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Women on boards and corporate environmental performance in Italian companies: The importance of nomination background

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Abstract

The relationship between women on boards and corporate environmental performance is puzzling because of the inconclusiveness of previous research. We study this association in light of the homophily and self-construct theories. Based on data on Italian FTSE-MIB companies from 2008 to 2017, we investigate how the significance of women directors in enhancing environmental performance varies with the nature of their nomination background. To understand the mechanisms behind the role of women on boards in environmental performance, we differentiate women according to their nomination background (family vs. non-family). Our panel regression results document that, upon reaching a threshold of three women on boards (the so-called critical mass), family women directors affect negatively corporate environmental performance. Breaking down the environmental performance powered by subsequential companies' actions into (1) firm environmental technology use, (2) firm resource use efficiency, and (3) corporate emission reduction, we also provide evidence for the negative effect of family women directors. This may suggest that family women directors do not reveal their communal characteristics; thus, they are not as sensitive to environmental issues as non-family women directors.

KEYWORDS
corporate governance, emission reduction, environmental performance, family women directors, green technology, women on boards

1 | INTRODUCTION

In recent years, environmental protection and the green revolution have been at the top of the political agenda of many countries, especially those with female leaders. In Europe, for example, Ursula von Leiden and Christina Lagard are determined to pursue the green transition to meet the climate change mitigation goals. In the United States, in an interview with *Forbes* magazine, U.S. Representative Barbara Lee said, "Women understand the importance of compassion, communication and reason. They bring a perspective and a voice that is too often overlooked and underrepresented, and yet they continue to unabashedly advocate for their families, communities and countries" (Zalis, 2020). This stylized evidence has reheated the debate on the importance of female traits in defining the future for businesses, especially with regard to the environmental agenda. Policy makers' increasing attention to better protection of

the environment has pushed firms to adopt sustainable strategies at the firm level (De Masi, Słomka-Gołębiowska, Becagli, et al., 2021; Madsen & Ulhøi, 2021). In this context, women on boards may play a significant role in shaping strategic corporate decisions (Farag & Mallin, 2018) related to environmental targets in the upper echelons.

Prior research shows that women directors care about the environment (Ben-Amar et al., 2017; Bhuiyan et al., 2021; Chams & García-Blandon, 2019; Hollindale et al., 2019; Zaid et al., 2020; Zaman et al., 2022). Liao et al. (2015) suggest that women directors are more concerned with environmental issues than their male counterparts are. The female representation on boards has increased considerably due to the implementation of the board quota law in most of the European Union countries (Hoobler et al., 2018; Seierstad et al., 2017; Terjesen & Sealy, 2016). One of the European countries that has introduced a gender board quota is Italy. Starting from very low female board representation, Italian public companies achieved one of the largest proportions of women on boards in Europe in 2015 (European Commission, 2019). Italy introduced the gender quota law for listed companies in 2011, and it has been binding since 2012. Before 2012, the majority of listed companies had no women on their corporate boards. Since 2012, every listed company has had to reach the intermediate threshold of 20% of women directors on the board for the first post-law board term and then 33% for subsequent board terms (Seierstad et al., 2017). The law has been effectively enforced as the sanctions for non-compliance are severe, and all listed companies have complied with this new board requirement. Reaching the critical mass of women on boards has been seen as the main political argument in favor of introducing gender-based quota regulations for boards. This increase in the number of women on boards gives us a perfect context in which to test the effect of the critical mass of women on corporate environmental performance and the role of women's nomination background.

The gender board quota is expected to exert a positive impact on corporate environmental performance, which is usually stressed by women directors (Ben-Amar et al., 2017; Francoeur et al., 2019). Prior studies, which remain scarce, focus on the relationship between women on boards and corporate environmental performance (Ben-Amar et al., 2017; Li et al., 2017; Liao et al., 2015). This is arguably an incomplete context as the research published so far does not analyze the effect of the background nomination of women on boards and its effect on the relationship between women on boards and corporate environmental performance. Women appointed to the board due to the gender board quota enforcement in Italy are typically non-family women directors (Ferrari et al., 2021; Rigolini & Huse, 2021). Previous studies on family business report that women on boards influence corporate social responsibility, which includes environmental protection, to a lesser extent in family firms than in non-family firms (Campopiano et al., 2019; Nadeem, Gyapong, et al., 2020; Rodríguez-Ariza et al., 2017). This suggests that women might not be considered a homogeneous group. It is interesting to test the relationship between women on boards and environmental corporate performance in the context of the Italian economy as it contains many family-owned companies (Canavati, 2018; Scafarto et al., 2020; Veltri et al., 2021).

Hence, our research question focuses on whether the significance of the role played by women on boards in enhancing corporate environmental performance could vary according to the nature of their nomination background. Specifically, we investigate whether the family nomination background is a moderating factor in the association between women on boards and corporate environmental performance. In this vein, we distinguish between family women directors and non-family women directors, depending on whether women belong to the family controlling shareholders.

Sociological theories offer two alternative explanations for the effect of family women directors on corporate environmental performance. The first explanation, employing the homophily theory, shows that family women directors associate themselves with other women based on gender characteristics. Thus, in line with empirical research on the critical mass of women on boards (at least three women; for details, see De Masi, Słomka-Gołębiowska, Becagli, et al., 2021; Dobija et al., 2021; Kinateder et al., 2021), they tend to collaborate with other women and create allies when they make up a sufficient number on the board (Birindelli et al., 2019; Cook & Glass, 2017). The alternative explanation is based on self-construal theory (Markus & Kitayama, 1991), which argues that women have interdependent self-construal and their motivation to act is the need to fulfill their roles within certain important relationships (Campopiano et al., 2019; Cross et al., 2011; Peake et al., 2017). This suggests that family women directors are interdependent with their family and might prioritize their family's interests over stakeholders' interests.

Our research question was empirically tested by analyzing a sample of FTSE-MIB Italian companies and compiling information from 2008 to 2017. The regulation in Italy on the gender board quota, which requires at least 33% of board members to be women, provides a quasi-natural experimental setting in which to investigate the effects of adding non-family female directors on environmental performance. Our findings are in line with the scarce studies showing that there is a significant relationship between the critical mass of women and the corporate environmental performance. However, interestingly, we find evidence that, upon reaching a threshold of three women on boards (the so-called critical mass), family women directors affect environmental corporate performance negatively. Breaking down the environmental performance powered by sequenced companies' actions into: (1) firm environmental technology use, (2) firm resource use efficiency, and (3) corporate emission reduction, we also document negative effects of family female directors. This may suggest that family women directors do not reveal their communal characteristics and thus are not as sensitive to environmental issues as non-family women directors. This contrasts with the gender diversity literature, which asserts that women on boards are a homogeneous group. We show that the role played by women on boards could vary according to the nature of their nomination background.

