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Global Finance Journal

journal homepage: www.elsevier.com/locate/gfj

Greenwashing, greenhushing, and the path to green banking

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ARTICLE INFO

Keywords:

Banks
Business models
Corporate governance
Greenwashing
Greenhushing
Gender diversity

ABSTRACT

This study investigates how governance characteristics, specifically gender diversity, and bank business models influence the transition from greenwashing and greenhushing to becoming green banks. A balanced panel of 150 listed banks worldwide from 2015 to 2021 is used. Latent Markov models are applied as a methodology capable of explaining the evolution of a group of banks and the characteristics that may affect their transition over time. Key findings reveal a positive correlation between having a female CEO with at least 30 % female board representation and the likelihood of a bank shifting from greenwashing to a green stance. Conversely, a higher proportion of women on the board appears to reduce the likelihood of transitioning from greenhushing to a vocal green position, suggesting a more risk-averse and conservative approach. Additionally, investment-oriented banks are more likely to evolve toward vocal green banking than retail and universal banks. The research advances the literature on greenwashing and greenhushing by highlighting the importance of governance characteristics in supporting environmentally responsible practices.

1. Introduction

Banks adopt different strategies to communicate their environmental and performance efforts, meeting stakeholders' and regulators' demands. On one side, a growing number of organisations are overestimating their commitment to Environmental, Social and Governance (ESG) principles by exaggerating their adoption and misleading stakeholders (Birindelli, Chiappini, & Jalal, 2024; Galletta, Mazzù, Naciti, & Paltrinieri, 2024; Lee & Raschke, 2023). Greenwashing, which involves making unsupported and excessive environmental claims to investors or consumers to enhance reputation and profits (ESMA, 2023a, b), has become a concern in the banking sector despite its relatively low environmental impact on energy, paper, and water usage. Conversely, 'greenhushing' describes a new phenomenon where banks deliberately under-communicate their sustainability activities to avoid potential misalignment between their values and customer expectations (Cheng, Dong, & Feng, 2024; Falchi, Grolleau, & Mzoughi, 2022; Tao, 2024). Both strategies, classified as misleading practices for sustainable development, can undermine market transparency, customers' trust and engagement, and, above all, banks' reputations in the long term (Cheng et al., 2024).

While the body of literature on greenwashing in banking has steadily grown (Galletta et al., 2024) and studies on greenhushing are emerging, to our knowledge, no study has yet probed into which internal factors – specifically governance and business model - affect a bank's transition from being a greenwasher/greenhushing to a vocal green bank. The rapidly evolving context of ESG regulations and

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<https://doi.org/10.1016/j.gfj.2025.101147>

Received 31 January 2025; Received in revised form 1 June 2025; Accepted 11 June 2025

Available online 13 June 2025

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different approaches developed among countries has led banks to adopt diverse sustainability strategies that can change over time and evolve at varying levels, e.g., greenwashing, greenhushing, silent brown and vocal green. In addition, the increasing importance of governance within ESG adoption significantly influences the effectiveness of these strategies, particularly for banks aiming to meet ESG targets. However, existing literature lacks a transactional perspective, which is essential for understanding the dynamics of behavioural patterns between different disclosure and performance strategies. This work aims to fill this gap by addressing the following research questions: 1) *Which internal characteristics influence the likelihood of transitioning from greenwasher/greenhushing bank to vocal green?* 2) *Do board gender diversity and a bank's business model play a role in this transition?*

Gender diversity constitutes a board's structural element, and studies reveal that the presence of women on the board positively affects the bank's ESG score and reduces misconduct (Ben-Amar, Chang, & McIlkenny, 2017; Birindelli et al., 2024). Greenwashing and greenhushing carry significant costs regarding bank profitability and reputation (Venturelli, Pedrazzoli, Pennetta, & Gualandri, 2024). Understanding the additional benefits that gender-diverse boards can provide, particularly regarding strategic environmental changes, is important for management scholars, shareholders, regulators, and policymakers. The bank business model (BBM) is an internal factor deemed vital for management (Altunbas, Manganelli, & Marques-Ibanez, 2017; Ayadi, Bongini, Casu, & Cucinelli, 2021). However, its relationship with greenwashing and greenhushing behaviour in the banking sector remains unexplored. Some scholars emphasise how a business model can signal a bank's propensity toward risk-taking, potentially paving the way for unethical practices (Köhler, 2015).

Our research questions demand a methodology capable of explaining the evolution of a group of banks and the characteristics that may affect their transition over time. Latent Markov models (LLMs) assume the existence of a latent process that follows a Markov chain and affects the dependent variable (Bartolucci, Farcomeni, & Pennoni, 2012). While alternative models (e.g. multinomial logit models) can handle categorical outcomes, they do not account for the sequential and probabilistic nature of transitions between different states over time. In our case, the goal of this study is to capture the evolution of the group of banks, considering the dependence structure of transitions between different states. Traditional categorical or panel-data models (e.g. multinomial logit or fixed-effects approaches) can estimate how governance-related variables influence a specific behavioural state or a single transition between states at a given point in time. However, they typically treat observations as independent and do not account for the broader temporal trajectory of each subject. In contrast, Latent Markov models are specifically designed to capture dynamic behavioural patterns over time. They allow us to model how banks move across different unobserved states throughout the entire observation period, considering both observed characteristics (e.g., board diversity, business model) and unobserved influences. This ability to explicitly model temporal behavioural evolution makes Latent Markov Models the most appropriate methodological choice for our research questions.

The analysis was developed on an international sample of 150 banks active in 35 countries from 2015 to 2021, resulting in 1050 bank/year observations. Data from multiple sources, including Bloomberg, Refinitiv Eikon, Bank Focus, and the SDG Index from the Sustainable Development Report based on Sachs, Lafortune, Fuller, and Drumm (2023), were combined for the analysis.

The results vary depending on the starting status. A positive transition effect from greenwashing to a green stance is found in the presence of a female CEO associated with a board reaching the critical mass threshold of 30 % female representation. In contrast, the presence of women on the board and a female CEO reduces the likelihood of transitioning from greenhushing to a vocal green position, revealing a more risk-averse and conservative approach. These results evidence a positive effect of gender diversity only when the strategic change involves reducing the overstatement in environmental communication and identifies different motivations and approaches behind the two behaviours. Furthermore, regarding business models, investment-oriented banks are more likely to transition from the greenhushing status to a vocal green one than retail and universal banks. This result highlights different stakeholder approaches, particularly for investment banks, where institutional investors prioritise genuine sustainability practices and a long-term perspective. Finally, our analysis reveals significant differences between excluding US and EU-based banks in the transition from greenwashing or greenhushing to a vocal green stance. Excluding the US banks, gender diversity within boards and the presence of female CEOs emerge as the only leading drivers of the transition from greenwashing status. While in the transition from greenhushing status, universal banks are also more likely to shift to the green status than other business models. These results reflect different banking environments, regulatory approach and stakeholders' perception in the US and EU that contribute to the observed differences in how internal factors influence the communication and development of sustainability issues into banks' strategic frameworks.

Our results contribute incrementally to the literature on greenwashing and greenhushing in three principal ways. First, our study shows that, as banks face significant pressure to meet stakeholder expectations regarding ESG claims, they adopt different strategies based on the coherence between environmental disclosure and performance, evidencing transitions between different statuses (Huang, Bui, & Lin, 2022; Khalil & O'sullivan, 2017). Second, to our knowledge, this is the first study to examine the governance factors influencing the shift toward becoming a vocal green bank. In this work, we introduce a novel statistical methodology that was applied for the first time to investigate the governance determinants of vocal green transitions. Third, we contribute to the literature on bank gender diversity and greenwashing/greenhushing (e.g., Birindelli et al., 2024; Birindelli, Chiappini, & Savioli, 2020; Ghitti, Gianfrate, & Palma, 2020; Venturelli, Pedrazzoli, Pennetta, & De Novellis, 2024; Venturelli, Pedrazzoli, Pennetta, & Gualandri, 2024), as well as recent research on banks' business model and ESG practices (Ielasi, Bellucci, Biggeri, & Ferrone, 2023; Palmieri, Ferilli, Altunbas, Stefanelli, & Geretto, 2024). Finally, our insights offer valuable implications for policymakers aiming to foster sustainable practices within the banking sector. Enhancing greater female board representation can encourage banks to become advocates for green initiatives.

The paper is structured as follows: Section 2 introduces the literature background and our hypotheses. Section 3 presents the sample, variables, and methodological approach, while Section 4 discusses the results. Finally, Section 5 concludes, outlining the implications and suggesting avenues for future research.

2. Literature background and hypotheses development

2.1. Literature background: Greenwashing and greenhushing

Although defined differently across studies, greenwashing primarily refers to the disparity between environmental disclosure and actual environmental performance, aimed at misleading stakeholders and enhancing the bank's reputation and legitimacy (Delmas & Burbano, 2011). ESMA (2023) highlights that the financial sector ranked second in the number of greenwashing controversies between 2020 and 2021, with instances of greenwashing surging by 70 % in 2023 alone (Reuters, October 2023¹). In 2022, the Securities and Exchange Commission fined BNY Mellon Corp. and Goldman Sachs Group Inc. \$1.5 million and \$4 million for ESG misstatements and policy failures, opening a discussion about greenwashing risks within the entire financial industry. Only in recent years has the literature begun to delve into the issue of greenwashing in finance. Whether intentional or not, studies have shown that greenwashing hurts banks' profitability (Birindelli et al., 2024) and reputation (Venturelli, Pedrazzoli, Pennetta, & De Novellis, 2024; Venturelli, Pedrazzoli, Pennetta, & Gualandri, 2024). Moreover, researchers have also examined the phenomenon by analysing its potential determinants, focusing on aspects related to banks' governance (Venturelli et al., 2024b) or loan-level practices (Giannetti, Jasova, Loumioti, & Mendicino, 2023; Huang, Fang, Fan, & Ly, 2024). For instance, some banks manipulate information to appear sustainability-oriented to customers and stakeholders by increasing their level of environmental disclosure while simultaneously addressing brown industry needs (Giannetti et al., 2023). However, banks with weaker ESG performance offer better loan conditions to firms with high ESG ratings, and the market reacts positively to these loan agreements (Huang et al., 2022).

