

## RESEARCH ARTICLE

# Gender quotas and the environment: Environmental performance and enforcement

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## Abstract

This study investigates the relationship between the implementation of mandatory gender quotas on boards and companies' environmental indicators for Italian listed firms from 2010 to 2018. First, based on the upper echelon and resource dependence theories, we expect that the resources provided by female directors appointed under a coercive legal approach will lead to a reduction in firms' greenhouse gas emissions and an increase in recycled waste. These resources are mainly based on female personality, backgrounds and environmental commitment, which improve firms' environmental decision-making. Second, based on the gender socialisation and overconfidence theories, we expect that women's attention to stakeholders and experts will be negatively related to firms' environmental violations, which result in litigation and penalties. To test our hypotheses we used a content analysis and a staggered difference-in-difference multivariate regression model. Our results confirm our expectations for environmental performance and litigation, but not for penalties.

## KEYWORDS

board of directors, climate litigation, environmental performance, gender-diverse boards

## 1 | INTRODUCTION

Growing concerns about companies' environmental performance and disclosures show that corporate governance is a driving factor influencing companies to adopt environment-oriented strategies. The links between a company's board structure, its composition, and its environmental performance are increasingly gaining scholarly attention (de Villiers et al., 2011; Kock et al., 2012; Nadeem et al., 2017; Ortiz-de-Mandojana & Aragon-Correa, 2015; Post et al., 2015) given that a company's board of directors (BoD) is largely responsible for deciding its corporate social responsibility and sustainability measures (Ingle, 2008). Moreover, these decisions usually require important, uncertain, and unfamiliar investments with long-term strategic implications (Walls et al., 2012), rather than short-term ones.

Several studies show that female directors make significant contributions towards improving corporate governance, and thereby positively affect a company's environmental performance (Kassinis et al., 2016; Orazalin & Baydauletov, 2020). However, gender is one of the major points of contention in the discussions regarding board diversity. Gender diversity, measured as the extent of a board's heterogeneity in relation to the gender of its members (Li et al., 2017), has become an important dimension of corporate governance. Globally, the pressure to expand the number of female directors on companies' boards is growing constantly, and countries have chosen to adopt either a coercive, enabling, or Laissez-Faire approach (Labelle et al., 2015) to achieve this goal. For instance, the setting of this research, Italy, has chosen a coercive approach by enacting Law No. 120/2011, the Golfo-Mosca Law, on gender quotas, which

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requires at least 20% female directors to be appointed to a BoD on renewal of the board.

This research aims to investigate the effects of a coercive approach to promote corporate gender diversity on companies' environmental performances. We hypothesise that the mandatory introduction of a gender quota to a company's BoD appointment is positively correlated with its environmental performance, particularly in terms of reduction in greenhouse gas (GHG) emissions and increase in recycled waste (H1).

In particular, we chose to link gender diversity on corporate governance with the emissions of GHG (carbon dioxide, nitrous oxide and methane) as literature find that the impact of the decision of the boards on climate change and related issues inside a company is crucial for their strategy (Herbohn et al., 2012; Liesen et al., 2015; Linnenluecke et al., 2015).

At the same time, as in literature (Nadeem et al., 2020), we consider recycled waste as a measure of the firms' environmental innovation, and for that reason we argue that board characteristics should impact on that, so reducing or increasing waste emissions and consequently environmental performance.

Additionally, we investigate whether the gender quota law negatively affects the frequency of environmental enforcement actions taken against companies in terms of litigations and penalties (H2). This hypothesis is formulated following the part of literature (Kassinis & Vafeas, 2002; McKendall et al., 1999) that has been examined the relationship between corporate governance characteristics, and corporate environmental misconducts, since the BoD is responsible for defining its corporate environmental policies, as a piece of its responsibility to define the firm's strategy to manage its environmental impact.

For H1, we apply upper echelon theory and resource dependence theory to examine whether the resources provided by women directors influence the decision-making process. These resources are mainly based on female personality, background and environmental commitment. For H2, we use gender socialisation and overconfidence theories to investigate whether female director's stakeholder engagement, reflecting gender socialisation, and whether experts seeking to reduce overconfidence-induced decision-making errors, decrease firms' environmental violations.