Our contributions are the following. First, our research extends the corporate governance and gender diversity literature by proving that women on boards are not a homogeneous group. Most of the previous studies test the effect of women on boards on specific outcomes, taking it for granted that all women on boards behave in similar ways and are driven by similar motives. We move the discussion about gender diversity forward, looking beyond the numerical female representation on boards (Pucheta-Martínez et al., 2019; Terjesen & Sealy, 2016). The introduction of gender quota laws increased the number of women on boards. It also helped women who were not affiliated to the family founder to be appointed as board members and to be part of the decision-making elite. These new female directors might have a different attitude from family female directors. They might be motivated by a need for recognition and visibility (Rigolini & Huse, 2021), which will help them to be appointed to other boards. Driving a company towards green and more sustainable behavior might give them more visibility. Differentiating women according to their nomination background might bring clarity to the inconclusive debate about women on boards, gender quotas, and financial as well as non-financial performance (Kinateder et al., 2021; Nguyen et al., 2020).

Second, we increase the understanding of the role of women directors in influencing corporate environmental performance. Studies on this topic are still rare as most studies investigate the relationship between women on boards and corporate social responsibility (for details, see the literature reviews by Nguyen et al., 2020; Zaman et al., 2022). We add to the scarce literature identifying the moderating effect that explains the relationship between women on boards and sustainability (Pucheta-Martínez et al., 2016). Focusing on the environmental dimension, we offer a more granular definition of environmental corporate performance. We provide different subsequential actions that should be considered separately since they make different contributions to the aggregate level of environmental corporate performance.

Third, by showing the moderating effect of family women directors, we also contribute to the family business literature, advancing the debate on the role of family women directors (Cordeiro et al., 2020; McGuinness, 2018). Most of the literature about family women directors concentrates on the involvement of women in family firms. This stream of research focuses on the difficulties that women face when joining their family firm, the lack of recognition for their work, their leadership style, and their career development (Campopiano et al., 2017). Very few papers analyze the difference between family and non-family women. We aim to expand this literature, providing new directions for future research in this field.

The structure of this paper is as follows. We start by reviewing the previous studies on women on boards and environmental performance. Then, we present our theoretical perspective and the development of the hypotheses. After the description of the methodology and the results, we discuss the results and conclude by proposing directions for future research.

2 | LITERATURE REVIEW, THEORETICAL FRAMEWORK, AND HYPOTHESIS DEVELOPMENT

There is a prominent and rapidly growing literature focusing on corporate environmental performance and the identification of its ascendants and moderators. Environmental performance is the result of the implementation of a series of environmentally sustainable actions that have attracted limited attention from empirical studies (Brahmana & Kontesa, 2021; Liao et al., 2015). One of the first actions that may lead to successful environmental performance is the adoption of environmental technologies. This refers to the introduction of investments aimed at reducing environmental costs, ensuring clean production, and protecting the environment. The second action involves the implementation of measures aimed at reducing the use of materials, energy, or water. This action is crucial for mitigating the environmental impact of corporate activities, but it is also important for increasing the operating efficiency of a company (Atif et al., 2020). The adoption of these initiatives relating to more efficient use of resources is connected to the reduction of corporate pollutant emissions, which is the third action (Gallego-Alvarez et al., 2015; Haque, 2017). For example, Dieste et al. (2019) and Moreno and García-Álvarez (2018) find that resource-efficient technologies are important for reducing emissions. The extent to which a company implements these environmental actions is typically a decision made by the board (Bhuiyan et al., 2021; Chams & García-Blandon, 2019; Francoeur et al., 2019; Rodríguez-Ariza et al., 2017).

The introduction of these innovative strategies and actions is related to the attitudes and the styles of the decision makers (Wang, Farag, et al., 2021). An increasing literature analyzes whether the board composition, in particular women on boards, affects companies' environmental performance. These studies are based on the socialization theories, reasoning that women's attributes might influence the corporate environmental performance (Ben-Amar et al., 2017). Firstly, women possess *communal characteristics* that make them more prone to focus on long-term outcomes, relationship building, and stakeholders' interests (Alonso-Almeida et al., 2017; Jain & Zaman, 2020). Because of their attention to the needs of others, women are more likely to work actively to push the board to adopt environmentally sustainable actions (Glass et al., 2016). Secondly, women are more likely to have a non-business background or hold environment-related positions (De Masi, Słomka-Gołębiowska, & Paci, 2021). Liao et al. (2015) document that women on boards are likely to be assigned to and accept roles that deal with environmental protection. Afzali et al. (2022), Farag and Mallin (2016), and Hollindale et al. (2019) confirm that women directors provide human capital that helps the board to understand their stakeholders' ethical, environmental, and social demands better. This suggests that female directors introduce a perspective and resources that make the board sensible to environmental and social issues.

Studies on gender diversity document that these positive benefits of women are exploited by the board when there are at least three female members, building on the critical mass theory (Birindelli

et al., 2019; De Masi, Słomka-Gołębiowska, Becagli, et al., 2021; Dobija et al., 2021; Farag & Mallin, 2017). Specifically, previous studies document that the mere presence of woman on boards is not enough to influence board decisions effectively (Schwartz-Ziv, 2017). When a board contains a solo woman, she is not able to create an impact since she can easily be marginalized and considered as a token. When there are two women on a board, they may feel more included and comfortable, but they still may not be able to ally and exert an impact on the board's decisions. This phenomenon of having only two women on boards is called "twokenism" (Chang et al., 2019; You, 2021). It is explained theoretically by Loyd et al. (2008), who argue that two women do not form a critical mass. The status of being one of two women might be even more stressful and isolating than that of being a single woman. This is because two women not only face negative pressure from members of a majority group (men) but also experience pressure to provide one another with social support. The total pressure (from the majority group on one side and from the other woman on the other side) decreases as the group of women increases in size (You, 2021). When the number of women reaches three, they become able to affect the board's decisions. Asch's conformity experiments (Asch, 1951) and empirical research on the context of boards (De Masi, Słomka-Gołębiowska, & Paci, 2021; Kinateder et al., 2021; Schwartz-Ziv, 2017; You, 2021) demonstrate that three people, compared with two people, influence the group outcomes because, when there are three women, they feel more confident about raising issues and voicing their opinions. They obtain trust and, hence, are able to influence board decisions (De Masi, Słomka-Gołębiowska, Becagli, et al., 2021; Dobija et al., 2021). This means that their different knowledge, experience, and values are more likely to be used by the board in an effort to satisfy stakeholders' needs (De Masi, Słomka-Gołębiowska, Becagli, et al., 2021; Pucheta-Martínez et al., 2016; Rao & Tilt, 2016). Studies about environmental disclosure confirm this argument, showing that women increase a company's responsiveness to environmental issues and foster actions that enhance corporate disclosure practices about environmental performance when they reach a minimum number of three (Amorelli & García-Sánchez, 2021; Ben-Amar et al., 2017; Cook & Glass, 2017).