Conversely, little is known about greenhushing, which has emerged as a significant phenomenon in various sectors, including banking, where institutions reduce the disclosure of sustainability initiatives (Cheng et al., 2024; Font, Elgammal, & Lamond, 2017; Tao, 2024). The literature mainly focuses on the motivations behind greenhushing, while further studies are needed to explore the factors influencing its adoption. At first, due to increased ESG awareness among regulators and stakeholders, institutions may opt to limit their sustainability disclosures to avoid the risks of failing to meet declared targets and the resulting potential reputational damage (Falchi et al., 2022; Tao, 2024). The competitive landscape of the banking industry, where banks strive to maintain a positive public image, can exacerbate this tendency. In this vein, those companies that are more conservative and thus avoid ambiguity, uncertainty, and risk may be more inclined to greenhushing since they are more risk-averse (Cheng et al., 2024). Secondly, an excessive focus on ESG issues may conflict with investors' scepticism regarding "sustainability over profit," raising concerns that a strong commitment to green practices could compromise performance in core activities (Falchi et al., 2022). In particular, sustainability promises may raise doubts regarding financial returns, negatively affecting investors prioritising immediate financial returns over long-term environmental impact. Finally, despite their environmental efforts, some companies perceive communication costs as unnecessary. This misperception is often reinforced by a desire for environmental perfection, where companies feel that everything must be flawless before any communication takes place (Falchi et al., 2022). Like greenwashing, greenhushing can have long-term implications for stakeholder trust and engagement, particularly among investors who prioritise transparency and accountability in sustainability practices. Both behaviours carry reputational risks, as shifts in stakeholder perceptions can create significant challenges for banks and financial institutions (Cheng et al., 2024).

Different scenarios emerge from the discrepancy between what a bank claims to be doing and what it does. Even when unintentional, this discrepancy can harm investors, customers, shareholders, and others who rely on this information for decision-making. These observations underscore the need for an in-depth analysis to identify the factors facilitating transitions between statuses.

2.2. Theoretical framework

Studies have examined the relationship between board composition and the adoption of sustainable practices. For example, a higher percentage of women on the board has been associated with the adoption of the United Nations' sustainable development goals, voluntary disclosure of climate change information, such as greenhouse gas (GHG) emission levels (e.g., Ben-Amar et al., 2017), the implementation of environmental strategies and a reduction in environmental controversies (Issa & Hanaysha, 2023). Studies in the banking sector support these findings, showing that a more diverse board is associated with improved ESG disclosure and performance (e.g., Gurol & Lagasio, 2023). These findings are attributed to the ability of diverse boards to engage with the demands of multiple stakeholders and effectively respond to their needs, as well as to the relational and monitoring skills of women directors (Galbreath, 2010). The findings involve complex underlying mechanisms, drawing from various theoretical insights such as resource dependence, stakeholder, agency theories, and risk propensity.

The resource-dependence approach states that the diversity of demographic and socio-cultural traits like gender, age, and management's professional experience provides various resources that can benefit the company. Thus, gender diversity allows firms to enhance their information set with broader perspectives, new skills, and competencies. Compared with their male counterparts, the different skills and leadership styles characterising women managers and board members identify a higher willingness to engage in dialogue with stakeholders and strengthen supervision and monitoring activities (Ben-Amar et al., 2017). Moreover, corporate economic performance depends on the ability of managers to implement policies that consider the interests of shareholders, employees, investors, communities, public government, and the environment. Stakeholder theory suggests that women are more stakeholder-

¹ <https://www.reuters.com/sustainability/banks-behind-70-jump-greenwashing-incidents-2023-report-2023-10-03/>

focused and long-term-oriented than men. Women tend to integrate various stakeholders' interests alongside shareholders' performance-based interests (Gulamhussen & Santa, 2015). Furthermore, agency theory focuses on the roles of board directors and potential conflicts of interest that may arise between monitoring and direction activities or between agents (managers) and principals (shareholders). Regarding the monitoring role, empirical research based on agency theory has partially confirmed that gender diversity enhances the board's independence. This is attributed to the 'old boys' phenomenon, where conflicts of interest are more common among male board members due to the historically higher prevalence of multiple memberships and cross-shareholdings among men. The agency theory has also been adopted to explain the relationship between board gender diversity and the adoption of ethical behaviour (McGuinness et al., 2017), as well as the reduction in environmental controversies (Issa & Hanaysha, 2023). In this vein, women are generally considered risky adverse and, from a managerial perspective, less prone to adopt opportunistic behaviour and misconduct (Huang et al., 2024).

In line with the aforementioned theoretical frameworks, studies examining the relationship between female board representation and greenwashing remain unexplored. Conversely, research on the impact of female board members on greenwashing behaviour is still in its early stages and presents mixed results. Zahid, Maqsood, Irshad, and Khan (2023) and Lin, Yu, Zhang, Lin, and Zhong (2022) found that female board members in Chinese companies can reduce greenwashing and promote green innovation, respectively. Similarly, Chen and Dagestani (2023) and Eliwa et al. (2023) support these results, evidencing that gender diversity has a dual effect: it enhances firms' ESG practices while simultaneously reducing opportunistic behaviour such as ESG washing. In the banking sector, two works explore the role of female board members concerning washing practices: Birindelli et al. (2024) evidence that women on boards moderate the negative impact of greenwashing on bank performance, while Venturelli, Pedrazzoli, Pennetta, and De Novellis (2024), (Venturelli, Pedrazzoli, Pennetta, & Gualandri, 2024) confirm that a more diverse board is less prone to adopting pinkwashing practice. However, Ghitti et al. (2020) and Zhang (2023) reported conflicting results. Ghitti et al. (2020) suggest that female board members may increase greenwashing, whereas Zhang (2023) finds no significant difference in greenwashing behaviour between female-led and male-led firms. These findings indicate that while female board members can positively promote environmental disclosure and performance, further research is needed to fully understand their impact on greenwashing behaviour and the adoption of green strategies.

2.3. Hypotheses development

2.3.1. Board diversity

Banks affected by climate change and regulatory requirements must implement ethical procedures and actively communicate their environmental strategy to the market. When faced with regulatory challenges, adopting an environmental strategy is based on the bank's capability to facilitate environmentally sustainable economic activities and achieve a sustained competitive advantage (Harris, 1996). As many in the banking and corporate sectors have begun preparing for environmental practices and disclosure changes, literature has explored how a firm's governance influences these changes (Galbreath, 2010). Key aspects of governance include board composition and CEO characteristics.

Research on board composition indicates that diversity is crucial in driving corporate strategic change. Strategic change reflects a firm's response to the recognised need to adapt to its environment. Upper echelons theory suggests that board composition influences strategic choices, resulting in varying corporate environmental change (Hambrick & Mason, 1984). Female directors are often more stakeholder-oriented, making them a valuable resource for fostering corporate environmental change. Corporate environmental change involves a range of voluntary environmental policies and their implementation. Women on corporate boards consistently prioritise ESG issues, including climate and sustainability, and provide a high level of disclosure (Gurol & Lagasio, 2023; Pucheta-Martínez, Olcina-Sempere, & López-Zamora, 2020). Their presence, therefore, significantly and positively affects the promotion of proactive environmental strategies, such as pollution prevention and sustainable development (Burkhardt, Nguyen, & Poincelot, 2020). These positive impacts help reduce stakeholder-agent conflicts and can lead to better alignment between environmental disclosure and performance in the long term. Therefore, the following hypotheses are proposed:

Hp1a. : Women on the board increase the likelihood of transitioning from greenwashers to vocal green banks.

Hp1b. : Women on the board increase the likelihood of transitioning from greenhusher to vocal green banks.

The presence of women in leadership positions, such as CEO and board chairperson, has been linked to higher ESG disclosure and performance (Glass & Cook, 2018). However, the impact of female CEOs on changes in banks' environmental strategy is an area that requires further exploration. On one side, female CEOs tend to be more risk-averse and more inclined to seek expert advice than their male counterparts (Huang & Kisgen, 2013; Levi, Li, & Zhang, 2015), which can reduce the firm's likelihood of adopting greenwashing practices. On the other hand, in profit-oriented cultural contexts, female CEOs may feel pressured to adopt male patterns of behaviour, such as a more self-serving and individualistic approach, to ensure company success (Uribe Bohorquez, Martínez-Ferrero, & García-Sánchez, 2019), potentially leading to practices that maximise banks' profit, such as greenwashing. Previous works also highlight differences between female and male CEOs in driving corporations to strategic change, with female leaders being more likely to adopt environmental innovation (Javed, Wang, Usman, Ali Gull, & Uz Zaman, 2023). These findings suggest that female CEOs are expected to influence environmental strategic changes positively. Therefore, we hypothesise that:

Hp2a. : The presence of a female CEO increases the likelihood of transitioning from greenwashers to vocal green banks.

Hp2b. : The presence of a female CEO increases the likelihood of transitioning from greenhushers to vocal green banks.

Previous studies have evidenced the combined effect of female CEOs and women on the board, thanks to the similarity effect (Birindelli et al., 2020; Glass & Cook, 2018). The similarity, or homophily, between female CEOs and female board members leads to better interaction, positively affecting strategic changes toward environmental strategies. According to social categorisation theory, Zhang, Guo, and Nurdazym (2023) find that firms led by female CEOs with women on the board are more likely to adopt environmental decisions, such as reducing emissions of waste gas, wastewater, waste residues, and greenhouse gases, thus implementing corporate sustainable environmental policies. In particular, studies evidence that women's board representation must reach a 'critical mass' level before affecting board members' decision-making process and firm performance (Huang et al., 2024). The critical mass theory on board gender diversity posits that when there are only one or two female directors, they may serve in a "token role," and their impacts on corporate decisions will be limited. It is suggested that at least 30 % of women on the board constitute a critical mass (Konrad, Kramer, & Erkut, 2008) and that female board participation needs to reach it before it starts influencing disclosures about climate change strategies (Ben-Amar et al., 2017). Therefore, we hypothesise:

Hp3a. : A female CEO combined with a critical mass of women on the board increases the likelihood of transitioning from greenwashers to vocal green banks.

Hp3b. : A female CEO combined with a critical mass of women on the board increases the likelihood of transitioning from greenhushers to vocal green banks.

2.3.2. Banks' business models

A more recent and less explored theme in academic literature is the relationship between bank business models and sustainability issues. Banks are adjusting their business models toward sustainability, including expanding their offerings to green products, evolving risk management practices to incorporate ESG risks, and disclosing sustainability-related information (Ielasi et al., 2023; Palmieri et al., 2024). Different bank business models correspond to various target markets, product offerings, pricing strategies, funding sources, and operational processes, which can influence their propensity and orientation toward sustainability topics. Among the few studies, Palmieri et al. (2024) detect the effect of ESG pillar scores on banks' risk profiles, finding that wholesale banks show a negative association between environmental score improvement and default probability, a trend also observed, to a lesser extent, in retail banks. In the social dimension, investment banks are highly responsive to social factors due to their extensive stakeholder interactions, impacting their risk profiles. Ielasi et al. (2023) conclude that the bank business model can influence a bank's sustainability performance, with traditional banks, more focused on credit intermediation, performing worse on average in terms of sustainability impacts than financial institutions specialised in financial or securities brokerage activities.

