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The impact of board diversity and sustainability engagement on bank performance

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Abstract

Today's organizations face unprecedented challenges related to societal and environmental matters. The long-term trends related to climate change are expected to generate instability in the credit market and negatively affect organizational performance. Organizations can mitigate these issues and better grasp different trends by having a diverse board (i.e., board members of different genders, ages, qualifications and nationalities). However, that same diversity may also create conflicts and worsen strategic decision-making. Grounded on stakeholder theory, this study investigates the impact of board diversity on bank performance, assuming that board diversity also shapes environmental, social, and governance (ESG) engagement, which is linked to financial performance. Our data comprises a sample of public commercial banks located in OECD countries. The results suggest that board diversity (as a bundle of different traits and characteristics) contributes positively to performance. However, the impact measured by the means of accounting-based and market-based performance measures differs. In addition, we found that ESG investments adversely affect profitability ratios, but a more diverse board mitigates the possible detrimental effects of ESG expenses on company returns. By helping to illuminate the short- and long-term effects of board diversity on bank performance, the results hold value for regulators, policymakers, supervisory authorities, banks, and managers.

Keywords Corporate governance · Board diversity · ESG · Financial performance · Bank · Risk · Z-SCORE

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1 Introduction

Social and environmental impacts of economic activities are pressing issues for governments and business actors across all sectors. Central bank authorities are also taking up the mantle of sustainability (ECB, 2020; EBA, 2021a, 2021b; EBA & ESMA, 2021). Banks are encouraged to take action toward sustainable development goals (Birindelli et al., 2022; Bruno & Lagasio, 2021) given their significant role in economies and high responsibilities toward stakeholders and societies (Chiaramonte et al., 2022; Khan et al., 2021).

To ensure that organizations are capable of responding to recent calls for greater sustainability and accountability, experts (ACCA, 2021; Deloitte, 2015), academics (Cormiers et al., 2024) and bank supervisory authorities (EBA & ESMA, 2021) have been calling for more stringent corporate governance rules and the necessity of having board members with a variety of backgrounds, nationalities, gender, expertise, ages and skills (Arora, 2022; Harrison & Klein, 2007). This board diversity can equip an organization with multiple perspectives when analyzing problems, promote a deeper understanding of stakeholders' social and environmental needs (Maxfield et al., 2018), and facilitate their inclusion into the business strategy (Bhagat & Hubbard, 2022; Cardoni et al., 2020; Scherer & Voegtlin, 2020). Under the stakeholder theory's argument (Freeman, 1984), a diverse board better shapes firms' environmental, social, and governance (ESG) strategies, which will, in turn, lead to favorable strategic outcomes.

However, the relationship among board diversity, ESG commitment, and financial performance has proven to be somewhat convoluted, with results often being inconsistent and context-dependent (Khan, 2022; Savio et al., 2023). When considering all three mentioned elements in unison, there is a need to account for the controversial relationship between ESG commitment and financial performance (Kramer & Pfitzer, 2022).[1] According to the World Economic Forum (2020), ESG investments have a negative (short-term) impact on financial performance (Skarmeas & Leonidou, 2013), but they can generate long-term sustainable value by mitigating risks related to ESG factors (Brogi & Lagasio, 2019; Friede et al., 2015; Whelan et al., 2021). Unfortunately, research does not provide a unified view on the relationship between sustainability and financial outcomes (Nollet et al., 2016; Lin et al., 2019). Inconsistencies pervade both management and banking literature (Gillan et al., 2021).

Being still at an early stage (Talavera et al., 2018), banking studies tend to emphasize the positive impact of board diversity on banks' ESG commitment (Galletta et al., 2022; Gangi et al., 2022; Shakil et al., 2020; Wu et al., 2024). Scholars focus on the advisory role and monitoring role of boards (Janahi et al., 2022), which are able to challenge bank management to build strategic decisions around stakeholders' relevant societal and environmental concerns (Birindelli et al., 2022; Gulati et al., 2020; Shakil et al., 2020; Tarchouna et al., 2017). At the same time, they posit that board heterogeneity is a solution to excessive bank risk-taking (Buchetti & Santoni, 2022;

[1] While being aware that CSR and ESG are different frameworks used to assess sustainability, we used the terms as synonyms. While CSR is more concerned with internally analyzing what a company does/its policies, ESG is considered the measure of sustainability used by investors.

Maxfield et al., 2018) and leads to healthier financial performance and market stability (Bryant et al., 2014; Arnaboldi et al., 2020; EU Directive 2022/2381, 2022; EBA/GL/2023/08; Leung et al., 2019; Shakil et al., 2020).

Despite apparently similar findings, previous studies lack comparability and convergence, mainly because board diversity has been conceptualized in different and often narrowly focused ways (Ben Selma et al., 2022). Gender diversity has been considered as the primary dimension of diversity by regulators, standard setters, and scholars (Ciappei et al., 2023). Yet, Wu et al. (2024) argued that this conceptualization is limiting and demonstrated that different board characteristics have different effects: for instance, gender diversity positively impacted financial performance, but the effect was negative for age and nationality diversity. In addition, impacts on financial performance change when researchers apply different variables—accounting metrics, like ROE and ROA, are not affected by board diversity as variables measuring market performance.

Given the importance of studying board diversity in banks, whose governance is challenged by high leverage, excessive risk-taking, regulatory complexity, and systemic financial stability, and considering the inconclusive findings of previous studies on the impact of board diversity on banks' performance that have focused on a limited set of dependent variables, this paper aims to advance knowledge in three main aspects. First, it employs a multi-dimensional approach to board diversity that goes beyond gender diversity to include different board characteristics. Second, it accounts for how board diversity affects ESG and financial performance and how they are related. Third, it unveils how a more attentive board can better design sustainability strategies that positively impact financial performance. Specifically, the main research questions posed are:

RQ 1. What is the impact of board diversity on banks´ financial performance?
RQ 2. What is the impact of ESG commitment on banks´ financial performance?
RQ 3. How does board diversity moderate the impact of ESG commitment on banks´ financial performance?

We are looking for answers to our research questions from banks in Organzation for Economic Co-operation and Development (OECD) countries. Focusing on these banks is relevant because their geographical scope offers substantial cross-country variation while still ensuring comparability and reliability in ESG data and financial reporting standards. Furthermore, commercial banks form the largest segment of the banking industry in OECD economies. Our center of attention should be able to capture the sector´s core dynamics without biases from specialized institutions such as cooperative or investment banks.

Our results suggest that age, gender, nationality, number of qualifications, and board tenure have different impacts on bank's key measures of financial performance, i.e., ROA, Tobin Q and Z-SCORE. While diversity in age has a systematic negative impact on all dependent variables, differences in qualifications and tenure affect market-based financial measures and risk but do not impact accounting measures expressed as profit ratios. In addition, the same board characteristics (e.g. age diversity) can have a positive effect on Tobin Q but a negative effect on ROA. Never-

theless, when summarized in one composite board diversity measure, heterogeneity seems to affect positively all metrics of bank performance we analyzed.

Also the impact of ESG commitment differs: while higher ESG investments decrease ROA, they slightly enhance Tobin Q, showing that investors better appreciate positive long-term effects of sustainable strategies. However, this adverse effect of ESG investments on profitability ratios is mitigated by board composition, as the combined effect (board diversity *ESG) has a positive impact on ROA. In other words, we presume that board diversification enhances ESG strategies and is able to compensate ESG costs with improved profitability.

This paper contributes to the recent literature (Shakil, 2021) on how to reconcile ESG investments, board diversity, and financial performance by providing a more comprehensive understanding on the relationship between board diversity, ESG, and bank performance. First, it considers five different attributes of board diversity. Second, it offers a novel operationalization of board diversity that better aligns with the concept of diversity and its ability to mitigate groupthink. Specifically, we measure the variables that express board members' characteristics not in terms of dominance or a percentage of one group over another (e.g., more women than men; more young directors than old ones), but as variance in the board's composition relative to the average value. Finally, this paper explores the impact of board diversity with an international scope (Lu et al., 2022), overcoming the limitations of the majority of studies related to board diversity focusing on one single nation (Baker et al., 2020). In short, this paper aims to advance knowledge in the fields of corporate governance and banking in order to benefit both academics and practitioners.

The rest of the paper is structured as follows: Sect. 2 reviews the literature around board diversity as part of corporate governance, followed by a review of ESG investments in banks and their impact on bank performance. Also hypotheses to be tested are presented in Sect. 2. Section 3 describes our data and analytical methodology. Section 4 reports the hypotheses testing and summarizes the main results while the final Sect. 5 draws the conclusions.

2 Literature review and hypotheses

2.1 Board diversity as a mechanism enhancing corporate governance effectiveness

In recent decades, corporate governance (CG) has been understood as a mechanism for creating value for both investors and other stakeholders- In line with the stakeholder theory (Freeman, 1984), CG effectiveness emanates from a company's ability to satisfy both shareholders' financial expectations and the needs of those agents who have a stake in the organization (Money & Schepers, 2007; Shahzad et al., 2016). The stakeholder approach to CG follows the corporate social responsibility discourse (Rodrigue et al., 2013) and suggests that CG may impact both financial and sustainability performance (Arnaboldi et al., 2020; García-Meca et al., 2015).

The board of directors is one of the key mechanisms of CG, as its members are responsible for monitoring and advising executives and managers (Janahi al., 2022).

The greater CG effectiveness associated with a diverse board is usually explained in terms of stakeholder theory, agency theory, and resource dependency (Ararat et al., 2015; Lu et al., 2022), but scholars also invoke behavioral theory, signaling theory, upper echelon theory and networking theory (Ali et al., 2013). What these frames have in common is the underlying idea that diversity creates value by enhancing the board's decision-making process and its monitoring role (Anderson et al., 2011).

We see stakeholder theory as particularly suitable for investigating the impact of board diversity (hereinafter BD) because it assumes that: i) organizational success depends on board members' ability to identify, interpret and integrate the interests of key external actors (Clarkson, 1995; Freeman et al., 2004); ii) diverse board members better understand (compared to uniform boards) different stakeholders' needs that are brought into the boardroom; and iii) a diverse board is able to recognize and modify company objectives and practices in light of current needs to better benefit organizational outcomes (Freeman et al., 2004; Mainardes et al., 2011). In sum, BD equips the boardroom with different stakeholders' perspectives, which can nurture group discussion, improve problem solving and promote learning. BD affects board dynamics, which in turn impact board decision making (Jonsdottir et al., 2025). This process can then positively affect decision effectiveness, as confirmed in the study of Cosma et al. (2021) on European banks with larger and more diverse boards (i.e., with more women, young and independent directors).

That said, BD can also have negative effects. Diversity may increase the degree of internal conflicts (Lount et al., 2015) and prolong decision-making, which means higher costs (Adams & Ferreira, 2009). Negative impacts are usually explained in terms of social categorization theory (Tsui et al., 1992; Williams & O'Reilly, 1998) and concepts such as fault lines and critical mass (Dobija et al., 2022; Peteghem et al., 2018; Schwartz-Ziv, 2017).

In the board context, fault lines refer to a situation in which a board´s diversity structure can result in the formation of subgroups along demographic or cognitive divides, which, in turn, reduce board effectiveness (Peteghem et al., 2018). The quality of interpersonal or group dynamics in decision-making processes may affect the board's functionality (Ararat et al., 2015). On this aspect, organizational research indicates that the mere presence of different characteristics is not effective if the board lacks inclusion mechanisms for diverse groups (Mannix & Neale, 2006; Van Knippenberg et al., 2010).

An alternative and more explored explanation for negative impacts of board diversity is provided by critical mass theory (Konrad et al., 2008), which posits that a low representation of the diverse or underrepresented group in the board is not effective unless it exceeds a certain threshold. Below this threshold, group dynamics worsens because of tokenism (i.e., the symbolic appointment of one or few individuals that remain isolated and cannot express their view to shift the dominant group norms), which leads to interpersonal conflicts, low team cohesion, and inability to leverage from diverse perspectives.