Empirical studies investigating the effect of women on boards on environmental performance remain scarce (Nguyen et al., 2020). Moreover, inconclusive evidence calls for a deeper and more nuanced analysis to verify the prior results. Some studies show an insignificant relationship, proving that a greater percentage of female directors does not lead to more socially and environmentally responsible corporate behavior (Zhuang et al., 2018). Similarly, Zaid et al. (2020) report that women on boards are not significantly associated with the level of corporate sustainability performance. Other studies, instead, document that women on boards have an important role in driving corporate environmental sustainability (De Masi, Słomka-Gołębiowska, Becagli, et al., 2021; Kassinis et al., 2016). They show that women are associated with better environmental and sustainable practices implemented by a company (Atif et al., 2020; Chams & García-Blandon, 2019; Haque, 2017; Lu & Herremans, 2019). In addition, they demand more information on the firm's environmental activities (Hollindale et al., 2019; Liao et al., 2015).

To understand the mechanisms behind the role of women in environmental performance, we focus on their nomination background. The appointment of board members is decided by the shareholders (Holderness, 2003). Controlling shareholders, such as family owners, are very likely to appoint their daughter, their wife, or another member of their family (Nadeem, Gyapong, et al., 2020). Research on family businesses argues that family involvement in the board significantly affects corporate decisions, making family board members theoretically distinct from their non-family counterparts (Rodríguez-Ariza et al., 2017). Specifically, family members might have interests aimed at the preservation of the family's interests (Dal Maso et al., 2020). For instance, they might push the board to invest in projects that advance their personal preferences, such as gaining a personal reputation or expropriating the firm's resources through tunneling activities or excessive compensation. As a result, family women directors and non-family women directors might be motivated by different interests.

There is only scant research differentiating women according to their family affiliation. Distinguishing between family and non-family companies, Nadeem, Gyapong, et al. (2020) document that women on boards in family companies are less concerned about stakeholder value than women on boards in non-family companies. Rodríguez-Ariza et al. (2017) show that women on boards affect corporate social responsibility, which includes environmental protection, to a lesser extent in family firms than in non-family firms. Regarding the differences in the role of women directors in family firms, Cruz et al. (2019) find that female outside directors, who are outside directors who do not belong to the family, and family female inside directors, who are in the position of an executive director as well as being a family member, increase the sustainability ratings of the company. Studying the different dimensions of corporate social responsibility, Campopiano et al. (2019) demonstrate that female directors increase corporate social responsibility engagement only if they do not belong to the family of the controlling shareholder. They argue the importance of disentangling the role of women, focusing on their family membership. We build on this and consider the family membership of female directors as a significant driver of environmental performance.

To understand the different roles of women according to their nomination background, we use two theories: the homophily and self-construal theories. They present two alternative views on women on boards' approach to environmental performance. The first theory adopts the homophily perspective (Rogers & Bhowmik, 1970). This is a tendency of individuals to associate with similar others. The like-mindedness emerges in different characteristics, such as gender, age, educational background, or social status. This similarity facilitates communication, which creates greater consensus among similar people (Lau et al., 2008), suggesting that homophily may guide the choices of individuals. The literature also documents that homophily affects the formation of social ties. People create connections with others whom

they consider to be similar, instilling ex ante trustworthiness (McPherson et al., 2001) and cooperation (Rivera et al., 2010). Hence, homophily and social ties promote cooperation, cohesiveness, and commitment among similar people (Cook & Glass, 2017; Westphal & Milton, 2000). Research on similarity and trust in the context of boards of directors supports these arguments. The trust among the members is stronger when the similarity within the board is greater. Women on boards, feeling similar because of their gender, may ally with each other (Konrad et al., 2008). This suggests that homophily may affect the ability and willingness of women (both family members and non-family members) to influence board decisions related to the environment. Family female directors might be motivated by their *communal characteristics and their stakeholders' approach*, revealing their care about the firm's environmental performance. As a result, gender homophily within the board of directors will positively affect a firm's awareness of environmental issues.

The alternative view is provided by the self-construal theory. This theory concerns "how individuals define and make meaning of the self" (Cross et al., 2011, p. 143). Self-construal theory is relevant because it has implications for women's behavior, influencing their cognition, their emotions, their motivation, and their relationships. It suggests that women are different from men. Men have characteristics of independent self-construal, whereas women have features of interdependent self-construal (Cross & Madson, 1997). Specifically, interdependent self-construal means that women base their self-definition on their group memberships and relational connections (Cross et al., 2000). According to this theory, women's decisions are guided by their need to fulfill their roles within certain important relationships since their self-perception incorporates their social context (Cross et al., 2011). This means that family female directors, with their interdependent self-construal attributes, are motivated by their need to do well for their family, acting to nurture and care for the family relationships. Thus, family women directors may prioritize the family's interests over stakeholders' interests, seeking the maximization of the family's wealth. This argument is reinforced by House et al. (1999), who distinguish between societal collectivism and family collectivism. Family collectivism is defined as the "extent to which individuals express pride, loyalty and cohesiveness in their families." When family collectivism dominates societal collectivism, both men and women on boards may give preference to the in-group (family firm) as opposed to the out-group (non-family members). Taking care of the interests of the family and preserving the family engagement and identity (i.e., family employment, maintenance of family traditions, harmony, etc.), family female directors may be less concerned about environmental issues than non-family female directors. Environmental performance is the result of activities that imply costly investments and actions that might not produce immediate financial results or great visibility for the family owner (Dal Maso et al., 2020). Campopiano et al. (2019), Nadeem, Gyapong, et al. (2020), and Seaman (2017) show that family female directors are more oriented towards activities that offer great visibility for the family, such as corporate philanthropy, rather than corporate social responsibility activities. Based on the above discussion, we formulate our hypotheses as follows:

Hypothesis 1 *In boards that have three women or more, family female directors have a negative influence on environmental corporate performance.*

Hypothesis 1a *In boards that have three women or more, family female directors have a negative influence on firm environmental technology use.*

Hypothesis 1b *In boards that have three women or more, family female directors have a negative influence on firm resource use efficiency.*

Hypothesis 1c *In boards that have three women or more, family female directors have a negative influence on corporate emission reduction.*

3 | METHOD AND VARIABLES

3.1 | Sample

Our sample consists of all the FTSE-MIB companies over the years 2008–2017. The number of companies is 38 because two companies were excluded from the sample as they do not provide information on their ESG score. The choice of the context and the period is crucial for our research question. We use a quasi-natural experiment (Farag & Dickinson, 2020) created by the introduction of the gender quota law in Italy. The Italian regulation on the gender board quota, which requires that women account for 33% of a firm's board directors, provides an appropriate setting in which to investigate the effects of adding non-family women directors on environmental performance. The Italian economy, including the stock exchange, is known to be populated by many family-owned companies (Canavati, 2018; Scafarto et al., 2020; Veltri et al., 2021). Families control their company directly or indirectly, influencing its corporate decisions through the family members sitting on the board (Zattoni, 2020). The FTSE-MIB companies include both family- and non-family-owned firms, allowing us to test the difference between family women directors and non-family women directors. The choice of the research period (2008–2017) gives variability in the number of women on boards in the sample. Italy is one of the EU countries that has introduced a gender quota law for public companies to increase the female board representation. Before the introduction of that law (2012), the number of listed companies with women on their board was very limited. Most boards had no female directors, and very few boards reached the critical mass of three women. The few women on boards were connected with the families that owned and controlled the company, being the controlling shareholder herself or his wife or another close relative (Bianco et al., 2015). Severe sanctions for non-compliance have been enacted (De Masi, Słomka-Gołębiowska,

Becagli, et al., 2021). All the companies in our sample comply with this gender board quota legal requirement. The introduction of the gender board quota law forced companies to add women with different non-family backgrounds to their boards (Rigolini & Huse, 2021).