What needs to be added is the evaluation of the relationship between the bank's business model and the likelihood of transitioning toward vocal green banking. Previous literature shows that the orientation toward sustainability can significantly vary depending on the bank's business model and the type of stakeholders it refers to (Jo, Song, & Tsang, 2016). An interesting aspect to explore is whether different predominant types of clientele, institutional or retail, can be associated with a distinct orientation toward greenwashing/greenhushing behaviour. From a stakeholder theory perspective, we surmise that if a bank's target market consists largely of institutional investors - such as pension funds, mutual funds, large investors, and corporations - these clients conduct rigorous due diligence and have the resources to uncover deceptive ESG practices. Additionally, these clients place significant importance on reputation and regulatory compliance, avoiding firms suspected of misleading ESG claims. Moreover, institutional investors typically have a long-term investment horizon, prioritising genuine sustainability practices that ensure long-term value and risk mitigation. Accordingly, the following hypotheses are tested:

Hp4a. : Investment-oriented banks are more likely to transition from greenwashers to vocal green banks.

Hp4b. : Investment-oriented banks are more likely to transition from greenhusher to vocal green banks.

3. Research design

3.1. Sample and data strategy

To explore our research questions, we identified a sample of listed banks for which granular information required for our empirical analysis was available, particularly regarding environmental disclosure and performance scores, key for calculating variables that capture banks' greenwashing and greenhushing behaviour. Our initial sample comprised 616 listed banks worldwide, each with a total market capitalisation exceeding 1 billion US\$, the ones that present the required level of information. Subsequently, we verified their inclusion in both Bloomberg and Refinitiv Eikon databases, ultimately identifying 414 banks for which we collected environmental-related data.

We chose to start our observation period in 2015 for two principal reasons. Firstly, in 2015, the international community established the Sustainable Development Goals (SDGs) as part of the UN2030 Agenda for Sustainable Development. This landmark initiative embodies a collective pledge by countries worldwide to eradicate poverty, pursue sustainable and inclusive development solutions, uphold human rights for all, and ensure that no individual is left behind by 2030. Secondly, 2015 also saw the introduction of the Paris Agreement, a legally binding international treaty adopted by 196 Parties, which was a significant milestone. The Agreement aims to guide all countries in substantially reducing global greenhouse gas emissions, limiting temperature increases, and periodically assessing collective progress toward achieving its long-term goals. These pivotal events prompted banks, organisations, and public institutions to prioritise environmental objectives. Consequently, we have chosen to focus our empirical analysis on the period from

2015 to 2021, the latest year for which data is available.

For the final sample, we selected only those banks for which it was possible to measure greenwashing and greenhushing behaviour over the entire observation period (2015–2021), thus allowing us to fully capture any bank transitions from greenwasher/greenhusher to vocal green status. In a similar vein and for the sake of a thorough investigation, we only included in our sample banks for which board diversity and business model data were consistently available throughout the observation period. In this way, we ensure reliable results regarding the influence of these features (board diversity and business model) on banks' transition between statuses. The final sample comprises 150 listed banks active in 35 countries from 2015 to 2021. The sample is internationally representative, with the most significant number of banks from the USA and Canada. It represents a balanced panel data with 1050 total bank/year observations, encompassing environmental disclosure from Bloomberg, environmental performance from Refinitiv Eikon, financial characteristics from BankFocus, and the SDG Index from the Sustainable Development Report based on [Sachs et al. \(2023\)](#).

3.2. Variables

3.2.1. Dependent variable

With the development and widespread adoption of ESG scores and ratings across all industries, these metrics provide a valuable means of gauging the level of disclosure and performance, even within the banking sector ([Ioannou & Serafeim, 2023](#); [Miras-Rodríguez, Bravo-Urquiza, & Escobar-Pérez, 2020](#); [Miras-Rodríguez, Carrasco-Gallego, & Escobar-Pérez, 2015](#)). In particular, the annual environmental alignment scores for banks are calculated as follows:

$$E_alignment_{i,t} = E\ disclosure_{i,t} - E\ performance_{i,t} \quad (1)$$

Disclosure and performance measures are divided by 100 and normalised before implementation, ensuring they operate uniformly ([Yu, Van Luu, & Chen, 2020](#)). Following the methodology and definition outlined by [Delmas and Burbano \(2011\)](#), [Miras-Rodríguez et al. \(2020\)](#), and [Testa, Miroschnyenko, Barontini, and Frey \(2018\)](#), we identify distinct scenarios based on the alignment between banks' environmental disclosures and their actual environmental performance, i.e., symbolic environmental disclosure and substantive environmental actions. Specifically, for each year of observation, we categorised each bank into four distinct clusters, depending on whether their scores were above or below the sample median values for environmental disclosure and performance ([Fig. 1](#)). The categorical variable alignment assumes the following labels: 1) Greenwasher: if the bank's environmental disclosure score is above the sample median but its environmental performance is below the median; 2) Silent brown: if both the bank's environmental disclosure and performance scores are below the sample median of the sample; 3) Greenhusher: if the bank's environmental disclosure score is below the sample median but its environmental performance is above the median; and 4) Vocal green: if both the bank's environmental disclosure and performance scores are above the sample median.



Fig. 1. Banks' transition status.

Table 1 presents the yearly number and percentage of banks in the four washing scenarios and highlights the transition patterns. Although the proportion of greenwashers, greenhushers, and vocal green banks is almost the same in the first and last year of observation, it is evident that some transitions occurred over the 2015–2021 period. Initially, the number of greenwasher banks showed a decreasing trend, which reversed in 2021. Greenhushing banks have shown a persistent negative trend since 2017. Vocal green banks, instead, show a fluctuating pattern and constitute the majority of the sample throughout the years, followed by silent brown banks.

3.2.2. Independent variables

We draw on previous literature to identify the board's gender diversity characteristics (e.g., Birindelli et al., 2020; Birindelli et al., 2024). To capture the board's gender diversity, we collect the percentage of women on the board (%Women Board) and a dummy variable equal to 1 for a female CEO (Fem. CEO). As an alternative variable to measure gender diversity, we use a dummy variable named Critical Mass that equals 1 when the percentage of women on the board exceeds 30 % and 0 otherwise.

Moreover, we performed a cluster analysis to identify the business model (BM) adopted by banks in our sample. A bank's business model outlines its strategic decisions regarding assets and liabilities and techniques for achieving profitability (Ayadi et al., 2021; Roengpitya, Tarashev, Tsatsaronis, & Villegas, 2017) and its unique approaches to customer service, revenue generation, and risk management approaches. The academic literature on bank business models is extensive and growing (Lagasio & Quaranta, 2022). Several studies focus on the quantitative methods to identify subgroups of banks with similar balance sheet and income statement compositions (Ayadi et al., 2021), while others examine the relationship between specific business models characteristics and bank risk (e.g., Altunbas et al., 2017; Köhler, 2015), performance and efficiency, and capital adequacy (Mergaerts & Vander Vennet, 2016). Focusing on risk, some authors (Altunbas et al., 2017) have highlighted how business models can signal a firm's risk-taking propensity and facilitate incentives to hedge risk. In line with extant literature, the business model of the sampled banks is defined by considering their comprehensive strategic framework, through which banks identify and set the optimal mix of assets, funding, and income sources (Curi, Lozano-Vivas, & Zelenyuk, 2015). Hence, the classification of banks is carried out relying on several economic and financial metrics, which include i) net fees over operating income, ii) net trading income over operating income, iii) net loans and advances to customers over total assets, iv) customer deposits over total assets, v) interbank assets over total assets, vi) securities over total assets, and vii) derivatives over total assets (Lagasio & Quaranta, 2022; Nucera, Lucas, Schaumburg, & Schwaab, 2017). Since short-term changes in banks' BM are uncommon, we assigned a single BM to each bank for the entire observation period by running the cluster analysis using the average values of the seven abovementioned variables. For clustering, we applied an agglomerative hierarchical cluster algorithm based on Ward's method and, based on a variety of tests and statistics, identified three clusters corresponding to distinct BMs. Our result is completely in line with studies adopting an international perspective. In particular, the three identified BMs, labelled as Investment-oriented Banks (BM1), Retail Banks (BM2), and Universal Banks (BM3), are similar to those proposed by Roengpitya et al. (2017, 2014) and Lueg, Schmaltz, and Tomkus (2019). More detailed information on the clustering process and validation can be found in Appendix A. Table 2 summarises the average characteristics of the identified BMs and their adoption rate. (See Tables 3 and 4.)

3.2.3. Control variables

As control variables, we incorporated several features related to governance quality. In particular, for board structure, we included the logarithm of the number of board members (Board Size) and the percentage of independent directors (%Indip. Direct) as their presence is assumed to be related to a bank's socially responsible behaviour (Galbreath, 2010). We also used the dummy variable ESG bonus, which equals one if the bank sets up remuneration packages linked to ESG targets, as a way to align executives' interests (principal) with those of ESG-oriented stakeholders (agents) (Cohen, Kadach, Ormazabal, & Reichelstein, 2022). In addition, we included an accounting-based bank control variable (Fiordelisi, Soana, & Schwizer, 2013), the logarithm of total assets to measure bank size (Size), as larger banks generally have more resources to invest in environmental practices and communications (Yu et al., 2020). Institutional controls refer to the GDP growth rate at the country level, considering that macroeconomic factors can affect bank performance, and the SDG Index provides an assessment of progress made toward the SDGs by the UN Member States. The SDG Index values are presented on a scale of 0 to 100 and can be interpreted as a percentage toward optimal SDG performance.

Table 1
Number and percentage of banks in the four washing scenarios: yearly overview.

	1 Greenwasher	2 Silent Brown	3 Greenhusher	4 Vocal Green
2015	12 (8 %)	33 (22 %)	19 (13 %)	86 (57 %)
2016	12 (8 %)	31 (21 %)	22 (15 %)	85 (56 %)
2017	11 (7 %)	33 (22 %)	25 (17 %)	81 (54 %)
2018	7 (5 %)	36 (24 %)	21 (14 %)	86 (57 %)
2019	8 (5 %)	37 (25 %)	19 (13 %)	86 (57 %)
2020	8 (5 %)	37 (25 %)	16 (11 %)	89 (59 %)
2021	11 (7 %)	42 (28 %)	10 (7 %)	87 (58 %)

Table 2
Average characteristics and adoption of the three BM identified via cluster analysis.

	BM1 Investment-oriented Banks	BM2 Retail Banks	BM3 Universal Banks
Net fees/Operating revenue	27.9 %	16.5 %	26.8 %
Net trading income/Operating income	20.7 %	3.8 %	9.3 %
Net loans and advances to customers/Total assets	43.5 %	66.7 %	50.5 %
Customer deposits/Total assets	34.6 %	71.8 %	58.6 %
Interbank assets/Total assets	6.8 %	3.7 %	8.8 %
Securities/Total assets	23.6 %	16.4 %	23.3 %
Derivatives/Total assets	5.8 %	0.9 %	3.6 %
Adoption rate	12.7 %	64.7 %	22.6 %

Table 3
Descriptive statistics of continuous variables.

