality.[17]

Robustness checks

We provide comprehensive empirical evidence for a positive, statistically and economically significant relation between BAD and voluntary GHG emission disclosure. Moreover, we document that this relation works through improved advising and monitoring capabilities. In the next step, we perform robustness tests to mitigate endogeneity concerns.

First, we address concerns regarding reverse causality by conducting an *instrumental variable regression*. Although our findings show that higher BAD drives improvements in voluntary GHG emission disclosure, one could argue that firms with higher voluntary GHG emission disclosure attract more directors with diverse ancestral backgrounds. In this case, we would also observe a positive relation in our analysis. To alleviate this concern, we estimate an instrumental variable regression that rests on the rationale that the supply of and demand for potential directors essentially shapes the

[15] In contrast to Coles, Daniel and Naveen (2008), we define firm size as the natural logarithm of total assets to ensure consistency with our previous definitions and analyses. However, using Coles, Daniel and Naveen's (2008) definition of firm size as the natural logarithm of sales does not qualitatively change our results.

[16] For robustness, we split the sample in Online Appendix C1 alternatively by the *linguistic complexity* of the company presentation during conference calls, as suggested by Bushee, Gow and Taylor (2018). The results do not change qualitatively.

[17] We perform additional analyses on institutional investors that are arguably superior monitors: long-term and independent institutional investors. In these tests, BAD has a consistently positive and statistically significant impact on voluntary GHG emission disclosure only for those subgroups that have poor external monitoring; that is, for those with low long-term institutional ownership and low independent institutional ownership.

Table 4. Heterogeneity across firms regarding advising needs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Disclosure scope		Disclosure verification		Integrated disclosure score		CDP score	
Structural complexity	High	Low	High	Low	High	Low	High	Low
Panel A: Regression estimates								
Board ancestral diversity	3.679***	0.957	3.301**	1.516	3.444***	1.335	3.613***	0.810
	(0.000)	(0.344)	(0.020)	(0.264)	(0.001)	(0.198)	(0.001)	(0.509)
Board diversity	0.257	0.418**	0.305**	0.262	0.347**	0.534**	0.378**	0.473*
	(0.108)	(0.031)	(0.023)	(0.301)	(0.012)	(0.010)	(0.011)	(0.058)
Board factor	0.235**	0.001	0.034	0.221*	0.093	0.096	0.017	0.102
	(0.013)	(0.991)	(0.732)	(0.077)	(0.400)	(0.290)	(0.864)	(0.404)
Firm size	0.814***	0.900***	0.817***	0.988***	0.815***	1.193***	0.865***	1.315***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Payout ratio	0.109	0.148	0.080	0.335	0.211	0.430**	0.234	0.359
	(0.626)	(0.493)	(0.512)	(0.158)	(0.213)	(0.014)	(0.280)	(0.110)
Leverage	−1.444*	−0.154	−1.258	0.362	−1.394*	−0.872	−1.779**	−0.636
	(0.086)	(0.889)	(0.177)	(0.809)	(0.099)	(0.405)	(0.023)	(0.595)
Profitability	0.309	−0.440	−0.386	1.188	0.013	1.198	−0.010	0.294
	(0.875)	(0.816)	(0.839)	(0.645)	(0.993)	(0.569)	(0.995)	(0.896)
Capex	−5.916*	0.239	0.333	−0.942	−2.754	−2.150	−0.465	−1.395
	(0.070)	(0.933)	(0.914)	(0.876)	(0.424)	(0.541)	(0.885)	(0.751)
Book-to-market ratio	−1.182**	0.154	−0.612	0.329	−1.100*	−0.472	−1.156*	−0.669
	(0.029)	(0.776)	(0.301)	(0.684)	(0.057)	(0.375)	(0.098)	(0.281)
Panel B: Magnitude of the effects – a 1% increase in board ancestral diversity								
0	−1.020	−0.029	−0.208	−0.001	−1.228	−0.050	−0.981	−0.016
1	0.580	0.604	1.955	1.043	0.586	0.857	0.951	0.535
2	1.069	0.619	2.104	1.044	1.537	0.900	1.695	0.548
3	2.032	0.646	2.240	1.044	2.026	0.915	2.228	0.556
4					2.303	0.921	2.465	0.558
N	1487	1487	1487	1487	1332	1258	1156	1093
Pseudo R^2	0.224	0.211	0.197	0.238	0.186	0.231	0.196	0.239
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the estimation results for an ordered logit regression of disclosure scope, disclosure verification, integrated disclosure score, and CDP score on board ancestral diversity and other control variables. Detailed variable descriptions are in Online Appendix Table A1. The sample is split along the median value of a complexity measure, defined as the first principal component of the number of business segments, the natural log of total assets, and leverage (Coles, Daniel and Naveen, 2008). Firm-year observations are assigned to the low (high) subsample if their complexity is below (above) the respective median value. Panel A presents the regression coefficient estimates. Panel B reports the magnitude of the effect of a 1% increase in board ancestral diversity. It shows the percentage changes in the probability that an average firm has a disclosure scope, disclosure verification, integrated disclosure score or CDP score of 0, 1, 2, 3 or 4. Standard errors are clustered at the firm and year level. *p*-values are in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