Our data about environmental and corporate governance variables were collected from the Refinitiv Eikon Thomson Reuters database. Specifically, this database offers information about corporate governance and environmental performance using corporate governance annual reports and other official company documents as primary sources. Data about family membership were hand collected from the corporate governance reports of each company.

3.2 | Model and variables

To test our hypotheses, we estimate the following regression model:

$$Env_{j,t} = \alpha_0 + \beta_1 CM_{j,t} + \beta_2 FAMILY\,WOMEN_{j,t} + \beta_2 CM^{*} FAMILY WOMEN_{j,t} + \beta_3 \left[\text{Control}\right]_{j,t} + \varepsilon_{j,t}$$

where j denotes the firm, t represents the fiscal year, and $\varepsilon_{j,t}$ is the residual term. To test our research question empirically, we employ panel data, which control for omitted variable bias and unobservable heterogeneity (Verbeek, 2008). Considering the results of the Hausman specification test, the fixed-effect method is used as the estimation method.

As dependent variables, we use *Env*, which is a set of environmental Refinitiv Eikon Thomson Reuters scores that assess the environmental performance of a company. These scores range from 0 to 100. The first dependent variable that we use is an aggregate measure called ENVIRONMENTAL PERFORMANCE. It measures aspects related to pollutant emissions, efficient use of resources, and the use of environmental innovation and renewable energy.[1] This aggregate variable is built on three different sub-actions: (1) firm environmental technology use; (2) firm resource use efficiency; and (3) corporate emission reduction. The first sub-action variable is called ENVIRONMENTAL TECHNOLOGIES and reflects the company's ability to decrease its environmental costs, ensure clean production, and protect the environment through the introduction of new environmental technologies. The second sub-action variable is called RESOURCE USE EFFICIENCY and indicates the company's performance in reducing the use of materials, energy, or water. It measures the efficiency of the investments in terms of the use of resources. The third sub-action variable is called EMISSION REDUCTION and measures a company's performance in terms of reducing the pollutant emissions in the production and operational processes. It refers to gas and water pollutant emissions, waste reduction, and biodiversity impact reduction (Thomson-Reuters Eikon, 2020).

Following De Masi, Slomka-Golebiowska, Becagli, et al. (2021), Dobija et al., 2021, and Kinateder et al. (2021), CM refers to the critical mass of women. It is a dummy variable that is equal to 1 if boards have at least three women (the critical mass) and 0 otherwise. This variable allows us to compare boards that have reached the critical mass with boards that have not. We introduce into the model the variable FAMILY WOMEN, which is also a dummy that assumes the value 1 if at least one female director belongs to the family that owns the company and 0 otherwise. The variable FAMILY WOMEN*CM is an interaction term between the CM and the FAMILY WOMEN. The coefficient of this variable measures the difference in the environmental scores between boards with more than three women and boards with fewer than three women when they have at least one female director belonging to the family controlling shareholder. If the variable is statistically significant, this outcome indicates that the differences in environmental scores between boards with at least three women and boards with fewer than three women depend on the presence of family female directors.

Then, we add to the model a vector of control variables that may influence environmental corporate performance (Rao & Tilt, 2016). We include the percentage of independent directors reported by the company since previous research shows that the presence of independent directors is considered to be particularly effective in protecting the stakeholders' interests (Patro et al., 2018). We also control for the board size, calculated as the total number of board members since the largest boards are associated with better environmental performance (Nadeem, Bahadar, et al., 2020); CEO–chairman, which is a dummy variable that assumes the value of 1 if the CEO is also the chairman and zero otherwise; and firm size, using the logarithmic transformation of the total assets as a proxy. The largest firms are more likely to be more sensitive to environmental issues since they are listed on the stock market and are under scrutiny from investors. We also include ROE, which is the ratio of income to total equity, and LEV, which is measured as the total debt to total equity ratio, as controls for firm characteristics. The definition of the variables is reported in Table 1.

4 | EMPIRICAL RESULTS

Table 2 presents the descriptive statistics of the variables used in this study. In our sample, the average environmental performance is 56.02, the maximum value being 98.30. The means of the three environmental sub-actions have the following values: ENVIRONMENTAL TECHNOLOGY is 41.41, whereas RESOURCE USE EFFICIENCY and EMISSION REDUCTION are 60.77 and 61.33, respectively. These environmental measures range from 0 to 100 (Thomson-Reuters Eikon, 2020). A high score indicates better corporate environmental performance. Table 2 also shows that 40% of the companies have at least three female directors and 15% of the companies have women directors who belong to the owning family. In our sample, women (both family and non-family directors) represent on average 14.69% of board members. The mean value of the variable INDEPENDENT DIRECTORS is 55.87%, and the mean value of the variable BOARD SIZE is 13. The number and the percentage of women on boards in Italian listed companies have increased over the years. Table 3 reports the descriptive statistics per year of the number and percentage of women on boards. Before the introduction of the quota law,

TABLE 1 Variables description

Variable	Description
Environmental performance	This score measures the environmental corporate performance. It "reflects how well a company uses best management practices to avoid environmental risks and capitalize on environmental opportunities to generate long-term shareholder value" (Thomson-Reuters Eikon, 2020). It is built on three sub-scores: (1) Environmental Technology; (2) Resource use efficiency; (3) Emission reduction. The score ranges from 0 to 100
Environmental Technology	This score reflects "a company's capacity to reduce the environmental costs, having clean production and protecting the environment" (Thomson-Reuters Eikon, 2020). It ranges from 0 to 100
Resource use efficiency	This score reflects "a company's performance and capacity to reduce the use of materials, energy or water, and to find more eco-efficient solutions by improving supply chain management" (Thomson-Reuters Eikon, 2020). It ranges from 0 to 100
Emission reduction	This score measures "a company's commitment to and effectiveness in reducing pollutant emission in the production and operational processes" (Thomson-Reuters Eikon, 2020). It ranges from 0 to 100
CM	It is a dummy that assumes value of 1 if a board has at least 3 women; 0 otherwise
Family women	It is a dummy equals to 1 if a board has at least one women director that belongs to the owner's family, 0 otherwise
CM*family_women	It is the interaction term between the variable critical mass and the variable family women
Percentage of women	The percentage of women on board
Independent directors	The percentage of independent directors reported by the company
CEO-Chairman	It is a dummy equal to 1 if the CEO is also Chairman, 0 otherwise
Board size	The total number of board members
Firm size	The logarithmic transformation of total assets as reported by the financial annual report by the company
ROE %	It is the ratio of income to total equity, multiplied by 100
LEV	It is the ratio of total debt to total equity ratio
Gender quota law	It is a dummy that assumes value of 1 if the year is after 2012; 0 otherwise

Source: Adapted from Refinitiv Eikon—Thomson Reuters, 2021.