	Mean	Median	Min	Max	SD
%Women Board	0.226	0.222	0.000	0.556	0.136
Board Size	12.030	12.000	3	24	3.314
%Indip. Direct	0.645	0.667	0.125	1.000	0.217
Size	18.240	18.050	14.310	21.760	1.599
GDP	0.159	0.183	-0.122	0.135	0.037
SDG Index	74.540	74.670	60.860	86.260	5.362

Table 4
Frequencies of binary and categorical variables.

	Category	Freq. (%)
Alignment	1 (Greenwasher)	6.6 %
	2 (Silent Brown)	23.7 %
	3 (Greenhusher)	12.6 %
	4 (Vocal Green)	57.1 %
Fem. CEO	1	4.7 %
	0	95.3 %
Critical Mass	1	32.3 %
	0	67.7 %
Business Model	Investment-oriented Banks (BM1)	12.7 %
	Retail Banks (BM2)	64.7 %
	Universal Banks (BM3)	22.6 %
ESG bonus	1	11.4 %
	0	88.6 %

3.3. Methodological approach

Latent Markov models (hereafter LMM) originate in the broader field of Hidden Markov models (HMM), which are stochastic models used to study the transition between states according to probabilistic rules. LMMs have been effectively applied in panel data analysis to account for several aspects, such as dependence between observations, measurement errors, endogeneity, and unobservable heterogeneity (Bartolucci et al., 2012). Specifically, LMMs incorporate latent or hidden states into the model, represented by unobserved variables influencing the observed data. The unobserved or latent variables represent the underlying factors governing the transition between states and are assumed to follow a Markovian process, i.e., the probability of transitioning to a given state depends on the current state. This characteristic has made LMMs valuable in various fields, including economics and finance, where understanding the underlying structure is essential in making informed decisions and accurate predictions. The latent states represent unobserved behavioural categories based on the alignment between environmental disclosure and performance. These include configurations such as greenwashing, greenhushing, vocal green, and silent brown. The model does not assign these categories directly, but rather identifies them statistically based on the patterns observed in the data. Each observation (bank-year) is assigned a posterior probability of belonging to each latent state, and the model estimates the likelihood of transitioning from one state to another across time. This structure allows us to study not only which state a bank likely belongs to at each point in time, but also how it changes behaviour across the observed period.

In the context of this study, the choice of LMMs is particularly justified by the nature of our research objective: modelling how banks move across different behavioural patterns over time and identifying which internal factors influence these movements. While other

approaches, such as survival analysis, Markov-switching models, or difference-in-differences (DiD), have been used in related literature to assess shifts in behaviour or regulatory impacts, they are not designed to capture transitions across latent states in a probabilistic and sequential framework. Survival models focus on the timing of observed events, DiD estimates the effect of discrete shocks or treatments, and Markov-switching models assume observed regime changes in time-series data.

LMMs are characterised by transition probabilities that capture the system's dynamics by identifying the probabilities of moving between states over time. Covariates can also be considered in LMMs as affecting transition probabilities. Specifically, logistic regression is used to model the relationship between covariates and transition probabilities. In a time-varying setting, transition probabilities are allowed to vary with time, and covariates are included to capture trends in the data. Consequently, the transition probability matrix can vary with time or remain homogeneous.

These characteristics significantly distinguish latent Markov models from multinomial logit models in studying transition probabilities. Firstly, LMMs consider latent states that can influence the transition between observed states, thereby rendering the transition probability dependent not solely on covariates. Introducing latent states helps capture unobservable factors often responsible for omitted variable bias in simpler models. This allows LMMs to account for the hidden influences driving transitions between states, which multinomial logit models fail to capture. Additionally, LMMs, designed to model dynamic systems, capture the temporal evolution of the system by explicitly modelling transitions. By explicitly incorporating temporal dependencies, LMMs can account for the endogeneity that may arise from the temporal ordering of events — for instance, when earlier states influence future outcomes. In contrast, multinomial logit models, which assume independence of observations and lack a temporal structure, fail to model such dynamics effectively. Moreover, in the context of endogeneity, the ability of LMMs to include latent variables and consider measurement errors significantly mitigates the potential risk of endogeneity. When using traditional methods such as multinomial logit, including time-varying covariates, endogeneity may inadvertently result if unmeasured variables (or omitted variables) influence both the transition probabilities and the covariates. Latent Markov models address this by incorporating these hidden variables, thus reducing the bias introduced by omitted variables. Lastly, by explicitly modelling the temporal dependencies between observations, LMMs allow a more accurate estimation of the underlying processes driving transitions over time, further limiting the risk of endogeneity due to temporal correlations.

In addition to these advantages, LMMs are particularly well suited to our research objective, which is to estimate the likelihood of transitioning between latent states over time as a function of internal bank characteristics. Unlike fixed-effects panel models or quasi-experimental approaches (e.g., instrumental variables or regulatory shocks), which are typically designed for causal identification, these methods do not model the dynamic and probabilistic nature of behavioural state transitions. In contrast, LMMs directly capture how observable covariates affect transition probabilities across time, while accounting for unobserved heterogeneity. Since our aim is not to infer causality but to explain how governance and business model features shape transitions in environmental communication behaviour, LMMs represent the most appropriate methodological framework.

4. Results

Before examining the characteristics that influence the transition probabilities, it is essential to identify the likelihood of transitioning between states, with the vocal green status representing the equilibrium between environmental disclosure and performance. The estimated transition probabilities reflect the average likelihood that a bank in a given latent state will move to another state (or remain in the same one) from one period to the next. These probabilities are not bank-specific but represent the overall dynamic patterns observed across the sample. They provide insights into the general tendencies of banks to maintain or shift their environmental communication and performance behaviours over time. In this framework, the transition matrix captures the systemic dynamics of greenwashing, greenhushing, and related behaviours, allowing us to understand whether such practices are persistent, transitional, or evolving across the banking sector.

Table 5 presents the average (time-homogeneous) transition probability matrix, showing the probability of transitioning from and to different states. Most banks retained their status throughout the observed period, with the majority classified as vocal green (80 %), followed by silent brown (73 %) and greenwasher (67 %). Notably, 13 % of banks transitioned from greenwashing to vocal green, while 11 % moved to a greenhushing status. Additionally, 16 % of banks moved from silent brown to greenhushing, closely mirroring the 15 % of greenhushing banks that transitioned to vocal green. These findings highlight the growing relevance of the greenhushing strategy in the banking sector in recent years, both as an initial and a final state.

Table 6 presents the factors influencing the transition probabilities from greenwashing and greenhushing to vocal green banks. These coefficients are estimated through logistic regressions embedded in the LMM framework and indicate how each covariate affects

Table 5
Transition probability matrix between status.

From To	Green Washer	Silent Brown	Green Hushing	Vocal Green
Greenwasher	67 %	9 %	11 %	13 %
Silent Brown	8 %	73 %	16 %	3 %
Greenhushing	1 %	19 %	65 %	15 %
Vocal Green	1 %	19 %	1 %	80 %

the log-odds of transitioning from a specific initial status to the vocal green state. A positive and statistically significant coefficient implies that the variable increases the likelihood of transition, while a negative coefficient suggests the opposite. This interpretation applies consistently to all subsequent tables reporting transition models. Models 1 to 3 consider greenwashing as the starting status. The results indicate that gender representation on the board positively affects the likelihood of transitioning from greenwashing to vocal green status (Model 1, $p < 0.05$; Hp1a supported). Conversely, having a female CEO alone shows a negative effect (Model 2, $p < 0.05$; Hp2a not supported). Interestingly, this negative impact reverses when a critical mass of women accompanies a female CEO on the board (Model 3, $p < 0.05$, Hp3a supported). This suggests that while a female CEO alone may not drive strategic change to reduce greenwashing misconduct, combining a female CEO and at least 30 % female representation on the board can facilitate this transition.

Models 4 to 6 focus on greenhushing as the initial status. Compared to previous results, the percentage of women on the board does not significantly affect the transition to vocal green (Model 4, Hp1b not supported), and having a female CEO continues to show a negative impact (Model 5, $p < 0.05$, Hp2b not supported). Moreover, the combined presence of a female CEO and a critical mass of women on the board reduces the likelihood of transitioning to vocal green status (Model 6, $p < 0.05$, Hp3b not supported). These findings suggest that gender diversity affects the transition differently, depending on the starting point. When transitioning from greenwashing, women can act as catalysts for change, driving the organisation away from misconduct. However, transitioning from greenhushing, characterised by lower disclosure than performance, presents more challenges for women in leadership to initiate significant changes, particularly in increased disclosure. This difference is likely due to the underlying motivations behind greenhushing (Falchi et al., 2022). A risk-averse approach often drives greenhushing, and the presence of women, who are more cautious and less inclined to take excessive risks (Palvia, Vähämaa, & Vähämaa, 2015), could exacerbate this tendency toward organisational conservatism. In contrast, greenwashing is an overestimation in terms of communication of environmental commitment. In this case, a diverse board reduces excessive communication, promotes equilibrium with environmental performance, and reduces potential reputational risk.

About banks' business models, our results indicate that retail and universal banks are less likely to transition to a vocal green status compared to investment-oriented banks, irrespective of their initial status (Models 1, 4, and 5; $p < 0.05$). Even when some models show non-significant values, the direction of the effect remains consistent (Models 2, 3 and 6). Notably, the retail bank business model loses its effect when both a female CEO and a critical mass are present, regardless of the initial status (Models 3 and 6). Therefore, the bank's business model is not significant at all when the initial status is greenwashing and all gender variables are considered (Model 3). These results partially support Hp4a, suggesting that the strategic shift toward a vocal green status from greenwashing is primarily driven by gender diversity factors rather than other internal banks' characteristics, while Hp4b is confirmed.

Among our control variables, other board characteristics play a significant role, including board size and ESG bonuses. A larger board negatively impacts the likelihood of transitioning to a vocal green bank ($p < 0.05$, Models 1 to 5). This finding aligns with previous research that has reported mixed results on the effect of board size on greenwashing behaviour. Some studies report no significant association (Yu et al., 2020), while others find a positive relationship (Venturelli, Pedrazzoli, Pennetta, & De Novellis, 2024; Venturelli, Pedrazzoli, Pennetta, & Gualandri, 2024). However, studies suggest that larger boards are less prone to greenwashing (Ghitti et al., 2020). Additionally, ESG bonuses, which align executives' incentives with ESG-oriented stakeholders' interests, show a positive effect on the transition to vocal green status ($p < 0.05$, Models 1 to 4, and 6), supporting literature that highlights their role in

Table 6
Parameters affecting the transition probabilities to Vocal Green bank.