Early studies in the board context have mainly focused on gender diversity. They suggest that a critical mass of three women can make the difference (Konrad et al., 2008): they can break the stereotypes that solo women are subjected to, help change an all-male communication dynamic, and are able to bring their different perspectives

in board discussions, raising issues that pertain to multiple stakeholders, using interpersonal skills, and asking difficult questions about tough issues. More recent studies on critical mass have confirmed the earlier findings showing that three women on board also positively affect firm innovation (Saggese et al., 2021; Torchia et al., 2011) and ESG performance and disclosure (Cambrea et al., 2023; De Masi et al., 2021).

To shed lights on the relationship between female board members and performance, other studies prefer investigating which is the percentage of women sitting on the board that allows this minority group to affect bank's decision making. Buallay et al. (2022) report that at a level of 21–50% female representation in bank board affects positively ESG disclosure, while Gharbi and Othmani (2023) indicate that the impact of women on board has a threshold effect at 34.17% with Tobin´s Q and 38.28% with ROA. These studies are inspired by the work of Joecks et al. (2013) who highlighted the presence of a non-linear (U-shaped) relationship between gender diversity and firm performance. Their findings indicate that, at lower levels of female representation, board diversity may initially be negatively associated with firm performance—possibly due to tokenism or the challenges of integrating minority perspectives. However, once a critical mass—typically identified as at least 30% female representation—is reached, the effect of gender diversity becomes significantly positive. Moreover, Joecks et al. (2013) underscore that the impact of board diversity is contingent upon the organizational context, with more pronounced benefits observed in firms operating in complex environments or with greater stakeholder exposure. These results are consistent with stakeholder theory, which suggests that diverse boards are better equipped to consider and balance a wider range of stakeholder interests, ultimately leading to improved governance and sustainable performance outcomes.

2.2 Findings on the link between board diversity and performance

Empirical research show inconsistent results, with BD having often positive, but also negative or no effect on performance (Baker et al., 2020; Wu et al., 2024). As pointed by Ben Selma et al. (2022) varying results are due to i) different conceptualization of BD diversity (using different variables) and ii) different measures for the same variables. So, it is still somewhat unclear which attributes of diversity are important and when they have a positive and desired impact on board functionality.

Regarding the first element, composition of BD, we noticed that early research mainly focused on gender (Adams & Ferreira, 2009), demonstrating that the presence of female directors typically improves performance (Bennouri et al., 2017; Farag & Mallin, 2017; Mateos de Cabo et al., 2012; Schadewitz & Spohr, 2022). However, also opposite results were found and explained in light of critical mass theory as above anticipated. Female gender quotas on boards may have negative impacts on performance (Ferreira, 2015) and reduce turnover (Buchwald & Hottenrott, 2019). Similarly, contrasting results refer to other board member characteristics related to demographic aspects such as age, nationality, and education (Cumming & Leung, 2021).

Another key variable used to measure heterogeneity in board members is age. Janahi et al. (2022) analyzed US banks performance from 1996 to 2018 and found that age-diversified boards were more effective monitors and were associated with

higher financial reporting quality. This positive influence rests on the assumption that directors with different ages hold different perspectives that increase conflict, which enhances monitoring (Li & Wahid, 2018). Another argument is that in an age-diverse board, it is less likely that any single-age group would dominate the board´s internal communication, resulting in better discussions and fostering better board performance as well. Yet, in Talavera et al. (2018), board age diversity is negatively associated with bank profitability. In addition, some studies associate young directors with high-risk propensity (Johnson et al., 2013).

Prior research also studied how diversity in board members' nationality affects board performance (Oxelheim et al., 2013). Internationalization (a higher number of foreign directors) is typically associated with board independence, better performance (Issa et al., 2021) and higher ESG commitment (Paolone et al., 2024) because directors have international networks that bring relational capital and enhance banks' resource provision (Hillman & Dalziel, 2003). However, in the context of EU-listed banks Arnaboldi et al. (2020) found that internationalization increased bank risk because of foreign directors´ short-termism and foreign directors´ problems to attend board meetings. In another study on 159 banks, García-Meca et al. (2015) found that national diversity inhibits performance. Authors' explanation returns to resource dependence theory and social psychology that suggest that decision-making may become slower and more complicated with diverse directors.

Diversity in the number of educational and professional qualifications is an additional characteristic that is desirable for performance because it contributes to team creativity and information processing, which could improve decision quality. While Ben Selma et al. (2022) assume that advanced education (i.e. summing bachelor, master, and PhD levels) enhance distinctive views and innovative social responsibility ideas, Katmon et al. (2019) posit that firms should not only point to have board members with high education levels, i.e., many qualifications. Having a board with diverse educational backgrounds help gain a competitive edge because directors with lower levels of formal education often possess greater hands-on experience compared to those with higher education, who may be more constrained by the limited scope of their academic curriculum. However, evidence of opposite findings also exists. For example, the study of Setiyono and Tarazi (2018) shows that education diversity leads to higher income volatility and leverage risk, while the findings of Issa et al. (2021) show an insignificant association between educational level diversity and bank performance.

Finally, many studies on BD also account for the presence of recently appointed directors togher with board members with long tenure (Wu et al., 2024). The latter are considered to be deeply involved in the banks' operations and history; therefore they are biased by their longstanding commitment. Form an agency perspective, a long tenure means increased familiarity between the board and the top management, and less control on their decisions that may increase risk and reduce company profitability (Huang & Hilary, 2018). Therefore, both short ad long tenure board members should be appointed. Yet, also opposite findings exist. For example Bonini et al. (2022) demonstrate that long tenured independent directors positively impact on company profitability, especially in complex and mature firms.

The second element, besides the composition of BD, that contributes to conflicting evidence is related to the various measures and methods applied for assessing BD (Kagzi & Guha, 2018). While many authors have studied the individual effect of a single diversity aspect (e.g., only the impact of age on banks' profitability), recent works have emphasized the importance to include several aspects of diversity simultaneously (Adams et al., 2015). Kagzi and Guha (2018) suggest that various characteristics can be used for building a comprehensive diversity index and many methodological approaches are possible. Two main approaches are used. One is the Blau (1977) index, which considers BD as an aggregate level index of inter-personal similarity along one or several dimensions. In line with this, Ararat et al. (2015), Arnaboldi et al. (2020) and Wu et al. (2024) have developed a composite index for capturing and measuring the diversity of boards. While this method has the advantage of covering multiple attributes taking place in real-life board work, it has the drawback of reducing comparability of results as different authors may use different categorization of variables to compute the index. The second approach is to use PCA—principal component analysis (Ammann et al., 2011; Tarchouna et al., 2017). This method transforms available individual firm's corporate governance characteristics to an aggregate index representing the corporate governance structure (Adegboye et al., 2020).

Given the above, we hypothesize:

H1: Board diversity — measured as a composite metrics including different board member characteristics — positively affect banks´ financial performance.

2.3 ESG and financial performance

According to the stakeholder theory (Freeman, 1984), ESG investments reduce risk with a positive impact on the firm value. Even the famous proponent of shareholder primacy, Nobel laureate in economics Milton Friedman, called for firms to address social concerns (Bhagat & Hubbard, 2022; Friedman, 1970). However, evidence for the relationship between ESG and firm financial value is not always robust, i.e., many studies have limited their scope of analysis to specific geographical areas due to data collection issues and have mainly addressed non-financial companies (Huang, 2021; Tsang et al., 2023). There is a lack of studies investigating the phenomenon at the international level (Aouadi & Marsat, 2018; Buallay, 2020) and considering the banking sector (Buallay, 2020; Chiaramonte et al., 2022; Galletta et al., 2022; Shakil et al., 2020).

Among the first empirical research having a more *holistic view* that analyzed the banks´ ESG performance – financial performance relation, we find the work of Wu and Shen (2013), who employed data from 22 countries. Building on the stakeholder theory, authors state that effective management of stakeholder relationships is a fundamental component of Corporate Social Responsibility (CSR) and results in better financial performance (measured in terms of ROA, ROE, net interest income, and non-interested income). Such a relationship is also confirmed when banks face disruptive events such as the financial crisis (Cornett et al., 2016). Other studies also report a positive impact of ESG aspects on banks' profitability (e.g., Brogi & Lagasio,

2019; Dam & Scholtens, 2015), which might be expected to increase bank value (Bolton, 2013). Similarly, Nizam et al. (2019), analyzing 700 banks from 75 countries, found out that social and environmental sustainability has a positive impact on banks´ financial performance. Yet, authors recognize some limits to their research and suggest two directions for future research: i) include governance dimension in future studies, and ii) examine the relation between financial performance and ESG aspects separating the three E, S and G dimensions.

Buallay (2019) has tried to address the two suggestions in his analysis of 235 European listed banks from 2007 to 2016. Interestingly, he found a positive association between ESG and financial performance (measured in terms of ROA, ROE and Tobin's Q) but when splitting ESG into its three components he found mixed results on the performance (Buallay, 2019). The E dimension was positively associated with ROE and Tobin's Q, indicating that stakeholders pay attention to E. On the contrary, the S pillar was negatively associated with ROA, ROE, and Tobin´s Q. The potential explanation for this outcome was said to be that board applied social policies that benefit themselves and caused stakeholders lower their expectations. Finally, G was positively associated with Tobin´s Q but negatively associated with ROA and ROE. This suggests that financial markets value G information (positive association with Tobin´s Q), while potential reasons for negative association between G with ROA and ROE were indecisive.

Explanations for contrasting results in the relationship between E, S and G dimensions and banks' performance have been put forward by Batae et al. (2021), who analyzed 39 European banks over the period 2010–2019. Their results (a negative relationship between CSR and financial performance and negative impact of CG quality to market valuation) are discussed in light of the stakeholder theory and the resource-based view. They state that banks' CSR commitment generates only some resource efficiency (in terms of environment-aware products and services process digitization), while investors do not value a bank's involvement in social responsibility and governance practices. According to the authors, findings indicate that boards and managers follow investors' preferences for short-term financial goals that downplay governance improvements and CSR strategies. Also in emerging markets, ESG activity seems to be negatively related to bank value. Azmi et al. (2021) found that high levels of ESG activity indicated diminishing returns to scale, but environmental activities had material effect on bank value. According to the authors the positive result for the E dimension, in line with the stakeholder theory, was natural for emerging markets where air quality and pollution are essential concerns.

Also, La Torre et al. (2021) found contrasting results. In the analysis of 44 banks covering 14 EU Member States, they discovered a positive relationship between ESG performance and Economic Value Added (EVA) spread but a negative relation between ESG performance and banks' market performance. Such finding means that the market is not incentivizing banks to engage significant ESG actions. Therefore, authors claim that banking authorities should continue concentrating their supervisory perspectives on ESG risk to convey banks to adopt ESG policies. In addition, authors suggest future research to take into account risk-adjusted performance measures and ESG ratings to better capture the ESG attitude of banks.

Given our choice of using stakeholder theory as main theoretical lens to inivestigate the relationship between ESG engagement and financial performance, we hypothesize:

H2: ESG commitment has a positive impact on banks´ financial performance.

2.4 The relationship between board diversity and ESG commitment

The shift in CG definition to include stakeholder needs and ensure sustainability through long-term value creation, has introduced ESG topics in the agenda of many boards. The role of boards in modifying bank's strategies toward more and better ESG investments is gaining momentum (Kahloul et al., 2022). Often framing their research on stakeholder theory (Valentinov, 2022), academics have tried to understand how a diverse board enhances ESG strategies that, in turn, should improve company financial performance.

With reference to banks, Shakil et al. (2020) investigated ESG performance of US banks over the period 2013–2017 and found that board gender diversity was positively and significantly associated with banks´ ESG performance. These authors state that firm ESG performance depends on the critical resources that (female) board members hold. Similarly, with an international bank sample from 48 countries over the period 2011–2019, Galletta et al. (2022) discovered that increasing the proportion of females on boards improves emission reduction strategies.