board's composition (a main determinant of BAD). We instrument our main independent variable using two instruments: one covers the impact of director supply (proxied by the ancestral diversity in the county where the firm is headquartered); the other covers the impact of director demand (proxied by average BAD among peer observations). The results of this instrumental variable regression further support our finding that higher BAD drives improved voluntary GHG emission disclosure. More detailed information on the derivation of the instruments and the regression outcomes are provided in Online Appendix D1.

Second, because the inclusion of a firm in our sample is not random but dependent on the CDP's decision to send out its questionnaire, we address concerns about selection bias by conducting a *Heckman* (1979) *selection correction* based on all firms for which we have non-missing data to compute the regressions' diversity, board and firm controls. Controlling for this selection bias using the inverse Mills ratio (*lambda*) from the first stage, the Heckman (1979) selection correction's second stage confirms the results from our baseline analysis. Detailed information on the empirical setup of the Heckman (1979) selection correction and the regression outcomes are provided in Online Appendix D2.

Third, we alleviate remaining concerns regarding estimation bias resulting from omitted variables by extending our regression setup by a large set of *additional controls*. Online Appendix D3 provides the regression results and detailed information about the additional

Table 5. Heterogeneity across firms regarding monitoring quality

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Disclosure scope		Disclosure verification		Integrated disclosure score		CDP score	
Institutional ownership	High	Low	High	Low	High	Low	High	Low
Panel A: Regression estimates								
Board ancestral diversity	1.026	3.582***	0.485	3.451***	1.191	3.149***	0.708	3.125***
	(0.295)	(0.000)	(0.710)	(0.004)	(0.231)	(0.000)	(0.532)	(0.000)
Board diversity	0.450***	0.361***	0.419**	0.266**	0.501***	0.314**	0.450**	0.344***
	(0.002)	(0.009)	(0.049)	(0.028)	(0.002)	(0.012)	(0.012)	(0.006)
Board factor	0.051	0.288***	0.218*	0.118	0.078	0.190**	0.039	0.197**
	(0.638)	(0.001)	(0.078)	(0.192)	(0.421)	(0.036)	(0.706)	(0.024)
Firm size	0.870***	0.732***	0.878***	0.861***	1.045***	0.774***	1.085***	0.857***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Payout ratio	0.291*	0.028	0.201	0.107	0.497***	0.045	0.440***	0.037
	(0.053)	(0.838)	(0.308)	(0.422)	(0.000)	(0.736)	(0.000)	(0.786)
Leverage	−1.518*	0.103	−0.187	0.479	−1.694**	0.320	−1.493**	0.137
	(0.081)	(0.880)	(0.833)	(0.559)	(0.034)	(0.615)	(0.044)	(0.846)
Profitability	−0.407	0.738	−0.418	1.226	1.058	1.734	0.724	1.947
	(0.794)	(0.725)	(0.828)	(0.488)	(0.519)	(0.319)	(0.697)	(0.320)
Capex	−0.847	−4.509	0.778	−1.907	−1.055	−6.321*	−0.562	−4.295
	(0.702)	(0.185)	(0.774)	(0.604)	(0.632)	(0.066)	(0.813)	(0.262)
Book-to-market ratio	−0.759*	−0.018	−0.545	0.311	−0.998**	0.030	−0.914*	0.238
	(0.081)	(0.974)	(0.295)	(0.580)	(0.047)	(0.957)	(0.099)	(0.732)
Panel B: Magnitude of the effect – a 1% increase in board ancestral diversity								
0	−0.089	−1.346	−0.007	−0.374	−0.078	−1.390	−0.030	−1.197
1	0.538	−0.139	0.325	1.764	0.715	0.032	0.444	0.143
2	0.580	0.423	0.330	2.035	0.781	1.025	0.468	0.982
3	0.665	1.703	0.334	2.293	0.808	1.669	0.483	1.750
4					0.820	2.065	0.488	2.108
N	1809	1810	1809	1810	1581	1599	1429	1355
Pseudo R^2	0.211	0.220	0.201	0.212	0.210	0.189	0.212	0.197