	Model 1 From Greenwasher to Vocal Green	Model 2 From Greenwasher to Vocal Green	Model 3 From Greenwasher to Vocal Green	Model 4 From Greenhushing to Vocal Green	Model 5 From Greenhushing to Vocal Green	Model 6 From Greenhushing to Vocal Green
%Women Board	1.669*** (0.155)	–	–	–1.012 (10.471)	–	–
Fem. CEO	–	–9.881*** (0.075)	–2.754*** (0.000)	–	–26.685*** (1.292)	–2.510*** (0.000)
Critical Mass	–	–	–4.972 (11.323)	–	–	–8.895*** (0.746)
Fem. CEO x Critical Mass	–	–	5.348*** (0.000)	–	–	–0.058*** (0.000)
Retail Banks	–47.743*** (3.168)	–6.507* (3.598)	–3.343 (11.291)	–10.206*** (0.128)	–32.379*** (1.841)	–6.049 (5.636)
Universal Banks	–27.389*** (7.746)	–7.733 (5.382)	–11.461 (12.570)	–5.932*** (0.071)	–6.712*** (1.292)	–4.331*** (0.000)
Board Size	–33.055*** (10.895)	–31.209*** (2.871)	–32.044*** (0.057)	–21.297*** (0.811)	–52.161*** (1.749)	–4.924 (6.709)
ESG bonus	31.051*** (0.000)	5.781*** (0.000)	22.761*** (0.000)	3.105 (2.687)	2.918*** (0.000)	2.613*** (0.000)
%Indip. Direct	–0.593*** (0.109)	0.001 (0.087)	0.015 (0.171)	–0.399 (1.779)	–0.402 (0.453)	–0.280 (0.194)
Size	0.214 (1.974)	–10.224*** (3.123)	–10.691 (9.250)	–3.681*** (1.254)	–0.678 (6.277)	–0.353 (1.215)
GDP	–0.445* (0.259)	–2.272* (1.317)	–2.396 (1.950)	–1.376 (11.434)	–3.038 (2.789)	–0.174 (0.415)
SDG Index	1.474*** (0.488)	3.230*** (0.603)	3.358* (1.925)	1.594 (1.551)	2.156 (1.390)	0.467 (0.452)
Intercept	–31.863*** (2.809)	–17.967*** (0.394)	–18.275*** (0.512)	–99.574*** (0.127)	–20.824*** (0.265)	–1.055 (0.712)

Note: The results refer to the sample of 1050 total bank/year observations corresponding to 150 banks. The observation period is 2015–2021. ***, **, and * indicate statistical significance at the 1 %, 5 %, and 10 % levels, respectively. Standard errors are in parentheses.

Table 7

Parameters affecting the transition probabilities to Vocal Green (from Greenwasher status as baseline level) excluding US-based and EU-based banks.

	Model 1 From Greenwasher to Vocal Green (excluding the US)	Model 2 From Greenwasher to Vocal Green (excluding the US)	Model 3 From Greenwasher to Vocal Green (excluding the US)	Model 4 From Greenwasher to Vocal Green (excluding EU)	Model 5 From Greenwasher to Vocal Green (excluding EU)	Model 6 From Greenwasher to Vocal Green (excluding EU)
%Women Board	1.790*** (0.059)			-0.626 (4.336)		
Fem. CEO		-2.011*** (0.000)	-1.551*** (0.000)		4.169 (3.926)	2.003*** (0.000)
Critical Mass			8.379 (10.896)			-6.085** (2.853)
Fem. CEO x Critical Mass			4.365*** (0.000)			8.063*** (0.000)
Retail Banks	-52.054*** (2.555)	-6.332 (7.164)	-13.967 (13.235)	-10.458*** (0.522)	-14.875 (10.563)	-16.877*** (6.032)
Universal Banks	-29.215*** (7.866)	8.320 (6.593)	0.110 (5.326)	0.122 (0.089)	0.779 (13.512)	-5.123*** (0.193)
Board Size	-35.992*** (11.554)	-31.284*** (3.629)	-30.571*** (2.204)	-7.656*** (0.142)	-13.279 (12.231)	-8.394 (7.321)
ESG bonus	-1.608*** (0.008)	-4.323*** (0.000)	-2.824*** (0.000)	23.042*** (0.355)	50.628*** (5.704)	54.449*** (2.214)
%Indip. Direct	-0.640*** (0.099)	-0.013 (0.140)	-0.027 (0.121)	0.592 (3.446)	0.201 (1.333)	0.356 (1.694)
Size	-0.542 (1.949)	-9.732** (4.102)	-9.010 (11.104)	2.025* (1.129)	8.771 (9.065)	2.718 (9.972)
GDP	-0.541* (0.278)	-2.103 (1.733)	-1.918 (2.193)	-1.596 (7.316)	-2.329 (3.261)	-3.312 (3.789)
SDG_Index	1.679*** (0.518)	3.085*** (0.754)	2.906 (2.404)	-0.535 (2.559)	-1.867 (2.405)	-0.660 (3.133)
Intercept	-26.626*** (2.815)	-13.849*** (0.634)	-12.661*** (0.586)	-15.131*** (0.051)	-20.824*** (0.694)	-23.339*** (0.152)

Note: Models 1–3 results refer to the sample of 798 total bank/year observations corresponding to 114 non-US banks. Models 4–6 results refer to the sample of 749 total bank/year observations corresponding to 107 non-EU banks. The observation period is 2015–2021. ***, **, and * indicate statistical significance at the 1 %, 5 %, and 10 % levels, respectively. Standard errors are in parentheses.

Table 8

Parameters affecting the transition probabilities to Vocal Green (from Greenhushing status as baseline level) excluding US-based banks and EU-based banks.

	Model 1 From Greenhusher to Vocal Green (excluding the US)	Model 2 From Greenhusher to Vocal Green (excluding the US)	Model 3 From Greenhusher to Vocal Green (excluding the US)	Model 4 From Greenhusher to Vocal Green (excluding EU)	Model 5 From Greenhusher to Vocal Green (excluding EU)	Model 6 From Greenhusher to Vocal Green (excluding EU)
%Women Board	-0.116 (0.367)			0.383 (1.274)		
Fem. CEO		-2.125*** (0.000)	-1.792*** (0.000)		-3.534*** (0.000)	-2.245*** (0.013)
Critical Mass			-4.034 (11.096)			-9.8228*** (0.201)
Fem. CEO x Critical Mass			-0.597*** (0.000)			0.102*** (0.000)
Retail Banks	-20.830 (16.936)	-18.882*** (0.068)	-19.976*** (3.856)	-34.866*** (0.239)	-2.023 (2.336)	0.761 (1.665)
Universal Banks	19.951** (10.656)	14.878*** (3.605)	7.378*** (1.272)	-9.163 (8.347)	-14.289*** (1.264)	-14.206*** (1.271)
Board Size	-31.366*** (9.268)	-31.720*** (3.175)	-42.275*** (6.070)	-2.014 (1.584)	-39.067*** (7.665)	-44.877*** (3.657)
ESG bonus	-3.464*** (0.976)	-4.153*** (0.000)	-3.611*** (2.134)	5.031*** (0.021)	20.599* (12.519)	24.477*** (7.111)
%Indip. Direct	-0.156 (0.477)	0.023 (0.166)	-0.261 (1.261)	-0.981 (1.756)	-0.519*** (0.157)	-0.723*** (0.178)
Size	-5.088 (6.864)	-3.811 (2.784)	-6.944* (4.207)	4.412*** (0.144)	-0.841 (1.277)	-1.202 (1.196)
GDP	-0.038 (1.736)	0.309 (1.863)	-1.071 (1.046)	-1.993 (1.874)	-0.371 (2.395)	-0.801*** (0.297)
SDG_Index	2.185 (1.567)	1.670** (0.729)	2.852* (1.488)	-0.393 (1.619)	-0.577* (0.320)	-0.509 (0.387)
Intercept	-4.744** (2.347)	0.533 (3.299)	4.317*** (1.629)	-5.496 (4.937)	-18.887*** (2.278)	-24.035*** (1.331)

Note: Models 1–3 results refer to the sample of 798 total bank/year observations corresponding to 114 non-US banks. Models 4–6 results refer to the sample of 749 total bank/year observations corresponding to 107 non-EU banks. The observation period is 2015–2021. ***, **, and * indicate statistical significance at the 1 %, 5 %, and 10 % levels, respectively. Standard errors are in parentheses.

enhancing environmental disclosure and performance (Cohen et al., 2022).

Finally, among the institutional conditions, countries that have made significant progress toward the SDGs are more likely to support the transition from greenwasher to vocal green banks ($p < 0.05$, Models 1 to 3).

4.1. Robustness and additional analyses

As robustness tests, we performed additional analyses with different sample specifications (Tables 7 and 8) and a different way to calculate our dependent variables (Table 9). Since most of our banks are American, we develop analyses excluding US-based banks.

Table 9
Robustness test: changing the dependent variable.

	Model 1 From Greenwasher to Vocal Green	Model 2 From Greenwasher to Vocal Green	Model 3 From Greenwasher to Vocal Green	Model 4 From Greenhushing to Vocal Green	Model 5 From Greenhushing to Vocal Green	Model 6 From Greenhushing to Vocal Green
%Women Board	6.181** (3.135)	–	–	–1.950 (5.753)	–	–
Fem. CEO	–	–6.594*** (0.013)	–6.882*** (0.011)	–	–7.496*** (0.012)	–9.359*** (0.000)
Critical Mass	–	–	1.563** (0.794)	–	–	–24.657* (14.747)
Fem. CEO x Critical Mass	–	–	8.804*** (0.000)	–	–	–3.553*** (0.000)
Retail Banks	–10.736*** (1.393)	–3.507* (0.795)	–1.316 (0.887)	–27.332*** (1.509)	–40.430*** (1.589)	–37.797*** (3.443)
Universal Banks	–8.456*** (1.579)	–0.275 (1.058)	–1.253 (1.180)	–20.237*** (1.993)	–43.164*** (1.873)	–32.339*** (0.023)
Board Size	–25.329*** (2.819)	–20.535*** (2.087)	–23.732** (2.520)	–22.094*** (5.630)	–32.362*** (12.530)	–6.212 (12.785)
ESG bonus	3.609* (1.948)	5.884*** (0.012)	4.253*** (1.528)	5.325*** (1.494)	6.369*** (0.085)	21.143*** (5.811)
%Indip. Direct	–1.464 (2.801)	1.111 (1.860)	–2.488 (2.476)	–2.086 (4.962)	–12.847* (7.680)	–2.597 (10.264)
Size	–2.059* (1.177)	0.579 (0.521)	1.150 (0.765)	–8.654*** (1.316)	–23.683*** (3.659)	–16.739*** (3.922)
GDP	0.036 (0.071)	0.037 (0.059)	0.079 (0.069)	–0.053 (0.138)	–0.657** (0.278)	–0.368 (0.252)
SDG Index	–0.091 (0.138)	0.030 (0.062)	–0.006 (0.081)	–0.164 (0.159)	0.681** (0.328)	0.250 (0.566)
Intercept	–4.849 (8.722)	–8.971* (5.149)	–4.619 (7.156)	50.121*** (2.643)	83.395*** (0.952)	69.716*** (3.434)

Note: The results refer to the sample of 1050 total bank/year observations corresponding to 150 banks. The observation period is 2015–2021. ***, **, and * indicate statistical significance at the 1 %, 5 %, and 10 % levels, respectively. Standard errors are in parentheses.