The existing literature on companies' environmental performance shows mixed results on the relationship between board gender diversity and GHG emissions. However, these studies have focussed on research settings with either enabling or Laissez-Faire approaches, which have a low percentage of women on BoD. Few studies have been made on the relationship between gender diversity and waste. In contrast, this study uses a setting with a coercive approach, which includes gender quota legislation that has brought about a higher increase in women's board representation, compared to countries without such laws. This study shows that the introduction of a mandatory gender quota is a key determinant in improving companies' reduction of GHG emissions and the recycled waste.

Our study is structured as follows. In Section 2, we review the existing literature, explain our research framework, and develop our

hypotheses. In Section 3, we explain our research methods, including the process of sample selection, content analysis and the regression model. Section 4 provides the empirical, descriptive and regression results. Finally, Section 5 discusses the results and concludes the study.

## 2 | LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Board gender diversity can improve a company's decision-making process as a result of the combination diverse knowledge and perspectives (Post et al., 2011). Bear et al. (2010) argue that female directors, with their alternative perspectives, are more participative and democratic compared to male directors in the decision-making phase, and therefore help the board to make better decisions and achieve better results. Kim and Starks (2016) indicate women have greater 'sustainability skills' than men, which gives female directors more expertise related to the natural environment, and allows firms access to resources not previously under their control (Kim & Starks, 2016). Female directors' sustainability skills and expertise may thus have a transformative effect on companies' decision-making processes and discussions about environmental issues (Post & Byron, 2015). Looking to specific sector, like the financial one, the study of Birindelli et al. (2019) find that there is nonlinear relationship between women directors and the environmental performance of banks and that female chief executive officers play a strategic role in shaping this relationship, by confirming the homophily perspective for the banking sector, thus concluding that leader gender diversity is an important driver of environmental sustainability in banks, which are increasingly involved in environmental issues either directly, as companies, or indirectly, through their lending activity.

Our hypotheses are influenced by both upper echelons theory (Hambrick, 2007) and resource dependence theory (Hillman & Dalziel, 2003), as for both theories, board composition is an important predictor of corporate decision-making (Forbes & Milliken, 1999). Upper echelons theory argues that board members' thought processes and decisions reflect their experiences, knowledge and values (Hambrick, 2007). Resource dependence theory states that directors themselves are a strategic set of resources at the service of the organisation, to which they provide advice and counsel, access to information channels, resources, and they also enhance the organisation's legitimacy (Pfeffer & Salancik, 1978). As stated by Hambrick (2007), knowledge, skills, experience, networks, and values are the main resources that directors bring to their company. Therefore, the more gender-diverse a board is, the wider the variety of perspectives and knowledge, which increases the company's the access to diversified networks, all of which contributes towards enhanced decision-making (Hambrick & Mason, 1984).

Several studies have analysed the advantages of the range of perspectives and values that women provide. For instance, some studies show that women and men have different personality traits, communication styles, educational backgrounds and expertise and these



attributes play an important role in fostering the firm's environmental commitment (de Villiers et al., 2011; Diamantopoulos et al., 2003; Haque, 2017; Mainieri et al., 1997). Additionally, women pay greater attention to environmental risks than men do (Bord & O'Connor, 1997; Fukukawa et al., 2007). Compared to men, women's socialisation orients them more towards quality of life than towards material success (Hofstede et al., 2010), which explains their approach towards environmental concerns. Thus, female directors are more likely to be assigned to and accept roles on the board that are related to environmental and sustainable development, as these types of position are more closely aligned to their societal roles (Jizi, 2017). Landry et al. (2016) find that the presence of women as board members increases the likelihood of a firm appearing in the Fortune 500 list of the most admired companies, the most ethical companies, the best companies to work for, and the best corporate citizens. Finally, the presence of female directors positively influences companies' environmental disclosures (Ben-Amar et al., 2017; Lagasio & Cucari, 2019; Liao et al., 2015; Rao et al., 2012; Valls Martínez et al., 2019).

## 2.1 | Greenhouse gas emission

In this research, we analyse environmental performance in terms of GHG emissions. On this subject, European legislation is different in relation to the sector where business entities operate; there is an harmonised framework which is based on an emission trading system (EU ETS). This scenario does not apply to the non-ETS sectors, where each country has to identify a specific regulation of GHG emission. Italian legislation on GHG emissions is based on the principles of Paris agreement of 2015, adopted in Italy in December 2016. In accordance with these agreements and EU Regulation 2018/1999, Italy developed a national integrated plan for energy and climate (PNIEC) with the aim to reduce the emissions in the period 2021–2030; in order to achieve the target identified in the plan, for both ETS and non-ETS sectors, Italy has decided to use fiscal leverage, basically by providing tax incentives for the energetic improvement of both the private and public sectors.