Combining the stakeholder theory with the conflict resolution hypothesis, Gangi et al. (2022) examined the impact of board gender diversity on banks´ environmental policy. From the analysis of 132 global banks over the 2009–2019 period, they found that the positive influence of gender diversity on CSR was negatively moderated by national gender inequality. Interestingly, Birindelli et al. (2018) described, based on European and US bank data, that the relationship between women on the board and bank´s ESG performance was an inverted U-shape. This means that only gender-balanced boards fostered a bank´s performance for sustainability. Similar results were reported also in Owen and Temesvary (2018) based on US banks. Focusing on ESG controversies of EU banks, Agnese et al. (2023) reported that higher presence of female board members is associated to lesser exposure to ESG controversies.

Another key board members´ characteristic affecting ESG practices is the board's independence. Recently, Menicucci et al. (2022a), who studied 105 Italian banks during the period 2017–2021, figured out that the board size, the board independence, the presence of a CSR/sustainability committee, and the gender-balance (critical mass of three women) positively influenced a bank´s ESG performance. Similarly, Gurol and Lagasio (2023) reportedthat the women ratio and the independent directors' ratio on board were positively and significantly related to ESG, E, and S disclosure scores in EU banks.

All these studies build on the idea that a more diverse board should allow to better recognize and capture stakeholders' needs and carry out more efficient ESG practices, which will ultimately enhance financial performance. The positive impact of the BD occurs even when ESG practices negatively impacts financial performance as demonstrated by Kahloul et al. (2022). These authors find that sustainable devel-

opment commitment negatively affects the financial performance of a business but when there are women on the board, their positive role in monitoring and controlling the effective use of CSR by managers, is likely to improve the company's financial performance.

However, there are also contrary findings. The recent research of Wu et al. (2024) shows that companies with a diverse board do not benefit from enhancing ESG practices. Since there is no common standard to measure ESG commitment, board members face difficulties in monitoring and advising managers regarding ESG themes. In addition, measurement difficulties make it hard for the board to hold managers accountable (Bhagat & Hubbard, 2022).

Given the lack of studies covering effects of board diversity and sustainability on financial performance (Bannò et al., 2023), and following evidence of Kahloul et al. (2022) on the positive moderating role of gender diverse board, we hypothesize:

> H3: Board diversity has a positive moderating impact on the relation between ESG commitment and banks´ financial performance.

All three research hypotheses guide the empirical analysis of this study, which focuses on several board diversity elements (i.e., age, gender, nationality, number of qualifications, and time on board) concurrently. Figure 1 visualizes our research setting and related hypotheses.

3 Data and methods

3.1 Sample and data sources

Data refer to a sample of commercial banks from 18 countries organized under the laws of the Organization for Economic Co-operation and Development (OECD). The selected geographical scope offers sufficient cross-country variation while still ensuring comparable and reliable ESG and financial reporting standards. The focus is on commercial banks because they form the largest segment of the banking industry in OECD countries, often accounting for more than 50% of total bank assets. This ensures that our study captures the sector's primary dynamics without dilution from specialized institutions like cooperative banks or investments banks. Moreover,

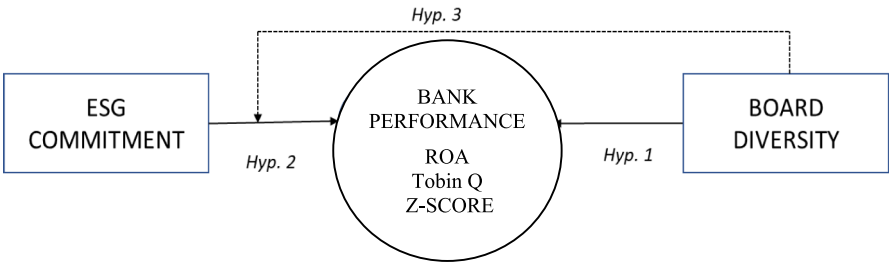

Fig. 1 Model for hypotheses development

since commercial banks operate with similar funding structures and are subject to similar regulatory duties (e.g., Basel standards), restricting the sample to this type of banks allows us to isolate the influence of board diversity and ESG engagement on performance, ensuring that the observed relationships are not driven by structural differences in business models. Finally, commercial banks are a suitable object of investigation because their business model centers on financial intermediation which exposes them directly to ESG risks.

The final number of countries (18 only) and the banks' geographical distribution, mainly concentrated in the US, UK and EU, is due to the limited availably of data for certain countries. Financial data and ESG scores were retrieved over the period 2008–2019 from three datasets. The first one is BoardEx collecting information on directors' characteristics. The second one is Bankfocus, which offers information on the banks' consolidated financial statements. The third one is Eikon Refinitiv database that infers information on the ESG scores. Eikon Refinitiv provides three ESG pillar scores: E (environmental), S (social) and G (corporate governance). Each pillar contributes to the calculation of the overall the ESG Score. Another score, named Controversy Score (ESG CONTR) is provided to specifically account for scandals and other controversies published in the media during the year.

In our paper we focus on the ESG Score and the ESG CONTR Score as they allow to assess the impact of BD on the overall ESG performance (the first score) and separately account for the distinctive capability of BD to prevent controversies (the second score). Both selected scores are used in academic research (Zhang, 2022) and in prior studies focusing on the banking sector (Agnese et al., 2023; Batae et al., 2021; Chiaramonte et al., 2022; Galletta & Mazzù, 2023; Gangi et al., 2019; Shakil et al., 2019, 2020). Although being aware that there are some criticalities on the reliability of ESG scores (Sahin et al., 2022), preference for data provided by Eikon Refinitiv is justified by the large number of organizations mapped and the availability of historical data. In addition, this database has a strong and clear structure.

We exclude banks with missing data. We utilize an unbalanced panel dataset. However, to limit the effects of the problem of sporadically missing data, that is to say, incomplete panels, we consider only banks that have data for at least 4 continuous balance-sheet years (Baltagi & Song, 2006). All variables (independent, dependent, and control variables) are defined in Table 1.

3.2 Board diversity: its elements and the board diversity index calculation

While most of past studies link bank performance to board gender diversity (e.g., Galletta et al., 2022), the authors realize that diversity is a wider multidimensional concept. Being aware that diversity may involve both demographic diversity, cognitive diversity (Cormier et al., 2024) and occupational diversity (Cumming & Leung, 2021), this study gives preference to demographic diversity (age, nationality, etc.) as these aspects are more objective and access to data exists (Adegboye et al., 2020; Ararat et al., 2015). In addition, our choice is justified by the fact that research shows a positive relation between demographic diversity and cognitive diversity (Cormier et al., 2024). This means that differences in age, nationality and other demographics are associated with different perspectives in values, beliefs, attitudes that business

Table 1 Definition of variables

Name	Definition
Dependent variables	
ROA	Annual ROA calculated as net income before tax over total assets
Tobin Q	(Market value of equity + book value of pref. stock + debt)/book value of total asset
Z-SCORE	$\frac{\mathrm{ROA}_{i,t}+\frac{E_{i,t}}{TA_{i,t}}}{\sigma(\mathrm{ROA}_{i,t})}$ where E = Equity and TA = Total assets
Independent variables	
Board measures	
AGE	It measures the standard deviation of directors' age
GENDER	It measures the standard deviation of the ratio between female directors over the total number of board directors
NATMIX	It measures the proportion of Directors from abroad (i.e. from other countries than the firm has its head office) at the Annual Report Date selected
NQUAL	It measures the standard deviation of the number of directors' qualifications
TIMEBRD	It measures the standard deviation of directors' years on board
BD	It is an index measuring the Board Diversity. It has been generated through the Principal Component Analysis using the following variables: AGE, GENDER, NATMIX, NQUAL and TIMEBRD
BOARD SIZE	It measures the number of board directors. It is used a control variable
ESG measures	
ESG	The overall company ESG score provided by Refinitiv, which measures the company's performance on environmental, social and corporate governance pillars
ESG_CONTR	The company exposure to ESG controversies and other negative events reflected in global media
E	The weighted average relative rating of a company based on the reported environmental information and the resulting three environmental category scores. Source: Refinitiv ESG
S	The weighted average relative rating of a company based on the reported social information and the resulting four social category scores. Source: Refinitiv ESG
G	The weighted average relative rating of a company based on the reported governance information and the resulting three governance category scores. Source: Refinitiv ESG
Bank-specific control variables	
SIZE	Size of the bank computed as Ln (Total assets)
CAP RATIO	The capital ratio defined as the ratio between Equity and Total assets
CREDIT RISK	The flow of loan loss provisions divided by the stock of gross loans, also called LLP
LIQUIDITY RISK	Ratio between cash-like assets (deposits & short-term funding) and all short-term liabilities (cash & balances at central bank, loans and advances to banks)

actors convey into decision making; therefore, demographic board diversity potentially allows to better understand stakeholders' needs that comprise a large range of beliefs and perspectives. This will lead to more effective problem-solving, while reducing group think within the board. All these capabilities should lead to a better performance and reduce the financial fragility of banks (Farag & Mallin, 2017).

In order to investigate the impact of board characteristics on bank performance (H1) and ESG commitment (H3), we perform a quantitative analysis based on the creation of an index capable to synthesize different relevant board characteristics,

named Board Diversity (BD). This index accounts for director's age, gender, nationality, qualifications, and time on board, being in line with literature and standard setter's preference for a multi-dimensional concept (e.g., EBA/GL/2023/08). Following the evidence in Sect. 2 and the study of Adegboye et al. (2020), we compute the subsequent variables to create our index (see also Table 1):

i) AGE, which accounts for the different age of board members; it is calculated as standard deviation of board members' age to capture the dispersion of age within the board of a bank. In this case heterogeneity means having both young and old board members, who bring their unique views and reduce group think. Past research also preferred using a coefficient of variation, i.e. the standard deviation divided by the mean of the ages of board directors (Olivera & Zhang, 2022) to measure age diversity within the board. This variable is usually negatively correlated with the size of the firm while is positively correlated with board size (Olivera & Zhang, 2022).
ii) GENDER, which measures the gender diversity of the board, is calculated as the standard deviation of the proportion of female directors over the total number of board directors. Previous studies suggest that boards tend to be dominated by male directors (Mateos de Cabo et al., 2012), which is associated with a high probability of group thinking. A less homogeneous board (i.e., with more female directors) should instead allow the company to better capture the stakeholders' different expectations (Bennouri et al., 2017). Theoretically speaking, a board with only female members can be categorized as a highly homogeneous board, but current data show that they remain a minority (OMFIF, 2022). Since there are legislative and normative pressures for the introduction of gender quotas in many countries (Birindelli et al., 2022), many banks may end up adopting a "comply behavior" that leads to a similar proportion of female directors, i.e., the minimum requirement for quotas. Therefore, in this paper we used the standard deviation, which allows to identify the banks that outperform in terms of difference from the average behavior.
iii) NATMIX, which describes the variability of directors' nationality and ranges from homogeneity (index nearly to zero) to maximum heterogeneity (index equal to one) when every director comes from a different country. Past research suggest that different nationalities favor financial performance and higher levels of ESG engagement ((Issa et al., 2021; Paolone et al., 2024)
iv) NQUAL, which defines the degree of knowledge of a director in terms of educational qualifications. A greater dispersion in NQUAL corresponds to higher variability in board competencies and thus more diversity. Qualifications usually mean greater competence, better company reputation and effective decision making (Katmon et al., 2019). However, highly qualified directors may also negatively affect board's decisions because these subjects have several job positions and personal engagements that lead to limited participation to board meetings. In addition, their presence may lead to extensive debates and discussions as each member seeks to assert their expertise and influence, potentially delaying decision making.

v) TIMEBRD – also named Board Tenure (Wu et al., 2014; Jebran et al., 2020) – which describes the number of years that a director sits on the Board, distinguishing members with a long track record at the bank from newly appointed directors. Research often assumes that higher values (a long tenure) mean that the company benefits of directors' great strong working relations and expertise relevant to the company's industry and operations, but it also means a lack of turnover that generates drawbacks such as groupthink, stagnation in strategic thinking and potential for entrenchment. As reported by Huang and Hilary (2018), long tenure means increased familiarity between the board and management that may compromise board and decrease the motivation of board members to provide information and resources to management.