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table presents the estimation results for an ordered logit regression of disclosure scope, disclosure verification, integrated disclosure score, and CDP score on board ancestral diversity and other control variables. Detailed variable descriptions are in Online Appendix Table A1. The sample is split along the median value of total institutional ownership. Firm-year observations are assigned to the low (high) subsample if their total institutional ownership is below (above) the respective median value. Panel A presents the regression coefficient estimates. Panel B reports the magnitude of the effect of a 1% increase in board ancestral diversity. It shows the percentage changes in the probability that an average firm has a disclosure scope, disclosure verification, integrated disclosure score or CDP score of 0, 1, 2, 3 or 4. Standard errors are clustered at the firm and year level. *p*-values are in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

controls that cover potential disclosure obligations, general disclosure levels, environmental performance, industry standards and additional board and ownership variables. After including this set of additional controls, the main results remain qualitatively unchanged.

Fourth, we finally address concerns regarding the definition of our explanatory and independent variables by re-estimating our main analysis with an alternative measure of BAD, that is, the average cultural distance between the directors, and dummy variables for voluntary GHG emission disclosure, respectively. Online Appendix D4 provides the detailed definitions and motivations of these *alternative variables*. Based on these results, we conclude that our findings do not depend on the definition of our empirical measures.

Discussion

Implications for theory

Our paper contributes to the existing literature in three key ways. First, we enrich the literature on board diversity by outlining that ancestral diversity covers an aspect of diversity not covered by other diversity dimensions. We address the criticism of an often too narrow focus and a lack of cognitive aspects in empirical board diversity research (Baker et al., 2020). Our specific application on voluntary GHG emission disclosure reveals not only that the (deep-level) ancestral diversity has an impact beyond the previously studied (surface-level) gender diversity (Ben-Amar, Chang and McIlkenny, 2017; Hollindale et al., 2019; Liao, Luo and Qingliang, 2015).

The impact of ancestral diversity remains also robust when controlling for a comprehensive list of other board diversity dimensions (Harjoto, Laksmana and Lee, 2015), including gender, race, age, outside directorships, tenure, co-option and expertise. Accordingly, we add to the general understanding of the impact of diversity.

Moreover, our supplementary analyses highlight that BAD improves both board advisory and board monitoring. Although this simultaneous improvement of board functions is comprehensible considering the theoretical implications of resource dependence, stakeholder and (stakeholder-)agency theory, our empirical findings add to the literature because previous studies have shown that the promotion of both board advisory and board monitoring is not evident for all board diversity dimensions (Guest, 2019). Additionally, speaking even more generally about board diversity, our results support the bright rather than the dark side of diversity. While other studies find that higher group heterogeneity could create communication problems and coordination challenges (Giannetti and Zhao, 2019; O'Reilly, Caldwell and Barnett, 1989), we provide strong evidence for the positive consequences of greater diversity within boards.