Table 10
Parameters affecting the transition probabilities to Greenhusher.

	Model 1 From Greenwasher to Greenhushing	Model 2 From Greenwasher to Greenhushing	Model 3 From Greenwasher to Greenhushing	Model 4 From Silent Brown to Greenhushing	Model 5 From Silent Brown to Greenhushing	Model 6 From Silent Brown to Greenhushing
%Women Board	0.542*** (0.149)	–	–	0.131 (0.089)	–	–
Fem. CEO	–	–3.166*** (0.072)	–4.172*** (1.042)	–	9.861*** (4.492)	1.640*** (0.000)
Critical Mass	–	–	10.209 (9.259)	–	–	1.399 (1.449)
Fem. CEO x Critical Mass	–	–	7.059*** (0.000)	–	–	4.520*** (0.000)
Retail Banks	–24.529*** (2.631)	–52.140*** (5.577)	–32.444*** (5.662)	2.901* (1.523)	–5.948 (1.742)	2.770 (7.058)
Universal Banks	–30.508*** (2.243)	–45.631*** (2.959)	–46.717*** (4.741)	–7.553*** (1.271)	–7.236*** (2.250)	–0.462 (8.393)
Board Size	8.711** (4.376)	39.578*** (4.301)	32.215*** (7.053)	5.242 (4.816)	–1.738 (1.668)	1.776 (3.287)
ESG bonus	22.614*** (2.215)	24.585*** (1.600)	22.162*** (1.427)	9.629*** (3.703)	5.578*** (1.898)	7.284*** (2.779)
%Indip. Direct	–0.236* (0.126)	0.101 (0.111)	–0.439 (0.334)	–0.234*** (0.074)	0.019 (0.033)	–0.023 (0.052)
Size	–0.646 (1.620)	–9.499*** (2.833)	–7.789** (4.188)	3.986*** (1.216)	2.935*** (0.678)	2.360** (1.044)
GDP	–0.147 (0.249)	–0.487* (0.295)	–0.601 (0.429)	0.306 (0.300)	0.264* (0.144)	0.506 (0.446)
SDG Index	0.363 (0.406)	1.522* (0.779)	1.423 (1.134)	0.263 (0.414)	–0.067 (0.170)	–0.152 (0.228)
Intercept	–20.819*** (0.254)	–13.750*** (0.204)	–3.171*** (0.391)	–99.574*** (0.377)	–44.405*** (0.477)	–43.459*** (13.821)

Note: The results refer to the sample of 1050 total bank/year observations corresponding to 150 banks. The observation period is 2015–2021. ***, **, and * indicate statistical significance at the 1 %, 5 %, and 10 % levels, respectively. Standard errors are in parentheses.

Additionally, previous studies have shown that European banks tend to have larger boards with more women and independent members and generally better ESG disclosure than other regions (Gurolo & Lagasio, 2023). This trend is attributed to the strong emphasis on ESG themes and gender representation by European regulatory authorities. In particular, the US and EU clearly present different approaches to ESG disclosure and performance; the latter is more regulatory-driven with comprehensive and stringent regulations, while the former relies more on voluntary frameworks, with some federal and state-level regulation. By excluding US-based banks, we aim to mitigate the potential confounding effects of differing regulatory environments and governance practices.

Table 7 presents the results considering greenwashing as the starting status. When excluding US banks (Models 1 to 3), we found consistent support for the positive impact of the interaction between female CEOs and at least 30 % of female board members ($p < 0.05$). The significance of business model variables decreased in particular when both a female CEO and a critical mass are present (Models 2 and 3, Table 7), highlighting the relevance of gender diversity factors in supporting transition. Otherwise, when excluding EU banks (Models 4 to 6, Table 7), the interaction effect between female CEOs and female board members remains positive and significant ($p < 0.05$), with female CEOs exerting a positive influence ($p < 0.05$). Regarding the impact of banks' business model,

excluding EU countries, investment banks are more likely to transition to a vocal green status compared to universal and retail banks, but only when gender diversity variables were considered ($p < 0.05$, Model 6). A comparative analysis between the two samples, excluding the US and the EU, also pinpoints the different role exerted by internal factors in promoting the vocal green transition. In the EU, gender diversity emerged as the primary driver, whereas in the US, both business model and gender diversity played significant roles.

Table 8 shows the parameters for the transition from greenhushing to vocal green banks. The results for non-US (Models 1 to 3) and non-European (Models 4 to 6) banks confirmed our previous results about gender diversity. Specifically, the presence of a female CEO (Model 2, $p < 0.05$) and a critical mass of female board members (Model 3, $p < 0.05$) has a negative effect on the transition from greenhushing to vocal green, indicating a more conservative approach.

Regarding business models, when considering all gender diversity variables, non-EU investment banks are more likely to transition from greenhushing toward a vocal green stance compared to universal banks ($p < 0.05$, Model 6, Table 8). Conversely, when excluding US banks, universal banks are more inclined to adopt a vocal green position than retail and investment banks ($p < 0.05$, Models 1 to 3, Table 8). This difference can be attributed to the distinct business models prevalent in the US and EU banking sectors. Investment banks are mainly of US origin and specialise in capital markets and advisory services, often leading to a more pronounced emphasis on short-term financial performance. This model may drive investment banks to adopt vocal green strategies as a means to align with investment preferences and expectations. In contrast, EU universal banks typically operate under an integrated banking model, encompassing retail, corporate, and investment banking services. Thus, the contrasting results about business models reflect different banking environments in the US and EU that contribute to the observed differences in how banks from these regions approach the integration of sustainability issues into their strategic frameworks.

Interestingly, the impact of ESG bonuses in both Tables 7 and 8 differed between the two regions: while they reduced the likelihood of transitioning from greenwashing in the US, they had a positive effect in the EU ($p < 0.05$). These findings underscore the importance of considering cultural and regulatory contexts when designing corporate governance mechanisms to promote the alignment between environmental performance and disclosure.

As a second robustness test, we change the way in which we calculate our dependent variables to mitigate the arbitrary sensitivity to sample composition. Following the approach of Testa et al. (2018), we compute an alternative categorisation of banks' environmental alignment status based on the gap between environmental disclosure and performance. Specifically, when the difference between disclosure and performance scores is positive, we classify banks as Greenwashers if they fall within the top 75th percentile of the positive-gap distribution. Those below the 75th percentile are categorised as 'Silent Brown'. Conversely, when the disclosure-performance gap is negative, we identify banks as Greenhushers if they fall within the bottom 25th percentile of the negative-gap distribution, and as Vocal Green otherwise. Subsequently, we re-estimate our baseline models with the new categorisation as a robustness test.

Results, which are reported in Table 9, support our hypotheses and corroborate the main findings of the study. In particular, gender diversity positively influences the transition from greenwashing to a genuine green stance, especially when a female CEO leads a board with at least 30 % female representation (Model 3). However, the same gender composition reduces the likelihood of shifting from greenhushing to vocal green, indicating a more risk-averse and conservative approach (Model 6). Additionally, from greenwashing status, banks' business models do not contribute to the transition to the vocal green stance (Model 3), while from greenhushing investment-oriented banks are more likely to adopt vocal green practices than retail or universal banks (Model 6).

4.2. Additional analysis

Since greenhushing is also an endpoint for 27 % of the banks in our sample, Table 10 reports the factors that affect this transition. Starting from a greenwashing position, we find that female board representation (Model 1) and the combination of a critical mass of women with a female CEO (Model 3) positively affect the likelihood of transitioning to greenhushing ($p < 0.05$). These findings are consistent with the factors driving the transition to a vocal green status from greenwashing (Table 6), suggesting that gender diversity can positively influence strategic shifts that reduce environmental overstatement and enhance transparency.

For banks starting from a silent brown position, characterised by both low performance and disclosure (Models 4–6), the presence of a female CEO and at least 30 % female board representation significantly increases the likelihood of transitioning to greenhushing ($p < 0.05$, Models 5 and 6). Female CEOs seem more effective at improving environmental performance rather than disclosure. Moreover, the likelihood of transition is lower for retail and universal banks than investment banks, aligning with previous results.

Finally, we conducted a survival analysis by modifying our dependent variable as an additional analysis. Survival analysis (Miller, 1997) is a branch of statistics used to predict the time until an event of interest occurs. Key components of survival analysis include the survival function, which represents the probability that the event has not occurred by a certain time, and the hazard function, which describes the instantaneous rate at which the event occurs, given that it has not yet happened. We used the Kaplan-Meier estimator (Kaplan & Meier, 1958) to estimate the survival function.

In our analysis, we applied this method to group banks based on whether their board composition includes over 30 % female representation (critical mass) and according to their business model. The dependent variable is a binary indicator set to 1 if the bank transitions to and remains in a vocal green status. This approach allows us to understand how the probability of remaining non-vocal green changes over time across different groups of banks.

From Fig. 2 – Panel A, we observe that retail banks exhibit a slower decline in the probability of remaining non-vocal green over time compared to other business models. Similarly, Panel B shows that banks without a board composed of more than 30 % women also experience a slower transition rate. This underscores the significant influence that a higher percentage of women on the board has on

accelerating the shift to vocal green practices. The 30 % female representation threshold proves critical in promoting the adoption of vocal green strategies. Furthermore, the analysis indicates that retail banks shift from non-vocal green to vocal green status more gradually than other bank types.

5. Discussion and implications

This work aims to identify the internal characteristics of banks that affect the likelihood of transitioning from greewasher and greenhusher banks to vocal green ones. Specifically, it investigates whether board gender diversity, female CEO, and the bank's business model affect this transition. The analysis was developed on an international sample of 150 banks between 2015 and 2021, encompassing 1050 total bank/year observations. This time frame included significant global and regulatory initiatives (i.e., SDGs as part of the UN2030 Agenda for Sustainable Development, the Paris Agreement, and EU Directive 2014/95/EU), which were expected to push banks toward better alignment between environmental disclosure and performance (i.e., vocal green status). We applied Latent Markov models to identify the parameters affecting transition probabilities to vocal green banks from different initial statuses.