All these board characteristics are used to create a single BD index obtained using Principal Component Analysis (PCA). PCA has been already used in banking studies to calculate corporate governance indexes capable to explain the quality of different governance mechanisms adopted (Adegboye et al., 2020; Ammann et al., 2011; Tarchouna et al., 2017).

The validity of PCA is tested through Kaiser–Meyer–Olkin (KMO), which is a measure of sampling adequacy. By this measure, if KMO is greater than 0.5 then it validates the suitability of using PCA (Florackis & Ozkan, 2009). In order to find the correct component of BD, authors ran K-fold cross validation. K-fold helps through Root Mean Square Error (RMSE) to find the best component. The correct component is selected based on lowest RMSE. Following lowest RMSE, authors employed the first component as BD in regression analyses.

3.3 ESG measures

In order to grasp the magnitude of Board Diversity on company's commitment to sustainability, the three individual sustainability dimensions have been considered, i.e., the E pillar, the S pillar, and the G pillar. As suggested by Menicucci and Paolucci (2022a), splitting the single ESG pillars can provide clearer findings regarding the relationship between ESG company engagement and bank performance. Considering the focus of this study on board diversity as a key governance mechanism that may impact bank performance, we believe important to clarify how the G pillar is computed by Eikon Refinitiv to control how it might be related to our BD variable. In details, the pillar G is computed as the assessment of three dimensions: i) CSR strategy; ii) stakeholder rights; and iii) management. The latter is the aggregate evaluation of several features: the structure of the board (which includes characteristics such as size, function, attendance, affiliations, gender diversity), compensation policy (e.g., the compensation committee and its independence, sustainability incentives, shareholders' approval of stock compensation plans) and some aspects referring to the CEO–chairperson separation, the nomination committee and its independence, remuneration packages linked to the total stakeholders' return, the succession plan, internal audits, the audit committee independence and external consultants (Menicucci & Paolucci, 2022a). Therefore, the quality of a company's governance expressed by the G pillar computed by Eikon Refinitiv is only partially overlapping with the board

diversity feature we aim to measure with the BD variable. By focusing on BD only, our analysis will be able to better identify the impact of board composition on bank performance.

This study also adopts two aggregate scores for ESG performance. The first one is ESG score and reflects the company's ESG performance, commitment and effectiveness based on publicly reported information. As the ESG score increases the underling company ESG orientation improves. The score varies between 0 and 100. The second one, defined as ESG Controversy Score (ESG CONTR), provides accounts for the impact of significant, material ESG controversies. Also, in this case the scale varies between 0 and 100, but high values of ESC CONTR mean having critical issues and bad news. Compared to the previous metric, ESG CONTR score is based on qualitative data. During the year, if a scandal occurs or bad news are reported in the media, the company score changes. Post-scandal developments, such as lawsuits, ongoing legislative disputes and fines may keep affecting the score over time (Agnese et al., 2023).

3.4 Performance measures

In this paper, we propose three different measures for bank performance: i) ROA, which is considered a proxy for operational performance; ii) Tobin Q, which measures the incentive to invest as it reflects not only the current return on capital, but also the expected return on equity in the future,[2] and iii) the Z-SCORE which is a measure for insolvency risk widely used in empirical research (Brighi & Venturelli, 2014; Demirgüç-Kunt & Huizinga, 2010; Stiroh, 2004). The Z-SCORE quantifies how many standard deviations profits must fall below its mean to bankrupt the firm. Higher values of ROA, Tobin Q and the Z-SCORE (as computed in our paper) are desirable as they respectively indicate higher bank profitability, higher investors' interest and lower insolvency risk.

Besides accounting measures of financial performance, research suggests considering market-related proxies of bank performance such as the Tobin Q. For example, Tobin Q is used by Adams and Mehran (2009) to measure the impact of corporate governance mechanisms on banks results, while authors, such as Brighi et al. (2025) and Wu et al. (2024), consider Tobin Q to study the relationship between ESG aspects and banks' financial performance. This performance variable is also largely used in the investigation of ESG performance- financial performance relationship in firms of all sectors (Atan et al., 2018; Aouadi & Marsat, 2018; Zhou et al, 2022; Gull et al., 2022).

The reason for considering both accounting-based and market-based approaches to assess financial performance is that they capture somewhat different aspects. The latter essentially reflect investors' perceptions. Tobin Q reflects the potential value of a firm as it can capture stakeholders' valuation of the intangible assets derived

[2] Adams and Mehran (2015) as well as Brighi et al. (2025) measure Tobin Q as (book value of assets plus market value of equity minus book value of equity)/book value of assets. While authors such as Gull et al. (2022) and Hou (2019) compute the Tobin's Q as (market capitalization plus total liabilities, both short and long term debts)/total assets; where market capitalization is almost equal to the market value of equity but it considers the total value of outstanding shares only.

from a firm's social and environmental awareness, while accounting-based measures like ROA typically reflects a firm's operational efficiency. For example, Wu et al (2024) show that environment-friendly practices positively affect firm's market value (in terms of Tobin Q) but do not improve accounting-based performance. In general, social and environmental factors have shown little to no power in explaining accounting-based performance like ROE, while market variables are affected by ESG strategies (Hansen & Sigurjonsson, 2024). This suggests that social and environmental investments have a long-term rather than a short-term effect on shareholder value creation.

3.5 Control variables

Since bank performance might be affected by several factors, we select bank-specific control variables to support the validity of our results. We control for the size of the board (BOARD SIZE), bank size (SIZE), capital ratio (CAP RATIO), the credit risk of the bank (CREDIT RISK), and the liquidity risk of the bank (LIQUIDITY RISK).

First, we control for the number of board members (BOARD SIZE), which has a positive correlation with bank performance and also with ESG dimensions (Birindelli et al., 2018; Jizi et al., 2014). This control is widely used in similar studies that often, but not always, find a positive correlation between the size of the board and the ESG scores. Some studies have found no relationship or negative relationship between board size and ESG performance or disclosure (Balogh et al., 2022; Halid et al., 2022).

Second, we control for SIZE that is the most relevant variable in determining bank performance (Menicucci & Paoloucci, 2022a; Nizam et al., 2019; Platonova et al., 2018). Larger banks easily attract affordable resources and access more capital, but are also more scrutinized by stakeholders; therefore, large banks usually have more resources to allocate for ESG (Siueia et al., 2019). To capture the effects of bank size, we use the continuous variable named SIZE, which is equal to the natural logarithm of Total assets, where Total assets is the year-end Total assets (Brighi & Venturelli, 2014; Chiorazzo et al., 2008; Stiroh, 2004). The continuous variable is normally expected to be a superior regressor than some arbitrary size dummies, except when there is a non-monotonic relationship between size and performance. We also introduce the variable SIZE_SQ (the square of Total assets) to capture the SIZE's non-monotonic path.

CAP RATIO is instead associated with the bank performance (Brighi & Venturelli, 2014). It represents a metric used to assess a bank's financial strength, solvency and ability to meet its obligations to lenders and customers. The variable CAP RATIO was computed as Equity divided by Total assets. As reported by Al Amosh et al. (2022), when debt financing is preferred (than equity financing), companies invest more in ESG and have better ESG performance.

CREDIT RISK is another important variable that may affect bank performance. Since uncollected loans represent a source of risk, we have controlled for credit risk by using a variable computed as the flow of loan loss provisions divided by the stock of gross loans. According to Salas and Saurina (2002), different bank organizational structures also imply a different credit risk policy. To control for these features, LLP

(Loan Loss Provisions) are considered. Several studies suggest that LLP can be used as a proxy for ex-ante credit risk (Laeven & Majnoni, 2003).

Finally, it is equally important to account for the impact of liquidity-related factors on bank performance, providing a more comprehensive and accurate analysis of the various elements influencing a bank's success. We include a liquidity ratio (LIQUIDITY RISK) among the control variables because good or sufficient liquidity allows banks to better handle day-to-day operations and meet short-term financial obligations, contributing to smoother overall performance Table 1.

3.6 Description of the models

To offer a comprehensive analysis of the relationships between BD, ESG commitment and financial performance we run seven models, which are displayed in the results tables. Each model is repeated three times (in Tables 6, 7, and 8) to show the impact on ROA, Tobin Q and Z-SCORE, respectively.

First, we run models (1) and (2) to test the effects of board diversity on financial performance (H1). The first model uses single board member characteristics: AGE, NATMIX, GENDER, NQUAL and TIMEBRD, while the second model uses the BD index created with the PCA. Then, we construct three other models ((3), (4), (5)) to test the effect of the ESG practices (using the scores provided by Eikon Refinitiv) on banks' financial performance (H2). We use different available measures of ESG: the single pillars (E, S and G), the aggregate score (ESG), and the score of controversies (ESG CONTR). Finally, models (6) and (7) are created to estimate the impact of BD on the relation between ESG practices and banks´ financial performance (H3). Moderation effects are operationalized in line with Kahloul et al. (2022) and Eklemet et al. (2023).

We employ a GMM approach to address endogeneity issues in the BD—financial performance relationship (Waddock & Graves, 1997). Many banking studies exploring this relationship, like Shakil et al. (2020), Agnese et al. (2023) and Wu et al. (2024) to name a few, adopt GMM, which is also the preferred method in studies focusing on the moderating effect of board diversity on ESG commitment and financial performance (Kahloul et al., 2022; Eklemet et al., 2023; and Makhija et al., 2025).

Edogeneity issues may arise from reverse causality—such as when bank profitability influences board diversity, rather than the other way around—, and omitted variable bias, where unobserved factors simultaneously affect both the board characteristics and the dependent variable.

To address these concerns in our models, we employed an instrumental variables (IV) approach. The choice of instruments is motivated by the lagged values of both the BD components and the ESG variables, in line with previous works (Birindelli et al., 2018; De Masi et al., 2021) that use lagged variables because board-related characteristics are considered sticky variables that many not vary substantially on a yearly basis. We estimate the models with a GMM-IV, using the two-steps estimator with high dimensional fixed effects, controlling for unobserved heterogeneity.

To enhance the reliability of our results we conduct a robustness tests focusing on European banks only (see the Appendix). In our sample US banks have a dominant

role, therefore, repeating the calculations without these firms allows us to examine whether the results are driven by these observations (Sandretto et al., 2025).

4 Results

4.1 Descriptive statistics

Tables 2, 3, 4, and 5 show the descriptive statistics, the sample structure, interrelations among board variables and the correlation matrix, respectively. The negative values of ROA and the high degree of dispersion (in terms of standard deviation) are likely due to the presence of Greek banks in the sample that incurred strongly negative results (many of them went bankrupt). As in resembling international studies on ESG performance (Sandretto et al., 2025), our sample is dominated by US banks which account for around one third of the total (see Table 3).

Concerning the board directors´ characteristics used to calculate our BD index, all our variables used in the PCA analysis are computed as standard deviations.[3]

For the sake of brevity, original demographic data are not fully displayed. We briefly report here that the average age of directors is 66 years, ranging from 32 to 90 years, while the number of qualifications varies from 0 to 11. On average, bank boards have about one quarter of international members. The average tenure — refer-

[3] The PCA is based on the computation of a covariance matrix that implies first the data centering. The result is that the origin of the PCA transform is moved onto the cloud's centroid. Hence, there will be positive and negative scores.