TABLE 2 Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Environmental performance	309	56.02	33.80	0.00	98.30
Environmental technology	309	41.41	37.38	0.00	99.57
Resource use efficiency	309	60.77	35.41	0.00	99.62
Emission reduction	309	61.33	36.34	0.00	99.83
CM	302	0.40	0.40	0.00	1.00
Family women	358	0.14	0.34	0.00	1.00
Board size	313	12.78	4.37	7.00	25.00
Independent directors	307	57.26	0.34	11.11	100.00
CEO-Chairman	309	0.22	0.41	0.00	1.00
Firm size	379	16.80	190	11.06	20.75
ROE %	373	10.76	20.14	−50.05	265.95
LEV	379	53.75	22.61	1.83	100.00

the presence of female directors was very limited (the mean value of the variable the "NUMBER OF WOMEN ON BOARDS" was 0.57 in 2008, 0.78 in 2009, 1.19 in 2010, and 1.98 in 2011). This number has increased over the years: in 2016 and 2017, the average number of women on boards was 4. In terms of the critical mass of women, before 2012, very few boards contained three women. With the new requirements mandated by the quota law, many firms have increased the number of women on their board up to the critical mass or even more. There were at least three women on 64% of boards in 2016 and 76% of boards in 2017. The Pearson's correlation matrix (Table 4) shows that the results are not affected by multicollinearity. The highest correlation is among the aggregate environmental performance and its three sub-actions. This is not an issue in our analysis because these variables are included in separate models.

Table 5 reports the empirical results concerning the relationship between women on boards and environmental corporate performance. When boards have three women or more, the aggregate environmental performance improves (column 1). Our variable of

TABLE 3 Number, percentage, and the critical mass of women on boards per year

	Mean value		
Year	Percentage of women on board	Number of women on boards	CM
2008	3.27	0.57	0.03
2009	4.69	0.78	0.03
2010	7.52	1.19	0.17
2011	8.34	1.32	0.14
2012	13.25	1.98	0.36
2013	18.62	2.61	0.41
2014	24.47	3.20	0.65
2015	26.74	3.66	0.62
2016	29.52	4.10	0.64
2017	33.61	4.40	0.76

interest is the interaction term CM*FAMILY WOMEN. Its coefficient indicates the difference between boards that have reached the critical mass of three women or more and boards with fewer than three women when the board has at least one family female director. The coefficient is negative and the relationship is statistically significant, showing that the difference in the environmental scores between boards with more than three women and boards with fewer than three women is increasingly more negative when at least one family female director is present on the board. In other words, family women directors reduce the environmental performance (column 3). Specifically, family women directors reduce the aggregate environmental performance by 8.44. Tables 6–8 present the three sub-actions of the environmental corporate performance. The results indicate that, when women on boards reach the minimum number of three, they positively influence these three sub-actions (column 1). However, when we distinguish women according to their nomination background, family women directors are not as sensitive to the environmental sub-actions as non-family women directors. Specifically, the performance of environmental technologies is reduced by 13.06, the resource use efficiency by 10.39, and the emission reduction by 10.08 when at least one family women director is present on the board. Thus, Hypotheses 1a, 1b, and 1c are supported.

5 | ROBUSTNESS CHECK

To validate our results, we employ a set of robustness checks. First, we prove that women affect the board when a minimum number of three women is reached. Following previous studies (Chang et al., 2019; De Masi et al., 2021; Kinateder et al., 2021; You, 2021), we use a set of three dummy variables: (1) one woman, (2) two women, and (3) three women (or more). Each variable assumes the value of "1" if the number of women directors is one, two, and three (or more), respectively, and "0" otherwise. Table 9 confirms our results: women directors influence the environmental performance only when a minimum number of three women on the board is reached. The two dummies "ONE WOMAN" and "TWO WOMEN" are not statistically significant in any of the models. These results document that the critical mass of women on boards is reached with a minimum of three women. Regarding the interaction term between the variable "CRITICAL MASS" and the variable "FAMILY WOMEN," this variable is negative and statistically significant in all the models. This confirms our main result once again: upon reaching a minimum number of three women on boards, family women directors affect environmental corporate performance negatively.

Second, we test the robustness of our findings further to address the endogeneity problem that might drive the relationships between environmental performance and women on boards, violating the causal relationships that we assume between them. Although we recognize this issue, we believe that our study design and data reduce the endogeneity concerns. To explain our argument, we follow previous studies in corporate governance that address the endogeneity problem with the two-stage instrumental variable approach (instrumental variable regression—2SLS). This method requires a valid instrument that has a significant relationship with the explanatory variable (in our case, it is the variable "CM") and no relationship with the dependent variables (in our case, the corporate environmental performance and its subsequential actions). We follow Kinatedder et al.'s (2021) intuition, and we use the introduction of the gender quota law to have the critical mass of women directors on the board as the instrumental variable. The results show that the relationship between the gender quota law (instrument) and the critical mass of women (our explanatory variable) is positive and statistically significant (Table 10, column 1). The endogeneity test confirms the reliability of our results: our model has no problem of under-identification and the instrumental variable (IV) is strong. The *F*-test value (78.53) of the first-stage regressions is significant at the 1% level. The under-identification test (Kleibergen–Paap rk LM statistic) has an *F*-value of 60.37, showing a significance level of 1%. Moreover, the value of the Cragg–Donald Wald *F*-statistics (73.13) is higher than the Stock–Yogo values (max. 16.38 at 10%), indicating that the instrument is not weak. The results of the 2SLS are reported from column (2) to column (5). They show that the relationship between the critical mass of women on boards and the environmental corporate performance (and its subsequential actions) is positive and statistically significant. To confirm the validity of our result, we also use the Hausman–Taylor (1981) estimator. This is an algorithm based on first-differencing, 2SLS, and calculating residuals, which is capable of providing correct instrumentalization for both fixed-in-time and time-variant covariates that are potentially endogenous. Table 11 displays the Hausman–Taylor estimation results, which confirm our earlier findings.

Third, we prove the non-linear relationship between women on boards and corporate environmental performance by adding the quadratic term of the percentage of female directors (Birindelli et al., 2019). This new variable, called "PERCENTAGE OF WOMEN SQUARED," indicates the level after which women on boards

TABLE 4 Correlation matrix

	1. Environmental performance	2. Environmental technology	3. Resource use efficiency	4. Emissions reduction	5. CM	6. Family women	7. CM*Familywomen	8. Board size	9. CEO chairman	10. Independent directors	11. Firm size	12. ROE%	13. LEV
1.	–												
2.	0.80***	–											
3.	0.93***	0.63***											
4.	0.93***	0.64***	0.90***	–									
5.	0.06	0.04	0.06	0.10**	–								
6.	−0.41***	−0.36***	−0.36***	−0.40***	0.06	–							
7.	−0.25***	−0.25***	−0.22***	−0.22***	0.28***	0.69***	–						
8.	−0.01**	0.13**	0.03	0.02	0.32***	−0.01	0.03	–					
9.	−0.13**	−0.12**	−0.11**	−0.12**	−0.03**	−0.01	−0.02	−0.10*	–				
10.	0.43***	0.52***	0.30***	0.41***	−0.13***	−0.36***	−0.17***	0.03	−0.30***	–			
11.	0.35***	0.45***	0.25***	0.35***	0.17***	−0.32***	−0.13**	0.32***	−0.23***	0.42***	–		
12.	−0.04	−0.10*	−0.01	−0.02	0.000	0.03	−0.12	−0.15***	0.13**	−0.18	−0.32***	–	
13.	0.07	0.15***	−0.04	0.09	0.15***	−0.25***	−0.17***	0.28***	−0.27***	0.27***	0.56***	−0.06	–