The results show that governance characteristics impact the likelihood of transitioning to a vocal green stance differently, depending on the initial status. For transitions from greenwashing to a vocal green stance, a high percentage of women on the board positively influences this shift (supporting Hp1a), as does the presence of a female CEO combined with at least 30 % female board representation (critical mass, supporting Hp3a). However, having a female CEO alone negatively affects the transition likelihood (not supporting Hp2a), highlighting the challenges female CEOs face in driving strategic change in a male-dominated corporate context. These results underscore that significant strategic shifts require a combination of gender representation in leadership and governance roles, supporting the critical mass theory and similarity effect (Birindelli et al., 2020; Glass & Cook, 2018; Venturelli, Pedrazzoli, Pennetta, & De Novellis, 2024). Conversely, when starting from a greenhushing status, having a female CEO and a board with more than 30 % female representation decreases the likelihood of transitioning to a vocal green status, revealing a more risk-averse and conservative approach (Hp1b, Hp2b and Hp3b not supported). These results suggest that gender diversity tends to have a positive effect, mainly when the transition involves reducing overstatements in environmental communication (i.e., greenwashing). Female CEOs effectively improve environmental performance when banks are in a "brown" status, confirming previous studies highlighting high ESG performances in female-led companies (Ali, Azmi, Kowsalya, & Rizvi, 2023). However, female-led banks tend to adopt more conservative, low-risk strategies (Palvia et al., 2015), which may explain their tendency toward greenhushing. Other governance factors, such as ESG incentives and board size, influence the transition, with ESG incentives being particularly impactful. To increase the likelihood of transitioning from greenwashing, ESG incentives must be aligned with the specific cultural context of the bank.

Furthermore, regarding banks' business models, investment-oriented banks are more likely than universal banks to transition to a vocal green stance when starting from a greenhushing position, thereby confirming Hp4b. Conversely, when greenwashing is the initial status and all board gender diversity characteristics are considered, the role of business models is not significant, thus not supporting Hp4a. In particular, when transitioning from greenwashing, non-US-based banks show a significant influence of board gender diversity, whereas non-EU-based banks show a dual impact from both business model and gender diversity. Conversely, when transitioning from greenhushing, the business model of banks emerges as a relevant factor across all countries studied.

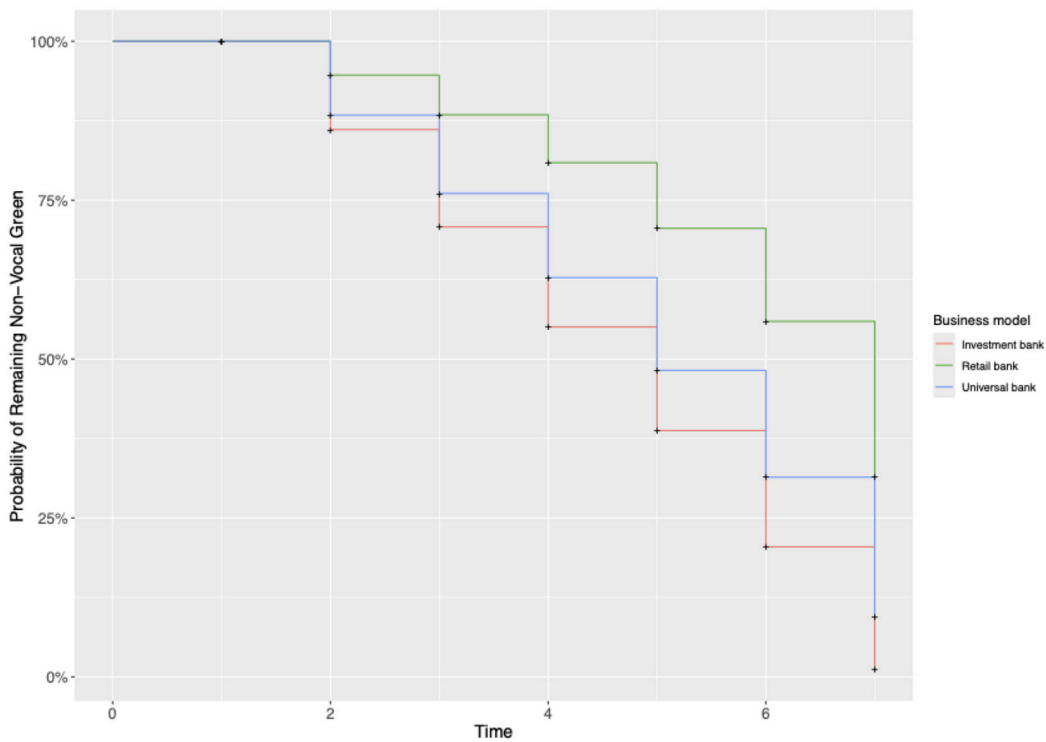
This evidence raises a broader question about the nature of these transitions: Are banks proactively aligning with long-term sustainability goals, or are they merely reacting to regulatory and reputational pressures? While our study does not directly disentangle whether transitions to vocal green status are driven by proactive strategies or reactive responses, several findings offer indirect evidence. The significant role of business models and governance characteristics, particularly gender diversity, suggests that internal strategic factors, such as leadership style and stakeholder orientation, play a crucial role. For instance, investment-oriented banks are more likely to transition to vocal green, which may indicate a deliberate, proactive alignment with the long-term expectations of institutional investors, who are typically more attentive to ESG commitments. However, such alignment may also reflect a strategic response to external pressure, making it difficult to clearly distinguish between proactive and reactive motivations. In contrast, greenhushing behaviours, especially among female-led banks, appear to reflect a more cautious, risk-averse stance, possibly rooted in reputational concerns and regulatory uncertainty, which suggests a more reactive approach. Overall, our findings suggest a heterogeneous landscape in which both strategic orientation and external pressures shape green transitions. A more definitive understanding of proactive versus reactive drivers will likely require complementary qualitative research capable of capturing banks' internal decision-making processes and strategic narratives.

5.1. Literature and managerial contribution

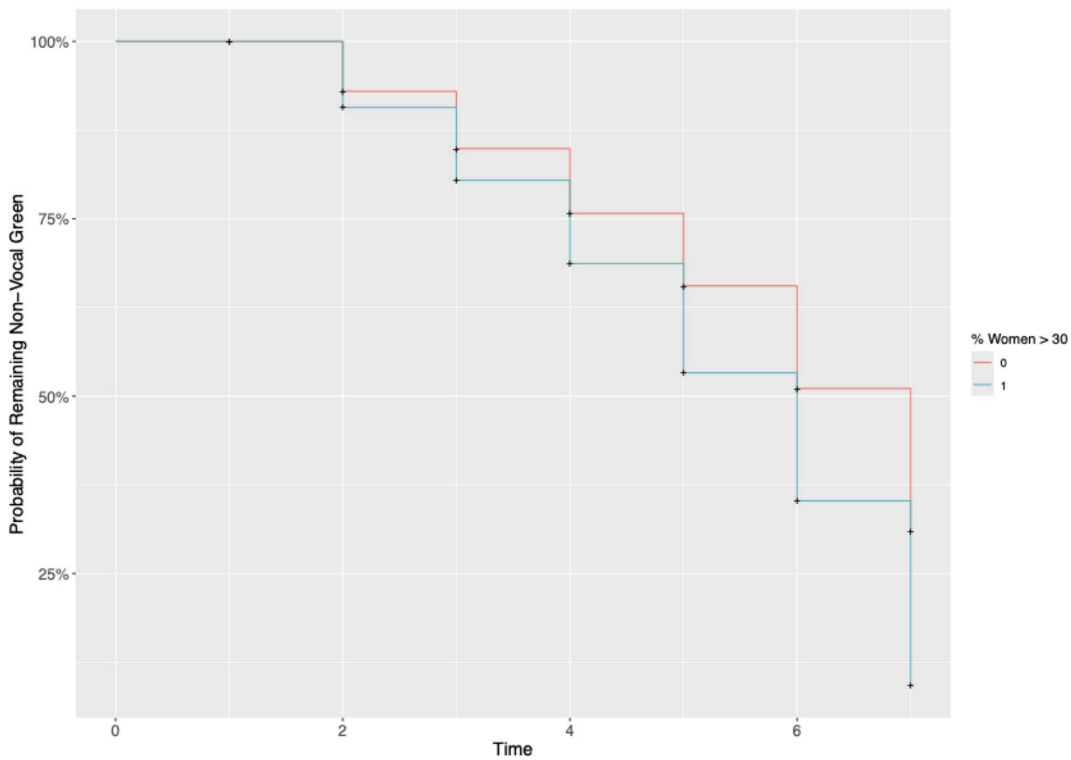
Overall, our paper contributes to several research streams. First, it contributes to the emerging research stream on greenwashing and greenhushing in the banking sector (Huang et al., 2022; Khalil & O'sullivan, 2017; Venturelli, Pedrazzoli, Pennetta, & De Novellis, 2024; Venturelli, Pedrazzoli, Pennetta, & Gualandri, 2024) by providing a dynamic view of the phenomenon and identifying different initial statuses that influence transitions. Internal elements contributing to the transition from greenwashing status to the vocal green ones pinpoint the strategic role of board composition and bank business models in achieving alignment between environmental performance and disclosure.

Second, it contributes to the research stream on female leadership and gender diversity in fostering ethical behaviour (Birindelli et al., 2024) and driving corporate environmental change. Female CEOs are considered change agents in corporate governance literature (Hobbins, Kristiansen, & Carlström, 2023; Javed et al., 2023). Our results indicate that board diversity and female leadership foster environmental strategic change toward vocal green status, in particular when addressing environmental issues overstatement.

Panel A – Business Model



Panel B – Critical Mass



(caption on next page)

Fig. 2. Probability of remaining non-vocal green over time, by business model (Panel A). by critical mass (Panel B). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Companies with gender-diverse leadership teams are more effective at pursuing environmentally friendly performance (Glass & Cook, 2018) and, when combined with a female CEO, tend to promote proactive environmental approaches. However, female-led banks face challenges in improving environmental communication levels due to their tendency to be more risk-averse and conservative, contributing to greenwashing behaviour (Cheng et al., 2024; Falchi et al., 2022).

Finally, the study sheds more light on the literature exploring the relationship between banks' business models and ESG performance (Ielasi et al., 2023, Palmieri et al., 2024). The study suggests that banks' business models significantly influence a successful transition toward green banking. Policymakers and regulators should develop and implement guidelines, policies, and incentives to stimulate retail and universal banks, primarily engaged in traditional credit intermediation activities, to transition toward green banking. For example, in April 2024, the Financial Conduct Authority (FCA) introduced guidance on anti-greenwashing rules to identify misleading sustainability-related claims about products or services. Additionally, the European Supervisory Authorities (EBA, EIOPA, and ESMA – ESAs) established communication standards in the “EU Green Claims Directive”, including a ban on general claims like “climate neutral” and the requirement for evidence to sustainability-related claims. These measures aim to promote the provision of green financial products and services through environmentally friendly distribution channels and with dedicated evaluation and pricing models, while fostering banks' commitment to transparent and truthful environmental disclosure. Moreover, our results underscore the importance of incorporating sustainability issues into the bank's business model analysis, which is gaining importance in the supervisory frameworks. These recommendations are particularly relevant given the pivotal role that credit intermediation plays in promoting sustainable behaviour among financed individuals and companies, thereby underpinning sustainability goals.