Table 2 Descriptive statistics

Variabile	Obs	Mean	Std. dev	Min	Max
ROA	36,528	0.46	1.17	−13.05	8.36
TOBIN Q	20,699	0.31	0.15	0.00	2.62
Z-SCORE	22,016	0.31	0.28	0.00	1.74
AGE	21,400	7.77	2.50	0.00	23.33
NATMIX	20,762	0.26	0.27	0.00	0.90
GENDER	36,462	0.08	0.02	0.00	0.18
NQUAL	21,422	1.07	0.43	0.00	3.61
TIMEBRD	21,422	4.15	2.58	0.00	18.46
BD	20,062	0.00	1.15	−3.65	7.81
E	14,736	67.12	29.16	0.00	97.47
S	14,736	61.83	22.46	2.63	97.58
G	14,736	64.49	23.12	1.88	99.38
ESG	14,736	62.42	20.63	4.43	94.25
ESG CONTR	13,861	70.30	36.98	0.50	100.00
SIZE	22,199	18.18	2.37	7.46	21.65
BOARD SIZE	21,198	14.77	4.55	7.00	24.00
CAP RATIO	36,528	5.22	6.04	0.00	36.25
CREDIT RISK	21,408	0.81	1.48	−48.01	17.24
LIQUIDITY RISK	21,354	10.01	11.58	1.35	114.45

Table 3 Geographical distribution of the sample

COUNTRY	Freq	Percent %	Cum. %
Australia	931	2.55	2.55
Canada	230	0.63	3.18
Chile	555	1.52	4.7
Colombia	235	0.64	5.34
Denmark	985	2.7	8.04
Finland	837	2.29	10.33
France	1.914	5.24	15.57
Germany	2.235	6.12	21.69
Greece	845	2.31	24
Israel	640	1.75	25.75
Italy	3.069	8.4	34.15
Japan	1.243	3.4	37.56
Poland	1.456	3.99	41.54
Spain	1.915	5.24	46.79
Sweden	601	1.65	48.43
Turkey	1.341	3.67	52.1
UK	3.659	10.02	62.12
USA	13.837	37.88	100
Total	36.528	100	

Table 4 Interactions among individual board characteristics

Variables	(1)	(2)	(3)	(4)	(5)
(1) directors' age	1				
(2) female presence	−0.199*	1			
(3) nationality mix	−0.113*	0.255*	1		
(4) time on board	0.109*	−0.104*	−0.118*	1	
(5) no. of qualification	−0.009	0.059*	0.221*	0.005	1
Variables	Obs	Mean	Std. dev	Min	Max
(1) directors' age	19,201	65.96	9.44	32	90
(2) female presence	22,198	19.35	12.540	0	60
(3) nationality mix	20,762	0.264	0265	0	0.9
(4) time on board	22,198	4.31	2.51	0	15.3
(5) no. of qualification	22,199	1.83	1.32	0	11
	VIF		1/VIF		
directors' age	1.053		.95		
female presence	1.116		.896		
nationality mix	1.146		.872		
time on board	1.03		.971		
no. of qualification	1.051		.952		
Mean VIF	1.079				

* $p<0.05$

Note: variables are not in capital letters because they refer to the original metrics describing age, gender, nationality, education, and tenure as provided by BoardEx. Values show that there is no evidence of severe multicollinearity. Very low multicollinearity is also confirmed by VIF values in a regression model

ring to the length of time a director has served on the board — is 4 years, with a maximum of 15 years, which means as many as five terms. Finally, we found significant differences in female representation across bank boards, with a high coefficient of variation (nearly 65%). Despite regulations and stock exchange guidelines mandating gender quotas for listed companies — which might be expected to result in more

Table 5 Correlation matrix

	ROA	TOBIN Q	Z-SCORE	AGE	NATMIX	GENDER	NQUAL	TIMEBRD	BD
ROA	1								
TOBIN Q	0.0991*	1							
Z-SCORE	0.1903*	0.0631*	1						
AGE	−0.0328*	0.1435*	−0.1653*	1					
NATMIX	0.0021	−0.0000	0.1570*	−0.1933*	1				
GENDER	0.0204*	−0.1337*	0.0452*	−0.0690*	−0.0946*	1			
NQUAL	0.0079	−0.1202*	−0.1412*	0.0925*	0.1215*	0.0195*	1		
TIMEBRD	−0.0394*	0.1274*	−0.0106	0.2217*	−0.0263*	−0.0711*	−0.0224*	1	
BD	−0.0651*	0.1834*	−0.1471*	0.7754*	−0.5183*	−0.1858*	−0.1376*	0.6347*	1
E	−0.2635*	−0.0192*	−0.1385*	−0.0960*	0.2698*	−0.0677*	0.0559*	0.0309*	−0.1520*
S	−0.1526*	−0.0745*	−0.2067*	0.0001	0.1569*	0.0724*	0.1546*	−0.0028	−0.1042*
G	−0.0597*	−0.0384*	0.0218*	−0.1532*	0.3808*	−0.0586*	0.0389*	−0.0438*	−0.2678*
ESG	−0.1654*	−0.0674*	−0.1305*	−0.0885*	0.3019*	0.0134	0.1033*	−0.0182*	−0.2095*
ESG CONTR	0.1076*	0.2879*	0.0632*	0.2259*	−0.3549*	−0.0302*	0.1476*	0.1345*	0.3249*
SIZE	−0.2688*	−0.0194*	−0.0041	−0.1855*	0.4223*	−0.1950*	−0.0050	0.1118*	−0.2358*
BOARD SIZE	−0.2476*	0.0729*	−0.1648*	0.0966*	0.0989*	−0.1018*	−0.0760*	0.0337*	0.0523*
CAP RATIO	0.5567*	0.1099*	0.1749*	0.0512*	−0.0548*	−0.0999*	−0.0957*	−0.1426*	0.0049
CRED RISK	−0.4290*	0.0018	−0.2112*	0.0409*	−0.0265*	−0.1482*	0.0330*	0.1189*	0.1085*
LIQ RISK	0.0490*	−0.1273*	−0.0154*	0.0459*	−0.2230*	0.0856*	0.0112	−0.0396*	0.0886*

	E	S	G	ESG	ESG CONTR	SIZE	BOARD SIZE	CAP RATIO	CRED RISK	LIQ RISK
E	1									
S	0.7356*	1								
G	0.5393*	0.4742*	1							
ESG	0.8325*	0.9055*	0.7836*	1						
ESG CONTR	−0.4759*	−0.3769*	−0.4439*	−0.4979*	1					
SIZE	0.7671*	0.5787*	0.5687*	0.7148*	−0.6233*	1				
BOARD SIZE	0.2756*	0.1844*	0.1253*	0.2100*	−0.2174*	0.4095*	1			
CAP RATIO	−0.2933*	−0.1358*	−0.0738*	−0.1665*	0.0814*	−0.5645*	−0.2226*	1		
CRED RISK	0.1256*	0.0392*	−0.0116	0.0362*	−0.0229*	0.0384*	0.0353*	−0.1550*	1	
LIQ RISK	−0.3893*	−0.2905*	−0.1512*	−0.3037*	0.2782*	−0.4494*	−0.1914*	0.2328*	−0.0346*	1

Notes: This is a correlation matrix providing correlation between dependents and independents accordingly. For variable definition please see Table 1

uniform board compositions — banks still show considerable variability in the number of female board members. This heterogeneity may also be explained by the fact that our sample spans a long time horizon, part of which predates the implementation of gender quota regulations.

In order to understand possible interactions among board variables (see Table 4), we considered linear relationships between age, gender, nationality, number of qualifications, and tenure using the original metrics provided by BoardEx. The results show a negative correlation between female presence and age as well as tenure, whilst simultaneously indicating a positive correlation between female presence and both nationality heterogeneity and number of qualifications. It can thus be concluded that boards comprising a greater proportion of women tend to have a younger directorate, with more qualifications and an international background, but with shorter tenure. This result confirms the position of Schwartz-Ziv (2017) that appointed women have less working experience (young) and therefore more female directors may negatively affect performance due to limited job experience. In addition, this result reiterates the idea that boards composed primarily of older members are homogeneous, entrenched, and domestically oriented.

Table 5 presents the correlation matrix, which provides initial insights into the characteristics and relations of all variables in our sample. It reveals, for example, that larger banks (as measured by SIZE) tend to invest more heavily in ESG factors. However, the matrix also shows that a strong commitment to ESG reduces banks' performance in terms of ROA, TOBIN Q, and Z-SCORE. Another interesting observation is the differential impact of BD on accounting-based and market-based performance measures. Specifically, the data indicate a slight inverse relationship between BD and ROA, while BD is positively correlated with TOBIN Q. In other words, as board diversity increases, ROA tends to somewhat decrease, whereas the market tends to value the bank's assets higher, likely perceiving BD as a contributor to improved governance, better strategic decision-making, and stronger overall performance. Additionally, the matrix highlights a strong positive correlation between ROA and the CAP RATIO, supporting the view that well-capitalized banks are more likely to generate higher returns. In the end, the relationship between SIZE, CREDIT RISK, and LIQUIDITY RISK suggests that larger banks tend to have higher credit risk, potentially due to the complexity and scale of their operations, but they tend to face less liquidity risk, which could be because of better access to capital markets or more diversified funding sources.

Table 5 also indicates that the vast majority of the correlations are significant but at a reasonable level providing a solid ground for testing the constructed models. The only exception is the ESG variable, which shows a correlation coefficient greater than 0.8. This high correlation could potentially cause issues in regression results due to multicollinearity. However, it is important to note that the correlation between the individual E, S, and G pillars with the overall ESG score is inherent in the construction of the composite ESG measure. To address multicollinearity across multiple factors, we have computed the Variance Inflation Factor (VIF), which helps assess whether any groups of variables are highly correlated with another variable and potentially biasing the results. We calculated the VIF for each group of explanatory variables across models 1 to 5, consistently finding values between 1.28 and

2.03, which indicates low multicollinearity. However, in models 6 and 7 — where interaction terms between ESG scores and board diversity (BD) are included — multicollinearity increases, with VIF values reaching 4.59 and 2.81, respectively. Based on these VIF figures we can conclude that multicollinearity is not a problem in this study (Rawlings, 1988).

4.2 Research findings on the relationship between BD, performance, and ESG

With reference to H1, we found that BD generally has a positive effect on banks' financial performance as suggested by stakeholder theory. Model 2 demonstrates that BD is positively correlated with ROA (although not always statistically significant) and BD influences positively on Tobin Q (see Tables 6 and 7). Results in Table 8 also show that BD reduces bank's risk as it positively affects Z-SCORE, a measure of financial stability and resilience, which is a crucial aspect of performance in risk and banking studies. However, when examining the impacts of specific characteristics of board diversity (AGE, GENDER, NATMIX, NQUAL, and TIMEBRD), the results become more nuanced as some variables have a positive impact, while others have a negative impact.

Model 1 in Tables 6 and 7 reveals that gender diversity (GENDER) has a negative impact on bank performance. This finding contradicts previous studies of Mateos de Cabo et al. (2012), Farag and Mallin (2017), Bennouri et al. (2017), and Schadewitz and Spohr (2022) while is in line with evidence provided by Ferreira (2015) and Buchwald and Hottenrott (2019). A dedicated investigation on the reasons that may explain negative impacts of female presence in bank boards usually characterized by a male dominance is presented in the following sub-Sect. 4.3.

Model 1 also indicates that tenure diversity (TIMEBRD) has a positive effect on both market value (TOBIN Q) and risk (Z-SCORE), while diversity in board members' age (AGE) and number of qualifications (NQUAL) generates some negative impacts on bank performance. Therefore, according to our regression results, a corporate environment characterized by a mix of directors with both long and short tenures fosters more effective decision-making, in line with Huang and Hilary (2018); this means that a bank benefits from knowledge continuity of directors that spent long time working within the bank and are able to interact with newly appointed board members at the same time, therefore decreasing the probability of groupthink (Li & Wahid, 2018).