Note: The levels of significance are $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

TABLE 5 Women on boards and environmental performance

	Environmental performance		
	(1)	(2)	(3)
CM	6.54***	6.56***	7.45***
	(4.46)	(4.47)	(4.89)
Family women		−2.35	1.07
		(0.74)	(0.30)
CM*family_women			−8.44**
			(−2.03)
Board size	−0.07	−0.08	−0.05
	(−0.34)	(−0.37)	(−0.25)
Independent directors	0.13**	0.12**	0.12**
	(2.26)	(2.16)	(2.04)
CEO-Chairman	2.85	2.57	2.23
	(1.24)	(1.11)	(0.96)
Firm size	4.65*	4.35*	4.01*
	(1.92)	(1.77)	(1.64)
ROE %	0.09***	0.09***	0.08**
	(2.53)	(2.43)	(−2.03)
LEV	−0.17*	−0.16	−0.15
	(−1.78)	(−1.60)	(−1.54)
Industry fixed effect	YES	YES	YES
R^2 (within)	0.21	0.22	0.23
N. Obs	299	299	299
N. firms	38	38	38

Notes: Fixed effect regression models. T-statistics are in parentheses. The levels of significance are $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

influence the environmental corporate performance with an opposite sign. The results, presented in Table 12, are compatible with our argument: they show that a turning point exists. The sign of the coefficient of the variable "PERCENTAGE OF WOMEN SQUARED" is negative, documenting a non-linear relationship between women on boards and environmental performance (Slomka-Golebiowska et al., 2022).

6 | DISCUSSION AND CONCLUSION

In this study, we offer novel insights into the role of women on boards, disentangling the effect of female directors according to their numerical representation (reaching the critical mass) and their nomination background (family or non-family members). Women and men have different values and attitudes that affect how they can influence the board's decisions. Women have a positive impact on environmental issues due to a leadership style that is more prone to consider stakeholders' interests (Alonso-Almeida et al., 2017; Campopiano et al., 2019; Jain & Zaman, 2020).

Differently from previous studies that focus mainly on an aggregate measure of environmental performance, we also analyze the

TABLE 6 Women on boards and the introduction of environmental technologies

	Environmental technology		
	(1)	(2)	(3)
CM	9.56***	9.54 ***	10.93***
	(3.90)	(3.88)	(4.28)
Family women		1.91	7.23
		(0.36)	(1.20)
CM*family_women			−13.16*
			(−1.89)
Board size	0.06	0.06	0.10
	(0.15)	(1.17)	(0.28)
Independent directors	0.26***	0.27**	0.25**
	(2.73)	(2.75)	(2.64)
CEO-Chairman	7.14*	7.36*	6.83*
	(1.86)	(1.89)	(1. 57)
Firm size	2.39	2.61	2.07
	(0.59)	(0.63)	(0.51)
ROE %	0.01	0.03	−0.01
	(0.02)	(0.06)	(−0.07)
LEV	−0.11	−0.12	−0.11
	(−0.66)	(−0.72)	(−0.66)
Industry fixed effect	YES	YES	YES
R^2 (within)	0.15	0.15	0.16
N. Obs	299	299	299
N. firms	38	38	38

Notes: Fixed effect regression models. T-statistics are in parentheses. The levels of significance are $^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

TABLE 7 Women on boards and the efficient use of resources

	Resource use efficiency		
	(1)	(2)	(3)
CM	5.56***	5.61***	6.71***
	(2.92)	(2.96)	(3.41)
Family women		−5.96	−1.75
		(−1.44)	(−0.38)
CM*family_women			−10.39**
			(−1.93)
Board size	0.30	0.28	0.32
	(0.13)	(1.06)	(1.18)
Independent directors	0.05	0.04	0.03
	(0.63)	(0.47)	(0.35)
CEO-Chairman	0.04	−0.66	−1.08
	(0.01)	(−0.22)	(−0.36)
Firm size	7.02**	6.27**	5.85*
	(2.24)	(1.98)	(1.85)
ROE %	0.11***	0.11***	0.10***
	(2.53)	(2.37)	(2.24)
LEV	−0.40***	0.36***	−0.35***
	(−3.21)	(−2.87)	(−2.82)
Industry fixed effect	YES	YES	YES
R^2 (within)	0.16	0.16	0.18
N. Obs	299	299	299
N. firms	38	38	38

Notes: Fixed effect regression models. T-statistics are in parentheses. The levels of significance are $^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

three sub-measures that reflect the sequence of actions that are decisive for improving environmental corporate performance: (1) firm environmental technology use; (2) firm resource use efficiency; and (3) corporate emission reduction. Our findings show that the positive impact of women on environmental performance (the aggregate measure and its sequential actions) is higher in boards with at least three female directors than in boards with fewer than three women. Among the three pro-environment actions, the introduction of green technologies is the action that benefits the most from the critical mass of women. This is in line with the studies by He and Jiang (2019) and Przychodzen et al. (2018), who find that women in top decision-making positions increase the likelihood of the firm introducing green product innovation and green IT technologies. Disentangling the role of women on boards, we show that this positive relationship between women on boards and environmental performance does not hold in the case of family women directors. Boards that have at least of three women experience worse environmental performance provided that at least one woman belongs to the family of the controlling shareholder.

Our results do not support the homophily theory, which argues that people behave in a similar way because of the common characteristic (gender) that they share. Gender might not per se be an element that makes people feel similar to each other. When women reach the minimum number of three, on one hand, their contribution to the board decisions becomes impactful. On the other hand, they create an intergroup dynamic between family and non-family women directors. In this case, women do not ally with each other and do not behave similarly just because they are women. The argument supported by the self-construal theory prevails—family women directors do not show their communal characteristics but continue to pursue the family's interests, which might not be in line with the environmental targets. Breaking down the environmental corporate performance into its three sub-actions, we report evidence about the impact of the family women directors' presence. Each environmental action implies costly investment, but the visibility associated with each action might be different. The visibility is a key element for the family since it increases the family's reputation (Campopiano et al., 2019). Among the three sub-actions, the one that is the most negatively affected by family women directors is the introduction of environmental technologies. When the board has at least three women, the family women directors are not prone to introduce green technologies. This might be because the introduction of environmental technologies is costly and does not give