Managerial implications should also be drawn from our results. Regardless of the level of alignment between environmental disclosure and performance, banks must establish a robust ESG governance framework to set clear goals and develop effective communication strategies. Within this framework, creating a supportive environment that empowers female leaders to initiate environmental strategic changes is essential, ensuring a diverse board backs them to maximise effectiveness. This approach could strengthen the transition from greenwashing to green banking. Banks could also implement educational programs to promote this transition from other statuses, including greenwashing, to ensure accurate and aligned ESG disclosure and performance. Overall, an effective ESG governance framework enhances stakeholder trust and engagement and helps reduce reputational risk.

Policymakers, in turn, should consider that mandates or guidelines on gender quotas could promote the transition toward green banking. Moreover, differentiated policy guidelines tailored to banking business models (investment, retail, universal) could encourage sector-appropriate green transitions.

These considerations open up several avenues for future research. One potential direction is to extend the observation period beyond 2015–2021 to include recent regulatory changes related to greenwashing and greenhushing. Moreover, future research could aim to explicitly distinguish between strategic (proactive) and compliance-driven (reactive) motivations for green transitions, and to distinguish between greenwashing from genuine lack of ESG disclosure and performance. To effectively explore these phenomena, future studies should adopt in-depth qualitative analyses or mixed-methods approaches to capture banks' managers' intentions and investors/stakeholders' perceptions. In addition, although our analysis does not explicitly include variables related to external audits or third-party certifications, our findings are consistent with the idea that banks respond to institutional pressure and stakeholder expectations regarding transparency. The observed transition toward vocal green strategies may, at least in part, reflect the influence of such verification mechanisms, as highlighted by Galletta et al. (2024). For this reason, future research could explore how different green transition trajectories—such as those from greenwashing or greenhushing to vocal green—affect stakeholders' perceptions and trust. This is particularly relevant given the growing evidence that greenwashing can significantly undermine consumer trust (Galletta et al., 2024), highlighting the reputational risks associated with misalignment between disclosure and performance. Furthermore, this study is a starting point for further financial research into phenomena requiring a more in-depth analysis of underlying processes and transitions between different states over time.

CRediT authorship contribution statement

Gennaro De Novellis: Visualization, Software, Methodology. **Alessia Pedrazzoli:** Writing – original draft, Data curation, Conceptualization. **Daniela Pennetta:** Writing – original draft, Investigation, Data curation. **Valeria Venturelli:** Writing – original draft, Supervision, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors have no conflicts of interest to declare. All co-authors have seen and agree with the manuscript's contents, and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Appendix A

A.1. Cluster analysis

In this Appendix, we provide a detailed description of the cluster analysis carried out to identify the business model adopted by the banks in our sample. The analysis was performed in the RStudio environment following these steps:

1. Computation of banks’ average economic and financial characteristics over the period 2015–2021. The selected characteristics are: i) net fees over operating income, ii) net trading income over operating income, iii) net loans and advances to customers over total assets, iv) customer deposits over total assets, v) interbank assets over total assets, vi) securities over total assets, and vii) derivatives over total assets (Lagasio & Quaranta, 2022; Nucera et al., 2017; Palmieri et al., 2024).
2. Assessment of the best agglomerative clustering algorithm by selecting the one with the agglomerative coefficient closest to 1 (indicating the strongest clustering structure). We compared four algorithms: i) average linkage, ii) single linkage, iii) complete linkage, and iv) Ward’s minimum variance method. The obtained agglomerative coefficients were, 0.872, 0.799, 0.906 and 0.958 respectively. Hence, we selected Ward’s method as the appropriate agglomerative clustering algorithm.
3. Computation of the dissimilarity matrix based on Manhattan distance, which is known to be less sensitive to outliers compared to other distance metrics, such as Euclidean distance. Manhattan distance is computed as the sum of absolute distances:

$$d_{\text{man}}(x, y) = \sum_{i=1}^n |x_i - y_i|$$

where x and y are two vectors of length n , and $d_{\text{man}}(x, y)$ is the distance between them.

4. Identification and validation of the optimal number of clusters. First, we checked the optimal number of clusters according to the Elbow method. As shown in Fig. A1, the optimal number of clusters ranges between 3 and 4.

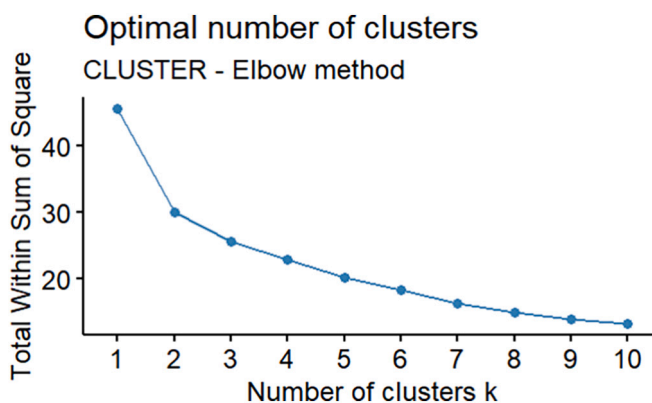


Fig. A1. Elbow method and optimal number of clusters.

However, for the sake of a thorough analysis, we also considered numerous validation indexes and methods (26 in total) with the support of the NBClust package, as shown in in Table A1. Specifically, 10 indices indicated 3 as the optimal number of clusters, 5 indices suggested 4 clusters, 3 indices pointed to 5 clusters, and finally, 7 indices recommended 6 clusters. Following the majority rule, we selected 3 as the optimal number of clusters for our analysis.

Table A1
Optimal number of clusters: comparison of different tests and metrics.

Index	Optimal number of clusters
Krzanowski and Lai Index	6
Calinski and Harabasz Index	3
Hartigan Index	6
Sarle Index	3
Scott and Symons Index	4
Marriot Index	4

(continued on next page)

Table A1 (continued)

Index	Optimal number of clusters
Milligan and Cooper Index 1	6
Milligan and Cooper Index 2	5
Friedman and Rubin Index 1	6
Friedman and Rubin Index 2	5
Hubert and Levin Index	6
Davis and Bouldin Index	6
Silhouette Index	3
Duda and Hart Index 1	3
Duda and Hart Index 2	3
Beale Index	3
Ratowski and Lance Index	3
Ball and Hall Index	4
Milligan Index	4
Frey and Van Groenewoud Index	2
McClain and Rao Index	3
Dunn Index	3
Hubert and Arabie Method	5
Halkidi Index	4
Lebart Method	3
Halkidi and Vazirgiannis Index	6

A.2. Variable description

Variable	Description	Source
E_Alignment	The difference between Bloomberg's environmental disclosure and Refinitiv Eikon's environmental performance	Bloomberg Refinitiv Eikon
Fem. CEO (d)	The dummy variable equals 1 if there is a female CEO and 0 otherwise	Bloomberg
%Women Board	The percentage of women on the board	Bloomberg
Critical Mass	The dummy variable equals 1 if the board has at least 30 % women, and 0 otherwise	Bloomberg
Board size	The logarithm of the number of board members	Bloomberg
%Indip. Direct	The percentage of independent directors on the board	Bloomberg
ESG Bonus (d)	The dummy variable equals 1 if the bank sets up executive remuneration linked to ESG targets and 0 otherwise	Bloomberg
Size	The logarithm of the bank's total assets in US\$	Bloomberg
GDP	The yearly GDP growth rate	World Bank Dataset
SDG Index	Country SDG performance	World Bank Dataset
Net fees/Operating revenue	The value of net fees over operating revenue	Bank Focus
Net trading income/Operating income	The value of net trading income over operating income	Bank Focus
Net loans and advances to customers/ Total assets	The value of net loans and advances to customers over total assets	Bank Focus
Customer deposits/Total assets	The value of customers' deposits over total assets	Bank Focus
Interbank assets/Total assets	The value of interbank assets over total assets	Bank Focus
Securities/Total assets	The value of securities over total assets	Bank Focus
Derivatives/Total assets	The value of derivatives over total assets	Bank Focus

A.3. Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
E_Alignment (1)	1										
%Women Board (2)	0.286*	1									
Fem. CEO (3)	0.04	0.118*	1								
Critical mass (4)	0.108*	0.223*	0.691*	1							
Business model (5)	-0.008	0.028	0.070	0.017	1						
Board size (6)	0.134*	0.207*	0	-0.004	0.235*	1					
ESG Bonus (7)	0.191*	0.304*	-0.051	-0.015	0.056	0.117*	1				
%Indip. Direct (8)	-0.042	0.351*	-0.059	0.022	0.023	0.051	0.226*	1			
Size (9)	0.565*	0.353*	-0.01	0.056	0.191*	0.341*	0.382*	-0.017	1		
GDP (10)	-0.056	-0.100*	-0.015	-0.041	0.061	-0.054	-0.031	-0.120*	-0.024	1	
SDG Index (11)	0.230*	0.546*	0.145*	0.148*	-0.044	0.192*	0.179*	0.319*	0.315*	-0.079	1

Note(s): * for 5 % significance level.

A.4. Number of banks per country

Country	N. banks	N. obs.	%
Australia	4	28	2.67 %
Austria	2	14	1.33 %
Brazil	2	14	1.33 %
Canada	8	56	5.33 %
China	6	42	4.00 %
Colombia	3	21	2.00 %
Denmark	2	14	1.33 %
France	3	21	2.00 %
Germany	1	7	0.67 %
Greece	3	21	2.00 %
Hungary	1	7	0.67 %
Indonesia	8	56	5.33 %
Israel	3	21	2.00 %
Italy	6	42	4.00 %
Japan	3	21	2.00 %
Malaysia	6	42	4.00 %
Mexico	2	14	1.33 %
Netherland	2	14	1.33 %
Norway	2	14	1.33 %
Oman	1	7	0.67 %
Peru	1	7	0.67 %
Philippines	6	42	4.00 %
Poland	4	28	2.67 %
Portugal	1	7	0.67 %
Republic of Korea	2	14	1.33 %
Saudi Arabia	3	21	2.00 %
Singapore	2	14	1.33 %
South Africa	3	21	2.00 %
Spain	5	35	3.33 %
Sweden	4	28	2.67 %
Switzerland	1	7	0.67 %
Thailand	4	28	2.67 %
Turkey	4	28	2.67 %
UK	6	42	4.00 %
USA	36	252	24.00 %
Total	150	1050	100 %

Data availability

Data will be made available on request.

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