On the contrary, age diversity negatively affects ROA (but does not impact TOBIN Q and Z-SCORE) and heterogeneity in the number of qualifications (NQUAL) negatively affects TOBIN Q and Z-SCORE. In line with the study of Setiyono and Tarazi (2018), our findings suggest that diverse perspectives associated to different ages and a mix of formal and informal, high and low levels of qualifications might not provide skills and expertise useful to lead a bank or even increase harmful internal discussions which hamper both the advisory and the monitoring role of boards as posited by social categorisation theory (Tsui et al., 1992; Williams & O'Reilly, 1998).

With regard to our second hypothesis (H2), we ran two models. Model 3 examines banks' commitment to separate E, S and G dimensions and it indicates that the all three pillars negatively impact ROA (with the E pillar being less significant). The

Table 6 GMM-IV analysis: impact on ROA

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ROA	**ROA**	**ROA**	**ROA**	**ROA**	**ROA**	**ROA**
AGE	−0.0113**						
	(0.004)						
NATMIX	−0.2473***						
	(0.053)						
GENDER	−1.0561***						
	(0.322)						
NQUAL	0.0234						
	(0.028)						
TIMEBRD	−0.0050						
	(0.006)						
BOARD SIZE	0.0178***	0.0183***	0.0038	0.0048	0.0061**	0.0052*	0.0024
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
SIZE	0.2680***	0.2645***	0.2136***	0.1802***	0.3423***	0.2453***	0.2595***
	(0.025)	(0.025)	(0.023)	(0.024)	(0.025)	(0.024)	(0.025)
CAP RATIO	0.1992***	0.1934***	0.1974***	0.1954***	0.2113***	0.1991***	0.2079***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
CREDIT RISK	−0.2238***	−0.2237***	−0.4174***	−0.4078***	−0.4104***	−0.4257***	−0.4114***
	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
LIQUIDITY RISK	−0.0048***	−0.0050***	−0.0009	−0.0036**	−0.0025*	−0.0036***	−0.0012
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
BD		0.0088		0.0008	0.0064	0.2149***	0.1131***
		(0.010)		(0.009)	(0.009)	(0.027)	(0.015)
E			−0.0009*	−0.0016***			
			(0.001)	(0.001)			
S			−0.0043***	−0.0049***			
			(0.001)	(0.001)			
G			−0.0053***				

Table 6 (continued)

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			(0.000)				
ESG					−0.0132***	−0.0107***	
					(0.001)	(0.001)	
ESG CONTR					0.0013***		−0.0000
					(0.000)		(0.000)
ESG*BD						0.0033***	
						(0.000)	
ESG CONTR*BD							−0.0020***
							(0.000)
Observations	18,666	18,743	13,842	13,221	12,525	13,221	12,525
F-stat	49	1069	976	948	1000	984	961
Kleib-Paap rk LM	44	18	32	29	24	37	24
Kleib-Paap rk WaldF	188	732	474	561	286	374	275

This table reports the results of GMM regressions which confirm the results of FE regression results available upon request to authors. Standard errors in parentheses. * $p<0.1$, ** $p<0.05$, *** $p<0.01$

This table and the following Tables 7 and 8 estimate the models with a GMM-IV. Since the number of instruments equals the number of endogenous variables, the models ares exactly identified. Instrument relevance was assessed using the first-stage F-statistic, while the Kleibergen-Paap rk LM statistic and the Kleibergen-Paap rk Wald F statistic were used to test, respectively, for identification and the strength of the instruments. This approach ensures that our estimates are robust to potential biases arising from endogeneity

Table 7 GMM-IV analysis: impact on Tobin Q

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	TOBIN Q	**TOBIN Q**	**TOBIN Q**	**TOBIN Q**	**TOBIN Q**	**TOBIN Q**	**TOBIN Q**
AGE	−0.0005						
	(0.000)						
NATMIX	0.0578***						
	(0.005)						
GENDER	−0.2740***						
	(0.026)						
NQUAL	−0.0427***						
	(0.002)						
TIMEBRD	0.0021***						
	(0.001)						
BOARD SIZE	0.0001	0.0002	0.0000	0.0001	0.0000	0.0001	0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SIZE	0.0149***	0.0159***	0.0109***	0.0103***	0.0061**	0.0024	0.0048*
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
CAP RATIO	0.0000	0.0012***	0.0012***	0.0017***	0.0013***	0.0015***	0.0017***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CREDIT RISK	−0.0081***	−0.0079***	−0.0051***	−0.0058***	−0.0061***	−0.0028***	−0.0038***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LIQUIDITY RISK	−0.0008***	−0.0008***	−0.0019***	−0.0026***	−0.0025***	−0.0027***	−0.0026***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BD		0.0022**		−0.0003	−0.0004	0.0639***	0.0299***
		(0.001)		(0.001)	(0.001)	(0.003)	(0.002)
E			0.0000	0.0001			
			(0.000)	(0.000)			
S			0.0002**	0.0002***			
			(0.000)	(0.000)			
G			0.0001**				

Table 7 (continued)

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			(0.000)				
ESG					0.0005***	0.0004***	
					(0.000)	(0.000)	
ESG CONTR					−0.0002***		0.0000
					(0.000)		(0.000)
ESG*BD						0.0010***	
						(0.000)	
ESG CONTR*BD							0.0005***
							(0.000)
Observations	14,321	14,377	13,076	12,603	12,284	12,603	12,284
F-stat	93	40	45	53	56	127	135
Kleib-Paap rk LM	34	12	27	26	23	37	23
Kleib-Paap rk WaldF	214	515	317	400	372	374	283

This table reports the results of GMM regressions which confirms the results of FE regression results available upon request to authors. Standard errors in parentheses.
* $p<0.1$, ** $p<0.05$, *** $p<0.01$

Table 8 GMM-IV analysis: impact on Z-SCORE

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Z-SCORE	**Z-SCORE**	**Z-SCORE**	**Z-SCORE**	**Z-SCORE**	**Z-SCORE**	**Z-SCORE**
AGE	0.0003						
	(0.000)						
NATMIX	−0.0173***						
	(0.003)						
GENDER	−0.0812***						
	(0.016)						
NQUAL	−0.0044***						
	(0.001)						
TIMEBRD	0.0019***						
	(0.000)						
BOARD SIZE	0.0014***	0.0015***	0.0015***	0.0014***	0.0013***	0.0013***	0.0013***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SIZE	−0.0239***	−0.0235***	−0.0264***	−0.0271***	−0.0271***	−0.0256***	−0.0319***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
CAP RATIO	0.0168***	0.0167***	0.0166***	0.0162***	0.0164***	0.0166***	0.0163***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CREDIT RISK	−0.0029***	−0.0029***	−0.0142***	−0.0140***	−0.0149***	−0.0138***	−0.0141***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LIQUIDITY RISK	−0.0007***	−0.0006***	−0.0001	−0.0007***	−0.0007***	−0.0007***	−0.0007***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BD		0.0057***		0.0040***	0.0092***	0.0103***	0.0024**
		(0.001)		(0.001)	(0.001)	(0.002)	(0.001)
E			−0.0000	0.0000			
			(0.000)	(0.000)			
S			−0.0003***	−0.0005***			
			(0.000)	(0.000)			
G			−0.0000				

Table 8 (continued)

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			(0.000)				
ESG					−0.0004***	−0.0005***	
					(0.000)	(0.000)	
ESG CONTR					−0.0002***		−0.0002***
					(0.000)		(0.000)
ESG*BD						−0.0001***	
						(0.000)	
ESG_CONTR*BD							0.0001***
							(0.000)
Observations	18,520	18,597	13,696	13,075	12,379	13,075	12,379
F-stat	973	1625	996	1005	971	858	965
Kleib-Paap rk LM	44	18	32	29	23	24	24
Kleib-Paap rk WaldF	187	728	468	553	278	203	270

This table reports the results of GMM regressions which confirms the results of FE regression results available upon request to authors. Standard errors in parentheses.
* $p<0.1$, ** $p<0.05$, *** $p<0.01$

negative impact of the S dimension on risk (Z-SCORE) can be explained in terms of bad board policies: as reported in the study of Buallay (2019). Boards apply social policies that benefit themselves while causing stakeholders lower their expectations or raising issues. The negative impact of the G score on ROA may be attributed to excessive costs associated to many and complex governance mechanisms put in place and conflicts exacerbated due to the burdensome monitoring processes. On the contrary, the relationship of E, S and G scores with Tobin Q is positive, though not always significant. These results suggest that the market appreciates investments in social policies, governance improvements, and other environmentally focused policies, as these initiatives are expected to enhance operational efficiency and generate savings. Model 4 experiments the substitution of the G score from Refinitiv with the BD index. While the impact of S and E pillar do not change when moving from model 3 to model 4, we find different impacts of the governance variable on bank performance. For example while G does not affect risk (the sign is negative but not significant), the BD index clearly has a positive impact on risk. These different impacts can be explained by the fact that the G score is built on other dimensions (i.e., CSR strategy, management structure and compensation as well as shareholders rights) besides accounting for board composition. So, it is quite different compared to our BD index based on directors' characteristics only.[4]

Finally, with model 5 we analyze the impact of the overall ESG score and ESG controversy score (ESG CONTR) on bank performance. In line with the direction of impact shown by the three single pillar scores, our regressions indicate that the bundle of ESG investments decreases ROA, while increases TOBIN Q. This result is in line with the findings of Batae et al. (2021) and Azmi et al (2021) who state that a bank's ESG commitment generates few resource efficiencies due to the high investment banks are implementing in the short run to be ESG compliant in line with the Bank supervisory authority expectations. Model 5 also includes the ESG CONTR that is factored in by market investors: higher values of controversies negatively affect values of TOBIN Q. The presence of bad news and/or legal issues does not reduce ROA as one might expect, probably because it takes time to be reflected in financial statements as provisions. In addition, it is possible that banks with ESG controversies have channeled resources to increase ROA instead of focusing so much on ESG matters. The ESG controversies are monitored because in the banking sector they may entail high reputational costs. Such perils are shown in the relationship between ESG CONTR and bank risk: more controversies mean more risk measured in terms of lower values of Z-SCORE.

With reference to the third hypothesis (H3), we run two models to test whether BD affects the relationship between ESG and firm performance. Both the ESG overall commitment (model 6) and ESG controversy score (model 7) have been combined with board diversity to assess their impact on bank profitability. The interaction (ESG*BD) shows that an appropriate composition of the board has a partial moderating effect on the impact of ESG strategies on bank performance. The partial moderating effect of BD on ROA is yet important as it 'counterbalances' the negative impact

[4] The negative relationship between BD and the G score displayed in the correlation matrix supports the argument that these two variables measure different aspects, although related to governance dimension.

of the ESG costs incurred by banks when trying to increase their ESG score. Positive signs on the interaction effect on TOBIN Q also indicates that banks with more BD capabilities extract more value from ESG activities. On the contrary, board diversity does not seem to be effective to improve the ESG-related impacts on Z-SCORE (i.e. ESG score continue to have a negative sign).

When called to face critical issues linked to ESG controversies (model 7), a good and well diversified board does not seem to flatten disputes. The interaction (ESG CONTR*BD) shows that board heterogeneity does not curb controversies that negatively impact on ROA. Therefore, a diverse board is not a panacea; it does not automatically lead to greater attention being paid to, or the selection of, better ESG practices aligned with stakeholder needs in a way that ensures greater performance. However, ESG CONTR*BD has positive and significant sign for both TOBIN Q and Z-SCORE highlighting the importance of board diversity when ESG controversies and other negative events occur.