TABLE 8 Women on boards and the reduction of pollutant emissions

	Emissions reduction		
	(1)	(2)	(3)
CM	7.15***	7.18***	9.33***
	(3.51)	(3.52)	(4.08)
Family women		−2.80	−2.55
		(−0.63)	(−0.48)
CM*family_women			−10.08*
			(−1.66)
Board size	−0.22	−0.23	−0.15
	(−0.77)	(−0.79)	(−0.45)
Independent directors	0.03	0.03	0.14
	(0.43)	(0.36)	(0.17)
CEO-Chairman	4.28	3.95	3.48
	(1.34)	(1.22)	(1.03)
Firm size	7.07**	6.72**	5.49
	(2.10)	(1.97)	(1.53)
ROE %	0.16***	0.16***	0.15***
	(3.30)	(3.31)	(3.12)
LEV	−0.33***	−0.32**	−0.31**
	(2.51)	(2.33)	(−2.29)
Industry fixed effect	YES	YES	YES
R^2 (within)	0.18	0.12	0.13
N. Obs	299	299	299
N. firms	38	38	38

Notes: Fixed effect regression models. T-statistics are in parentheses. The levels of significance are $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

enough visibility to the family in the short term. The effect of family women directors is not so negative in the case of the efficient use of resources since this action is important for increasing the operating efficiency, which might lead to an immediate cost reduction (Atif et al., 2020). These findings show that women on boards are not a homogeneous group.

In a recent study, Wang, Luo, et al. (2021) show the effect of women on CSR, integrating the female director typology (outside vs. inside) with their numerical representation. We take a step further and show that it is important to focus on their family membership to understand further how women on boards affect environmental performance. Our results provide suggestions for the corporate governance of family firms. Since the main aim of family firms is to protect the family wealth (Dal Maso et al., 2020), it is necessary to introduce other corporate governance measures that might reduce the family's dominance and limit the danger of not considering the environmental consequences of corporate decisions. Since non-family women directors are more prone to consider environmental performance than family women directors, they may be considered as a driver of the environmental performance and as a corporate governance measure that aims to protect stakeholders' interests.

7 | IMPLICATIONS, LIMITATIONS, AND SUGGESTIONS FOR FUTURE RESEARCH

Our study offers important regulatory implications. It offers insights into the consequences of having a gender quota law and the type of women who have been appointed since its introduction in Italy and abroad. Before 2012, in Italy, most women on boards were affiliated with the family founder (Bianco et al., 2015). The law has considerably increased the number of women on boards, pushing firms to reach a minimum number of three women directors (De Masi, Słomka-Gołębiowska, & Paci, 2021). Most of the newly appointed women on boards do not have connections with the founder's family (Rigolini & Huse, 2021). Our findings provide evidence that, thanks to the introduction of the quota law, a new type of woman has been elected. The selection of women takes place on merits and not on family ties, so they bring different perspectives and values. As suggested by Johannisson and Huse (2000), these non-family members might introduce an ideological change within the board, reducing the dominance of family collectivism, which is the main ideology in family businesses (Bullough et al., 2017). The consideration that family firms are the most common form of business organization not just in Italy (Canavati, 2018; Scafarto et al., 2020; Veltri et al., 2021) but also across the world (Ye & Li, 2021) makes research on the significance of family female directors in enhancing environmental performance particularly important.

Although there might be some strong country-specific characteristics in our study, our findings can still be applied to other European countries. In the last 20 years, most of the Member States have faced the harmonization of company law within the European Union (Enriques, 2017). All large companies in Europe have experienced the same very strong regulatory pressure to improve their ESG metrics. Thus, EU companies have taken bold actions with respect to improving especially their environmental ratings to meet the goals of the Green Deal. Moreover, firms in Europe and all over the world have restructured their boards to conform to a set of governance practices constituting globally accepted good governance (Ponomareva et al., 2022). Many countries, for example, comply with *good corporate governance practice* to increase the number of women directors, and some of them have implemented a gender quota law to push companies to reconfigure their boards (Hoobler et al., 2018; Seierstad et al., 2017; Terjesen & Sealy, 2016). Many Member States have required boards to reach the minimum mandatory thresholds of women on corporate boards. These thresholds are usually in line with the reasoning on the critical mass of women on boards. In this vein, the learning from our results based on the case of Italy can be used in other countries. Specifically, our results reinforce the gender quota law initiatives being undertaken not just in Europe but around the world to increase board gender diversity, showing the positive effects of women on corporate environmental performance.

Our study also demonstrates that the quota should not only be considered for public companies. Most family firms are not listed.

TABLE 9 Robustness check: One, two and three women on the boards

	Environmental performance			Environmental technology			Resource use efficiency			Emissions reduction		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
One women	−1.97	−1.85	−0.78	6.21	5.71	7.21	−2.39	−1.22	0.09	−14.84	−13.33	−12.39
	(−0.48)	(−0.45)	(−0.19)	(0.94)	(0.83)	(1.05)	(−0.45)	(−0.21)	(0.02)	(−1.76)	(−1.60)	(−1.47)
Two women	0.30	0.52	0.98	−4.89	−4.61	−3.95	−2.92	−2.76	−2.18	8.86	9.15	9.56
	(0.08)	(0.14)	(0.27)	(−0.79)	(−0.74)	(−0.64)	(−0.58)	(−0.53)	(−0.43)	(1.06)	(1.10)	(1.14)
Three women	6.90***	6.84***	8.13***	19.37***	10.00***	11.81***	5.58***	6.18***	7.77***	6.62	7.42	8.57
	(4.55)	(4.35)	(4.97)	(4.22)	(3.81)	(4.30)	(2.79)	(2.83)	(3.41)	(1.36)	(1.34)	(1.41)
Family women		−4.43	0.09		0.42	6.77		−9.44**	−3.86		−6.63**	−2.61
		(−1.39)	(0.03)		(0.08)	(1.11)		(−2.14)	(−0.77)		(−2.08)	(−0.80)
CM*family_ women			−10.44***			−14.64**			−12.88			−9.27*
			(−2.50)			(−2.09)			(−2.21)			(−1.97)
CONTROL	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
R^2 (overall)	0.13	0.26	0.24	0.07	0.28	0.27	0.08	0.18	0.16	0.18	0.30	0.28
R^2 (between)	0.14	0.25	0.22	0.09	0.33	0.32	0.06	0.12	0.09	0.13	0.22	0.17
R^2 (within)	0.14	0.20	0.24	0.11	0.15	0.17	0.07	0.11	0.13	0.13	0.16	0.18
N. Obs	293	293	293	293	293	293	293	293	293	293	293	293
N. firms	38	38	38	38	38	38	38	38	38	38	38	38

Notes: Fixed effect regression models. T-statistics are in parentheses. The levels of significance are *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