Second, we contribute to the literature on the impact of ancestry on corporate decisions. Focusing on ancestral roots and the transferred values and beliefs, we cover a particularly salient part of individual personality inherited from ancestors. Unlike other work and life experiences, it is not subject to individual choice and not determined by the current institutional environment (Bae et al., 2023; Brochet et al., 2019; Giannetti and Zhao, 2019; Liu, 2016; Pan, Siegel and Wang, 2017, 2020). Owing to the persistent influence of ancestry, it is important to consider this personal characteristic when analysing business decisions. Especially in an environmental context, the persistent effect of ancestry will be better aligned with the long-term nature of addressing climate change.

Third, we provide new insights into the drivers of the scope and quality of voluntary GHG emission disclosure. Distinct from the growing literature focusing on the impact of institutional investors (Döring et al., 2023; Ilhan et al., 2023), we focus on another important governance mechanism: the board. In particular, we extend our understanding of the board's role by looking beyond its outside perception (Ben-Amar and McIlkenny, 2015) as well as its mere structure, which previous literature has characterized by, among other factors, its independence, CEO–chair duality, female representation (Prado-Lorenzo and Garcia-Sanchez, 2010) and the existence of an environmental committee (Peters and Romi, 2015; Driss *et al.*, 2023). By highlighting board diversity, we provide new empirical evidence regarding the notion from the sociological and psychological literature that sociological determinants also matter and that the dynamics and efficacy of a group such as a board are affected by the diversity of its members (Anderson et al., 2011).

Implications for practice

From a management perspective, our empirical results are consistent with resource dependence, stakeholder and (stakeholder-)agency theory. They suggest that board diversity improves advising and monitoring through the greater variety of experiences, values and perspectives brought to the boardroom (Anderson et al., 2011; Baker et al., 2020; Carter, Simkins and Simpson, 2003). By showing a positive association between BAD and voluntary GHG emission disclosure, we contribute to a better understanding of the mechanisms that foster the desirable improvement of environmental disclosure, which is a prerequisite for managing carbon transition risk and represents the bedrock on the path to the net-zero target (Bolton et al., 2021). Customers, employees and investors appreciate this reduction in information asymmetries for making more informed consumption, employment and investment decisions.

Furthermore, our empirical evidence for improved advising and monitoring capabilities through more diversity provides new arguments in favour of diversity in corporate boards beyond our environment-related setup. Translating our findings to the corporate world and acknowledging the positive valuation, risk and stakeholder effects of voluntary GHG emission disclosure, we confirm managerial statements like the one attributed to Alphabet Inc.'s CEO Sundar Pichai: "A diverse mix of voices leads to better discussions, decisions and outcomes for everyone".

Limitations

Although it provides a broad set of robustness tests, our study has some potential limitations. Our methodology for identifying a director's ancestral background is an approximation rather than a certain determination. While our approach of matching ancestries by last name is common and accepted practice in the literature (Bae et al., 2023; Giannetti and Zhao, 2019; Liu, 2016; Merkley, Michaely and Pacelli, 2020; Pan, Siegel and Wang, 2017, 2020), it has difficulties in controlling for directors who have changed their last name during their life. This issue is particularly pronounced among female directors, as many females in the United States traditionally change their original surname to their husband's surname after marriage. Although we minimize this issue by recalculating our diversity variables only among men and find that our baseline results remain qualitatively unchanged, this cannot fully address all concerns. Building on improvements in machine learning and text mining, further research could circumvent this issue more effectively by building more detailed

family trees for each director through scraping biographies, public CVs and social media profiles. Such an approach could not only refine the ancestry determination but also mitigate our dataset limitations in terms of geography and time.

Conclusion

This study finds a positive and statistically significant relationship between BAD and firms' voluntary GHG emission disclosure. Our results remain robust after addressing potential endogeneity and sample selection problems. Supplementary analyses reveal a higher impact of BAD on voluntary GHG emission disclosure for firms with higher corporate complexity and lower institutional ownership. This indicates that BAD is more effective in firms with stronger advising and monitoring needs. Taken together, our findings are consistent with the broader idea that board diversity is a critical governance factor in corporate environmental decision making.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section at the end of the article.