Coming to the control variables, the bank SIZE is positively associated to ROA and TOBIN Q, while it negatively impacts on Z-SCORE; thus confirming that larger banks are also more profitable but more risky. BOARD SIZE positively impacts on ROA and Z-SCORE: this result is in line with to past literature that promotes larger boards because they improve the effectiveness of monitoring and control activities (see for example Elyasiani & Zhang, 2015; Hakenes & Schnabel, 2011; De Andrés & Vallelado, 2008). Finally, as for the capital ratio (CAP RATIO), it impacts positively—as expected—on profitability. In line with expectations, also the CREDIT RISK and the LIQUIDITY RISK negatively impact on bank performance and increase risk.

4.3 Identification of a critical mass for female presence impact

Given the relevance of board gender diversity in the academic debate and from a regulatory perspective, we explore the reasons for a negative relationship between board gender diversity and performance in light of critical mass theory (Konrad et al., 2008). This theory calls for a minimum number of women in the board to be effective and suggest to check for potential non-linear effect of the proportion of women relative to the total number of board members (here called gender ratio). We adopt two complementary methodological approaches. First, we include a quadratic term of the gender ratio in the regression model to capture potential U-shaped or inverted U-shaped relationships. Second, we construct categorical variables based on regulatory thresholds of female board representation[5]—specifically, below 30%, between 30 and 40%, and above 40%—to examine whether the impact differs across these normative intervals.

[5] In Europe, Norway was one of the first countries to impose a law in 2003 requiring public-limited companies to fill at least 40% of board positions with women by 2008 (Ahern & Dittmar, 2012). Spain and France followed Norway's example and enacted a law prescribing a 40% quota of female board members in 2007 and 2011. More recently, other EU countries like the Netherlands prescribe a minimum of 33% female representation, while the EU Directive 2022/2381requires listed companies to achieve 33% of the underrepresented sex among all directors to be reached by 2026.

4.3.1 Quadratic specification of the gender ratio

Guided by critical mass theory, which posits that a threshold level of female representation is necessary to realize governance benefits, we examine how gender ratio influences ROA, TOBIN Q, and Z-SCORE. This approach builds on prior findings by Konrad et al. (2008), Joecks et al. (2013), and Buallay et al. (2022). To examine whether a non-linear relationship exists between the gender ratio and our dependent variables, we include the squared term of the gender ratio in our regression model. This specification allows us to test for the presence of a threshold effect, consistent with critical mass theory using Eq. (1) below:

$$y_{it} = \alpha + \beta_1 \times Gender_{it} + \beta_2 \times Gender_{it}^2 + X_{it}\prime\gamma + \mu_i + \lambda_t + \epsilon_{it} \qquad (1)$$

where:

y_{it} is the dependent variable for bank iii at time ttt, representing ROA, Tobin Q, or Z-SCORE;

$Gender_{it}$ is the proportion of women on the board;

$Gender_{it}^2$ captures the non-linear (quadratic) effect of board gender diversity;

$X_{it}\prime$ is a vector of control variables, including board size, bank size, capital ratio, and other relevant characteristics;

μ_i is a term indicating the bank fixed effects (capturing time-invariant heterogeneity across banks);

λ_t is a term indicating the year fixed effects (capturing common shocks across time);

ϵ_{it} is the idiosyncratic error term.

We employed a fixed effects panel regression model to account for unobserved heterogeneity at both the bank and year levels by absorbing individual and time fixed effects. By doing so, we control for all time-invariant characteristics of each bank, as well as common shocks affecting the entire banking sector in a given year.

Our results, reported in Table 9, are consistent with the critical mass theory, revealing a non-linear, U-shaped relationship between the gender ratio and performance for TOBIN Q and the Z-SCORE, whereas ROA exhibits a positive but largely linear pattern. The estimated turning points—approximately 27–30 percent for market valuation and 23–31 percent for financial stability—suggest that once female representation exceeds roughly one-quarter to one-third of the board, the marginal effect of gender diversity becomes positive (see Fig. 2). These thresholds are broadly consistent with recent EU gender-quota targets.

Finally, in the same table, we investigate interactions among board member characteristics. Results indicate that the benefits of female participation depend on board demographics. For ROA, the positive effect of women weakens in older and more tenured boards, and excessive nationality heterogeneity dampens performance, implying that overlapping diversity dimensions can create coordination frictions. In contrast, for TOBIN Q and the Z-SCORE, gender diversity interacts positively with nationality diversity, enhancing both market valuation and financial stability. Overall, the evidence supports the view that gender diversity improves bank performance,

Table 9 Non linear effect of gender and interaction effects of key characteristics on Bank Outcomes

	(1)	(2)	(2)	(4)	(5)	(6)
	ROA	TOBIN Q	Z SCORE	ROA	TOBIN Q	Z SCORE
no. of qualification	−0.00318	−0.00044	−0.00071***	−0.00164	0.00333***	−0.00089**
	(0.004)	(0.000)	(0.000)	(0.009)	(0.001)	(0.000)
directors' age	0.00028	0.00005	−0.00006**	0.00403**	−0.00003	0.00009*
	(0.001)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)
female presence	0.00472**	−0.00383***	−0.00228***	0.02561***	−0.00171***	−0.00187***
	(0.002)	(0.000)	(0.000)	(0.005)	(0.000)	(0.000)
female presence_sqr	0.00002	0.00007***	0.00005***	0.00010**	0.00003***	0.00003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
nationality mix	−0.30513***	0.04212***	−0.02907***	0.13138	−0.07190***	−0.08792***
	(0.071)	(0.006)	(0.002)	(0.094)	(0.007)	(0.003)
time on board	−0.01062	0.00164***	0.00291***	0.01461	0.00763***	0.00168***
	(0.007)	(0.001)	(0.000)	(0.009)	(0.001)	(0.000)
BOARD SIZE	−0.01568***	0.00149***	0.00206***	−0.01894***	0.00174***	0.00226***
	(0.003)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)
SIZE	0.47510***	0.02289***	−0.03321***	0.45711***	0.02996***	−0.03016***
	(0.046)	(0.003)	(0.001)	(0.046)	(0.003)	(0.001)
CAP RATIO	0.20671***	−0.00040	0.01623***	0.20689***	0.00080	0.01643***
	(0.012)	(0.001)	(0.000)	(0.012)	(0.001)	(0.000)
CREDIT RISK	−0.23041***	−0.00344***	−0.00132***	−0.23471***	−0.00113	−0.00087**
	(0.037)	(0.001)	(0.000)	(0.037)	(0.001)	(0.000)
LIQUIDITY RISK	0.00583***	−0.00019*	−0.00020***	0.00565***	−0.00006	−0.00015***
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
directors' age*female				−0.00020***	0.00000	−0.00001***
				(0.000)	(0.000)	(0.000)
time on board*female				−0.00133***	−0.00031***	0.00006***
				(0.000)	(0.000)	(0.000)
no. of qualification* female				−0.00013	−0.00015***	0.00002
				(0.000)	(0.000)	(0.000)
nationality mix*female				−0.02188***	0.00570***	0.00311***
				(0.002)	(0.000)	(0.000)
_cons	−9.34546***	−0.09529*	0.76554***	−9.38431***	−0.26613***	0.70409***
	(0.908)	(0.055)	(0.028)	(0.928)	(0.054)	(0.028)
Observations	17,104	13,055	16,949	17,104	13,055	16,949
R-squared	0.68435	0.86382	0.98731	0.68684	0.87542	0.98814
F ratio test	600	67	1147	37.75	123.08	401.16
Adj R-sqr	0.67815	0.8614	0.9871	0.6806	0.8732	0.9879
Bank FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Standard errors in parentheses. Bank and Year fixed effects included. * $p<0.1$, ** $p<0.05$, *** $p<0.01$

Original variables representing Board characteristics are used (we do not use standard deviations)

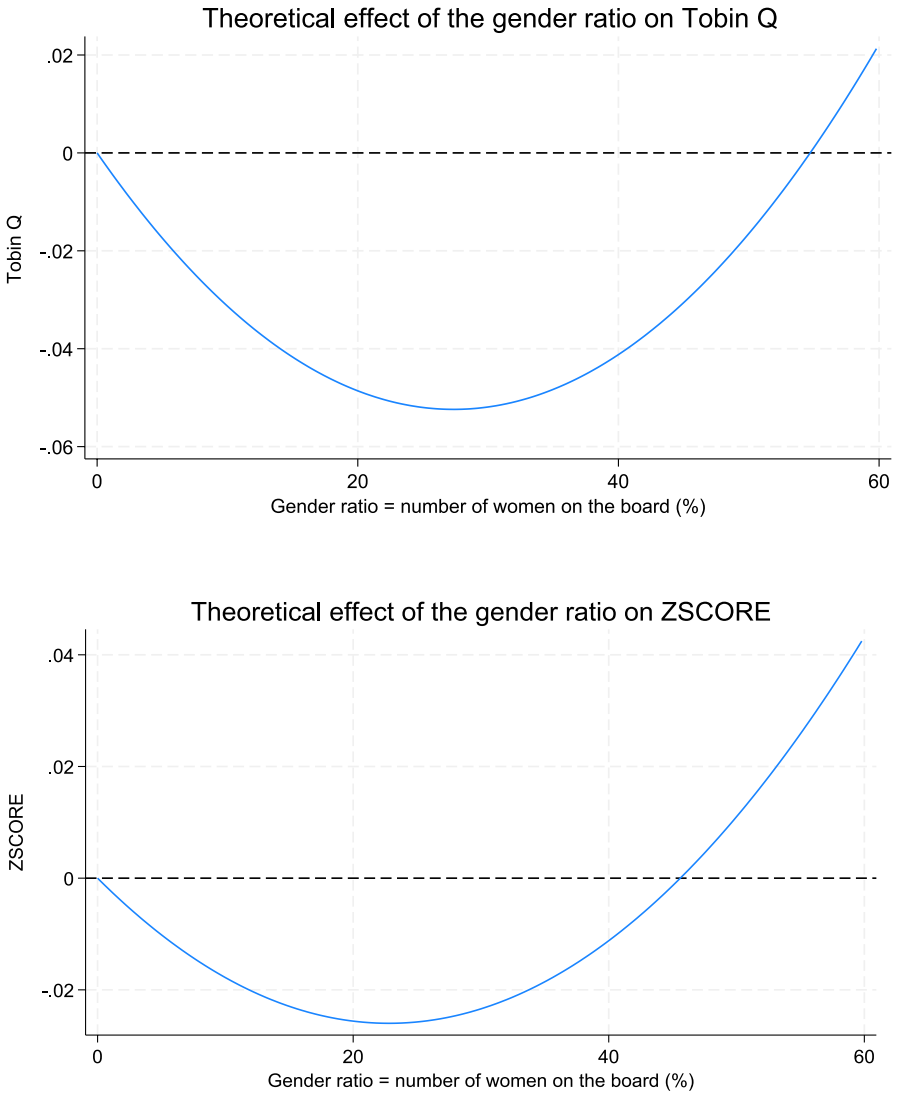

Fig. 2 Non-linear relationship between gender, market value, and risk

with its effectiveness contingent on achieving a sufficient critical mass and on the broader composition of the board.

4.3.2 Categorical threshold analysis

To strengthen our results and test the magnitude of threshold effects, we created three categorical variables for female board representation to examine whether the impact differs across these normative intervals. First, we created three dummy variables:

dummy_low which equals 1 when the proportion of women on the board (female presence) is less than or equal to 30%,

dummy_mid which equals 1 when female presence is between 31 and 39%, and.

dummy_high which equals 1 when female presence is 40% or higher.

These dummy indicators were then interacted with the continuous female presence variable to form three level-specific terms:

female_low = dummy_low × female presence,

female_mid = dummy_mid × female presence, and.

female_high = dummy_high × female presence.

This construction allows us to estimate the marginal effect of gender diversity on performance and risk within each range, rather than assuming a linear or quadratic relationship across the entire distribution.