TABLE 10 Solving endogeneity using instrumental variable approach

	(1) 1st-stage CM	(2) 2st-stage Environmental performance	(3) 2st-stage Environmental technology	(4) 2st-stage Resource use	(5) 2st-stage Emissions reduction
Gender quota law	0.41***				
	(8.55)				
CM-instrumented		12.84***	20.12***	8.26**	14.93***
		(3.98)	(3.73)	(2.04)	(3.32)
Family women	−0.15	2.06	8.62	−1.29-	1.84
	(−1.18)	(0.57)	(1.42)	(−0.28)	(0.36)
CM*family_women	0.65***	−13.32***	−21.88***	−11.52**	−12.74**
	(4.53)	(−2.86)	(−2.81)	(−1.97)	(−1.96)
Board size	0.01*	−0.06	0.10	0.30	−0.25
	(1.66)	(−0.32)	(0.28)	(1.17)	(−0.87)
Independent directors	(0.01)***	0.04	0.13	0.00	−0.08
	(3.76)	(0.58)	(1.11)	(0.04)	(−0.88)
CEO-Chairman	−0.23***	3.38	8.79**	−0.68	5.28
	(−2.87)	(1.38)	(2.14)	(−0.22)	(1.54)
Firm size	0.04	2.43	−1.50	5.79**	5.57*
	(0.55)	(1.07)	(−0.40)	(2.04)	(1.76)
ROE %	0.00	0.08**	0.01	0.10**	0.15***
	(0.80)	(2.21)	(−0.16)	(2.30)	(3.06)
LEV	−0.00	−0.13	−0.08	−0.34***	−0.29**
	(−0.31)	(−1.36)	(−0.49)	(−2.82)	(−2.08)
N. Obs	297	297	297	297	297
Instruments validity tests for IV regression					
(i) *F*-test for excluded instrument in first stage Sanderson–Windmeijer *F*-test					
Sanderson–Windmeijer *F*-test	73.13				
(ii) Under-identification test Kleibergen–Paap rk LM	60.37				
(iii) Weak identification test Cragg–Donald Wald *F*-statistic	73.13				
Stock–Yogo weak ID test					
10% max. IV size	16.38				
15% max. IV size	8.96				
20% max. IV size	6.66				
25% max. IV size	5.53				

Notes: 2SLS regression models. T-statistics are in parentheses. The levels of significance are $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

However, sustainability and environmental corporate performance are their business imperative. Both regulatory and market pressure make environmental corporate performance critical to business success. Whether companies are focused on reducing their carbon footprint or radically transforming their business to gain a competitive advantage, they might need to increase the representation of women on their board to create a stronger and healthier family business.

Moreover, since the protection of the environment and the possible negative externalities created by pollutant production are important issues for policy makers, investors, and the society at large, firms that

TABLE 11 Solving endogeneity using instrumental variable Heckman's estimator

	Environmental performance	Environmental technology	Resource use efficiency	Emissions reduction
	(1)	(2)	(3)	(4)
CM	6.98***	9.86***	6.45***	7.08***
	(1.40)	(2.39)	(1.83)	(1.94)
Family women	0.50	5.59	−2.62	−1.06
	(3.36)	(6.78)	(4.38)	(4.65)
CM*family_women	−7.31*	−13.07*	−10.14*	−5.31
	(3.97)	(15.61)	(5.18)	(5.50)
Board size	0.04	0.3	0.24	−0.06
	(0.20)	(0.33)	(0.25)	(0.27)
Independent directors	0.13**	0.27***	0.09	0.05
	(0.05)	(0.09)	(0.07)	(0.07)
CEO duality	−14.13	−13.31	−16.02	−18.02
	(14.40)	(15.61)	(16.02)	(16.02)
Firm size	−0.00	0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)
ROE %	0.07**	−0.02	0.10*	0.14***
	(0.03)	(−0.07)	(0.04)	(0.05)
LEV	−0.10	(−0.07)	−0.28**	−0.23*
	(0.08)	(0.14)	(0.04)	(0.11)
Industry fixed effect	YES	YES	YES	YES
R^2	0.96	0.91	0.94	0.94
N. Obs	299	299	299	299
N. firms	38	38	38	38

Notes: Hausman–Taylor estimations. Standard errors are in parentheses. The levels of significance are *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

are interested in improving their environmental performance might signal their attention to this topic, carefully scrutinizing the board composition and in particular the type of women who are appointed to boards. On the one hand, our research documents the importance of having a law that pushes companies to increase the number of women on boards to at least three. On the other hand, it sheds light on the fact that the impact of female family members on environmental performance is negative and weakens the positive effect of the critical mass of women on boards. To strengthen their sustainability agenda, firms nominate more women for boards to legitimize their environmental activities. Thus, our findings provide insights for policy makers about the positive spillovers of the gender quota.

Our research also has implications for academics and studies on gender diversity. Extending the literature on women on boards, we provide insights into how to explore the topic of board gender diversity and its nuances in more detail. We look beyond the numerical female representation, proving that women constitute a diverse group by themselves. Future research might explore further the concept of "diversity within diversity," examining other attributes than the nomination background that might explain different women's behavior and the different motivations for women's actions.

This study has a few limitations. Because of the lack of availability of data on environmental performance, our study focuses only on listed companies. Future research may disentangle the contribution of women on boards in the context of private firms. Moreover, future studies might focus on other countries that do not have a gender-based board quota law. The focus of women on boards in different contexts may have interesting implications considering the influence of institutions on corporate governance practices and on gender diversity.

PEER REVIEW

The peer review history for this article is available at https://publons.com/publon/10.1111/beer.12467.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from Thomson Reuters - Eikon database. Restrictions apply to the availability of these data, which were used under license for this study.

TABLE 12 The non-linear relationship between women on boards and environmental performance

	Environmental performance	Environmental technology	Resource use efficiency	Emissions reduction
	(1)	(2)	(3)	(4)
Percentage of women	0.51***	0.50*	0.33	0.71***
	(3.07)	(1.82)	(1.56)	(3.14)
Percentage of women squared	−0.01**	−0.01	−0.01	−0.01***
	(−2.19)	(−1.06)	(−0.83)	(−2.37)
Board size	0.06	0.11	0.35	−0.22
	(−0.28)	(0.30)	(1.28)	(−0.76)
Independent directors	0.15***	0.30***	0.05	0.05
	(2.57)	(3.02)	(0.73)	(0.61)
CEO-Chairman	1.26	4.85	−1.02	2.64
	(0.55)	(1.26)	(−0.35)	(0.84)
Firm size	5.03**	2.91	7.00**	7.35**
	(2.03)	(0.70)	(2.19)	(2.17)
ROE %	0.09***	0.16***	0.12***	0.16***
	(2.57)	(3.30)	(2.53)	(3.41)
LEV	−0.17*	0.01	−0.38***	−0.33***
	(−1.72)	(0.02)	(−3.02)	(−2.46)
Industry fixed effect	YES	YES	YES	YES
R^2 (within)	0.20	0.18	0.19	0.13
N. Obs	299	299	299	299
N. firms	38	38	38	38

Notes: Fixed effect regression models. T-statistics are in parentheses. The levels of significance are $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

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ENDNOTE

[1] ENVIRONMENTAL PERFORMANCE is the Thomson–Reuters Refinitiv Score, which is the weighted sum of the following Refinitiv category scores: resource use, emissions, and innovation. The variable "resource use efficiency" includes, among others, an item indicating the total energy generated from primary renewable energy sources divided by the total energy used in the company. This is the result of investments in renewable power for a company's facilities (so-called environmental technology use). For all the details about the environmental performance score and its calculation, please visit https://www.refinitiv.com/en/sustainable-finance/esg-scores

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