As reported by Liao et al. (2015) and Lash and Wellington (2007), GHG differs from water, air, or other pollution, hazardous, and toxic waste, because it is a more global and long-term issue. Therefore, we separate GHG emission in our analysis. Emissions of GHG (carbon dioxide, nitrous oxide and methane) are an important indicator of performance, and the impact on climate change and related issues is crucial for companies' strategy and ethics (Herbohn et al., 2012; Liesen et al., 2015; Linnenluecke et al., 2015).

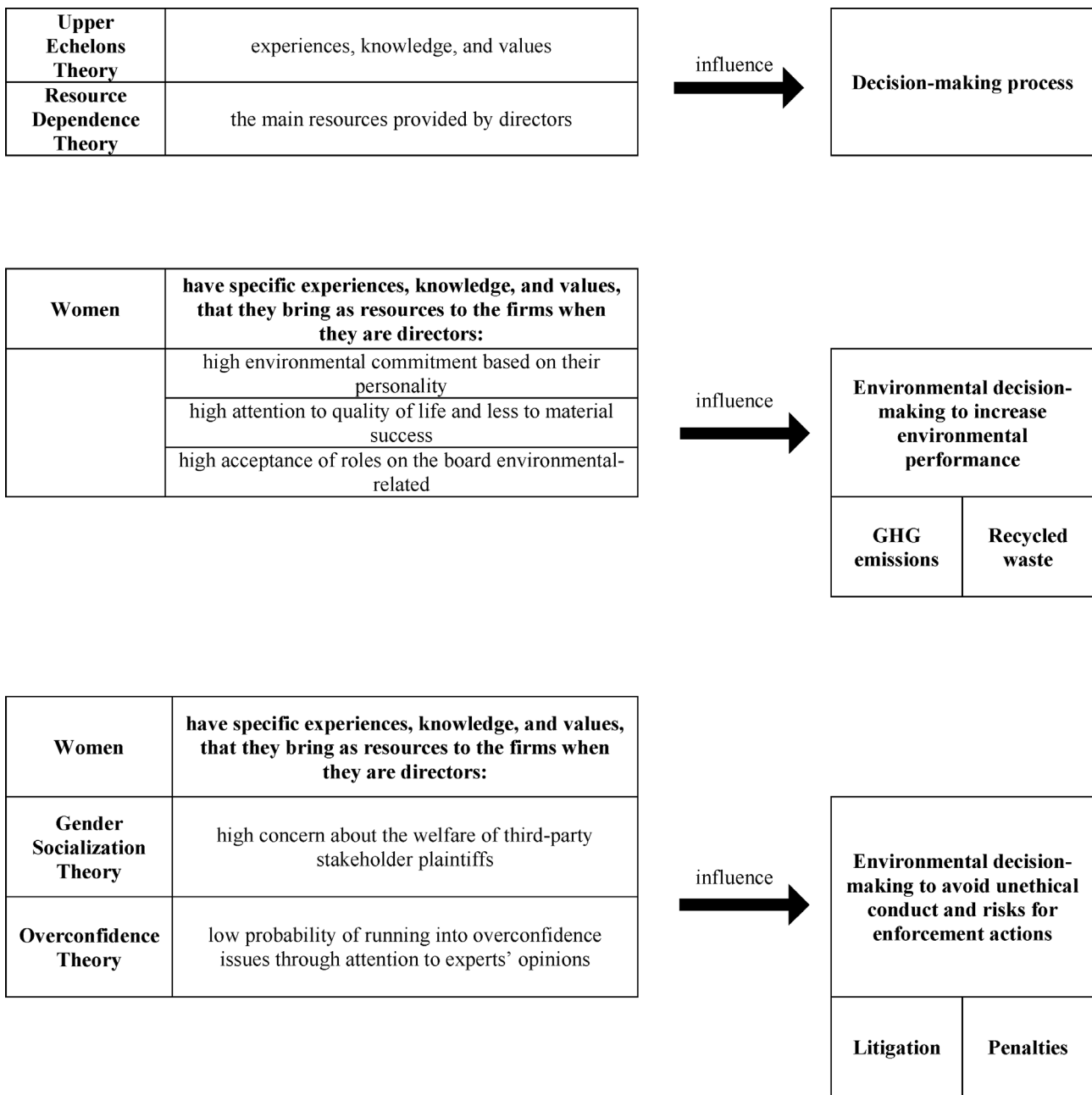
Female board directors are likely to provide companies with critical advice and resources to engage in sustainable corporate initiatives such as carbon strategies and innovations to implement low-carbon activities. Prior studies (Ben-Amar et al., 2017; Haque, 2017; Liao et al., 2015; Prado-Lorenzo & Garcia-Sanchez, 2010) have examined the effect of gender diversity on GHG emissions with mixed results. Prado-Lorenzo and Garcia-Sanchez (2010) did not find any significant impact of women's presence as board members on companies' GHG disclosures. Liao et al. (2015), on the other hand, report a positive