Categorical variables are included in our regression model that employs fixed effects as follows (Eq. (2)):

$$y_{it} = \alpha + \beta_1 \times female\_low_{it} + \beta_2 female\_mid_{it} \times \beta_3 female\_high_{it} + X_{it}\prime\gamma + \mu_i + \lambda_t + \epsilon_{it} \quad (2)$$

where:

y_{it} is the dependent variable for bank i at time t, representing ROA, TOBIN Q, or Z-SCORE;

$female\_low_{it}$ the proportion of women on the board if below or equal to 30%, 0 otherwise;

$female\_mid_{it}$ the proportion of women on the board if between 31 and 39%, 0 otherwise;

$female\_high_{it}$ the proportion of women on the board if 40% or higher, 0 otherwise;

$X_{it}\prime$ is a vector of control variables, including bank size, board size, capital ratio, and other relevant characteristics;

μ_i is a term indicating the bank fixed effects (capturing time-invariant heterogeneity across banks);

λ_t is a term indicating the year fixed effects (capturing common shocks across time);

ϵ_{it} is the idiosyncratic error term.

The regression results (see Table 10) provide consistent evidence that the impact of female board representation varies across regulatory-relevant thresholds, supporting the use of a categorical specification to capture potential non-linearities. The results suggest that even boards with less than or equal to 30% female representation generate some positive performance effects as measured by ROA, but the magnitude increases as the proportion rises. The results for TOBIN Q reveal

Table 10 Effect of thresholds on bank performance

Model	(1)	(2)	(3)
	ROA	**TOBIN Q**	**Z-SCORE**
no. of	−0.0030	−0.0003	−0.0007***
qualification	(0.005)	(0.000)	(0.000)
directors' age	0.0004	0.0001	−0.0000
	(0.001)	(0.000)	(0.000)
female_low	0.0049***	−0.0014***	−0.0005***
	(0.001)	(0.000)	(0.000)
female_mid	0.0055***	−0.0000	0.0002***
	(0.001)	(0.000)	(0.000)
female_high	0.0074***	0.0001*	0.0005***
	(0.001)	(0.000)	(0.000)
nationality mix	−0.2920***	0.0432***	−0.0270***
	(0.053)	(0.005)	(0.002)
time on board	−0.0101*	0.0018***	0.0028***
	(0.006)	(0.001)	(0.000)
BOARD SIZE	−0.0157***	0.0017***	0.0019***
	(0.003)	(0.000)	(0.000)
SIZE	0.4861***	0.0262***	−0.0311***
	(0.028)	(0.003)	(0.001)
CAP RATIO	0.2070***	0.0004	0.0166***
	(0.004)	(0.000)	(0.000)
CREDIT RISK	−0.2307***	−0.0033***	−0.0015***
	(0.005)	(0.001)	(0.000)
LIQUIDITY	0.0059***	−0.0001	−0.0002***
RISK	(0.001)	(0.000)	(0.000)
_cons	−9.5560***	−0.1913***	0.7125***
	(0.517)	(0.049)	(0.022)
Observations	17,104	13,055	16,949
F ratio test	48	78	397
R-sqr	0.6851	0.8650	0.9872
Adj R-sqr	0.6789	0.8627	0.9870
Bank FE	YES	YES	YES
Year FE	YES	YES	YES

Standard errors in parentheses

Original variables representing Board characteristics are used (we do not use standard deviations)

Bank and Year fixed effects included

*$p<0.1$, **$p<0.05$, ***$p<0.01$

a more nuanced pattern given that lower levels of gender representation may be penalized by the market, possibly due to tokenism or perceived ineffectiveness of diverse boards below this critical mass threshold. Once the board surpasses the 40% mark, the effect turns positive, though only weakly significant, suggesting that market confidence may require more substantial female representation before being considered as value-enhancing. Finally, in terms of risk (Z-SCORE), a low female representation (lower or equal to 30%) is related to more uncertainty and risk, while higher representation (especially above 40%) is positively associated with Z-SCORE, indicating improved risk resilience. These results strongly support the argument that only boards with sufficient female presence contribute to sounder and more resilient risk governance.

5 Discussion and conclusions

The most recent regulations on bank board governance (Financial Reporting Council, 2018; EBA, 2021b; EBA & ESMA, 2021) suggest that increasing diversification among board members could enhance board dynamics, encouraging the adoption of more effective strategies and, in turn, leading to improved returns on investments. Previous literature has sought to empirically test the relationship between board diversity and performance but the findings have been mixed and very few have explored how board diversity might moderate the relationship between ESG investments and financial performance (Wu et al., 2024).

Our results support hypothesis 1 and therefore corroborate with the idea that a good governance shaped by board diversity positively impacts banks' financial performance. In line with stakeholder theory, financial performance benefits from better strategies, stakeholders' trust, legitimacy, and reduced external potential conflicts obtained through a diverse board that better understands and represents different stakeholders' expectations in board work. That is to say, diversity manifests its influence primarly through group dynamics during strategic decision making disciplined by the advisory role of the board. Results also provide support for the agency theory rationale that associates the positive impacts of diversity to the monitoring role of the board. Oversight increases because diversity reduces groupthink and increases questions on decisions of managers that might be led by personal opportunism. Thus, group dynamics (Murphy & McIntyre, 2007) — that is, the ways in which board members interact, build cohesion or conflict, and make collective judgments —, may represent a key mechanism through which board diversity affects performance. Future studies could seek direct support for the relevance of group dynamics through access to board minutes and textual analyses of board members' discussions.

Our results on the impacts of individual board member diversity dimensions and the interactions effects between key demographic characteristics suggest to conduct future studies on group dynamics at the board level because not all aspects of diversity enhance board decision making. In certain conditions (for example, in boards dominated by old and long tenured members) adding gender diversity is not fruitful as expected. Therefore, diversity has to be carefully planned and adjusted to identify which specific aspects are likely to be beneficial. On one hand, our board diversity index confirms that homogeneous boards are less effective, as groupthink may reduce decision-making quality and generate potential issues of independence to the detriment of the board' s advisory and monitor role (Li & Wahid, 2018). On the other hand, the existence of positive and negative impacts of different single board characteristics suggest that the composition of the board should be designed to account for possible conflicts and communicatiton patterns that impact on participation and decision making.

Most importantly — and novel when compared to previous studies — our results provide evidence in support of Hypthesis 3, therefore they show how board diversity may redirect banks' strategic ESG investments toward greater profitability by examininig the impact on banks' profitability of both the aggregate ESG performance indicator and its single Environmental, Social, and Governance dimensions. While ESG investments decrease short term profitability, an heterogeneous board, which is more

capable to understand external challenges, will guide the organization to select better ESG strategies that will benefit financial results at the end. The above results are in line with a stakeholder-centric approach to governance (Clarkson, 1995; Money & Schepers, 2007; Shahzad et al., 2016) that explains the benefit of having a diverse board in terms of higher capability promote attention to different stakeholder groups and their interests inside the boardroom (Maxfield et al., 2018), while enhancing the business strategy (Bhagat & Hubbard, 2022; Cardoni et al., 2020). A possible mechanism explaining how board diversity enhances ESG decisions is the appointment of a CSR/sustainability committee within the board, as well as the adoption of ESG-related remuneration policies. Future studies could investigate whether these additional governance mechanisms are associated to the presence of a diverse board or the appointment of young, female and internationally diverse new board members that are more sustainability oriented. Furthermore, as suggested by Bourveau et al., (2025, forthcoming), future studies may include racial diversity and analyse its interaction with gender diversity.

Our study provides a novel contribution to corporate governance literature by focusing on several board diversity elements (i.e., age, gender, nationality, number of qualifications, and board tenure) simultaneously, which actually reflects what is taking place in corporate practice. While most of previous studies have focused on the impact of gender diversity (Cucari et al., 2018; Menicucci & Paolucci, 2022a, 2022b; Miranda et al., 2023) or separate impacts of other demographic variables, we operationalize diversity as a composite of five different aspects because, in practice, we cannot "separate" the impact of more women on performance as all different characteristics are mixed and interact together. In addition, it contributes to critical mass theory, confirming that a minimum amount of women sitting on the board is necessary to effectively curb banks' decision making toward more profitable and less risky strategies.

At the same time, our examination on the different impacts of the Governance score provided by Eikon Refinitiv and the board diversity index here computed calls researchers to pay careful attention when selecting a corporate governance indicator to be used in their studies. As reported by Komath et al. (2023), many different measures exist leading to different impacts: examples include the Governance Metrics International (El-Helaly et al., 2018); the Corporate Governance Quotient (Ertugrul and Hedge, 2009); the Deminor Rating on board structure and functioning provided by a private rating agency (Bauwhede, 2009); the Governance score provided by Bloomberg and many others.

Finally, our study contributes to existing banking literature by offering an international view of the phenomenon investigated. Following the call of Cucari et al. (2018) for more multi country analysis, our study includes 18 OECD countries while most of previous studies focused on specific countries or geographical areas (Lu et al., 2022). While this wide geographical scope may add to the generalizability of our findings, we also acknowledge that different contexts and regulations may change the impact of the relationship between board diversity, ESG investments and financial performance here investigated. As reported by Rixom et al. (2023), the presence of quota laws is an important boundary condition that affects the effectiveness of a diverse board. This aspect, together with the prominence of the US banks in our sample, has led the authors to focus on a sub-sample comprising only European banks,

which have to be compliant with quite severe regulation regarding both the board composition and the environmental/climate change question. Despite such institutional differences, regression results of the sub-sample (in Appendix) do not change the major inferences made by the whole sample.

Our insights also provide relevant suggestions for both policymakers and practitioners, who are called to attentively evaluate the ESG dimensions and design corporate governance mechanisms, like board composition, that contribute to the long-term sustainability of banks. An important practical evidence is that low female representation (<30%) may produce weak or even negative effects, in line with critical mass theory, particularly for market performance and risk. Therefore, current mandatory quotas for EU large banks do not seem to be promising. Policy makers and supervisory authors should promote mid-range representation (30–40%) at least, which brings partial benefits, mostly visible in accounting profitability and stability. Since only high representation (>40%) yields strong and more consistent positive effects, managers, stock market bodies and regulators are invited to carefully plan possible mandatory thresholds to improve governance through enhanced gender diversity. Exceeding the quota could also respond to concerns regarding tokenism perceptions. More broadly, our evidence suggests banks to carefully design the composition of the board with reference to gender, age, nationality, qualifications, and tenture and to align it with corporate strategies on ESG matters and risk. Given that the market appreciates some board member characteristics (e.g. the nationality mix positively impacts the market value), but the same aspect holds an opposite impact on accounting returns, banks are invited to advise their nomination committees, which can be changemakers, to dedicate more attention to the appointment of new board members and their integration as legitimate and committed contributors in board work.

Another relevant insight of our study is that ESG investments increase risk. Our evidence of the negative impact of ESG on ROA, but positive impact on Tobin's Q, supports the argument that ESG investments incur short-term costs but create long-term value, particularly in highly regulated sectors such as banking. Yet, the novel insight is that ESG investments also have a negative impact on Z-SCORE. This may indicate that banks promoting themselves as ESG-focused are failing to meet expectations (risk reputational capital). An alternative explanation is that bank's risk is not related to ESG activities (other factors have a stronger magnitude) or that ESG activities actually may expose banks to new, not previously identified, issues. In any case, incentives for banks to be sustainable may be limited.

Finally, we acknowledge that our study is not free from limitations. One important aspect to consider is that the five-dimensional index created to measure boardroom diversity may not fully capture the complexity of this construct. As a result, there may be aspects of diversity dynamics that our study has not considered. Thus, future research may include additional characteristics to measure and test board diversity, also considering other different regional and organizational settings.

Our study also does not explore whether ESG engagement is driven more by regulatory compliance or strategic decision-making. Future research could account for different country-level regulatory frameworks while keeping in mind that laws and guidelines are evolving over the years and may apply to different types and size of banks.

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Declarations

Conflict of interest The authors whose names are listed above certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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