effect of female board membership on GHG disclosures among UK firms, and Ben-Amar et al. (2017) find that female boardroom participation is positively related to the voluntary disclosure of climate change information in Canada. Hollindale et al. (2019) show the importance of having multiple female directors to increase the quality of GHG emission-related disclosures in a company's annual and sustainability reports. Haque (2017) found that gender diversity has a positive impact on carbon performance. As stated by Cucari et al. (2018), there is no unanimous scholarly consensus regarding the role of female board members in reducing firms' GHG emissions and improving their carbon performance. The differences in results may be due to the low representation of women on boards for specific countries or to the use of an enabling or a Laissez-Faire approach. Therefore, we expect Italy to be an interesting setting for our analysis, as the percentage of women as board members is not as low as in other countries, thanks to its gender quota law, which mandates 20% representation for women.

## 2.2 | Recycled waste

Waste policy in Italy shows how socio-economic factors difference across regions within a country due to the impact of social and economic factors, exposing the dichotomy between poor performance hot spots and better performing regional clusters. The regulatory framework is defined by the Italian Legislative Decree No. 152/2006 which defines 'waste' as any substance or object that its holder discards, or intends, or is required, to discard. It is also important that Italian legislation identifies different types of obligations in relation to the categories in which they are classified (e.g., urban; special; hazardous and otherwise). The same legislation defines recycling as any recovery action by which waste is treated to obtain products, materials or substances to be used for their original function or for other purposes.

Scholars have mostly studied the influence of the characteristics of BoDs on firms' environmental performance using GHG emissions as an indicator. However, there is scope to widen the definition of environmental performance by considering the waste generated and/or recycled by the firm (Berrone & Gomez-Mejia, 2009; García Martín & Herrero, 2020). Other studies in fact consider the percentage of recycled waste as a measure of the firms' environmental innovation (Nadeem et al., 2020), and find that board gender diversity has a significantly positive impact on environmental innovation, and reduces waste emissions and improves environmental performance. Waste reduction is measured in terms of whether a company reports on initiatives to recycle, reduce, reuse, substitute, treat or phase out its total waste. Burkhardt et al. (2020) show that firms with gender-diverse boards have a strong commitment towards environmental issues and innovation, which has a positive impact on reducing waste. Nadeem et al. (2020) and Burkhardt et al. (2020) analyse the role of waste reduction without separating it from other issues under a single indicator. This study, on the other hand, isolates the effects of waste recycling, and investigates its relationship with the introduction of a mandatory gender quota for BoD.



**FIGURE 1** Research framework

In the light of resource dependence and upper echelon theories, female directors are expected to enhance a company's environmental performance in terms of reducing GHG emissions, and increase the quantity of the waste recycled. The cultural and social characteristics of women, their personalities, backgrounds, expertise and environmental commitment, in addition to their attention to quality of life and acceptance of environmental roles on the board, are all values that are considered resources for firms. So when women are represented on BoDs, these values and their capacity to influence the decision-making process are expected to enhance firms' environment performance (Figure 1 - Framework), which is reflected in the following hypothesis.

**H1.** The mandatory introduction of gender quotas in BoDs is positively related to firms' environmental performance.

### 2.3 | Enforcement: litigation and penalties

In many countries, governments have developed new enforcement tools to address environmental issues. These include climate litigation, a regulatory measure in which a company's violations of environmental regulations results in a legal action against it, and the top



management are summoned to the courtroom (Cormier & Magnan, 2003). In recent years, pro-environment non-profit organisations and citizens have used these regulations to take legal action against large corporations. For example, in 2001, the inhabitants of Sibatè (Colombia) started litigation against Emgesa, a subsidiary of Italy's Enel group, for the damage caused by the company redirecting contaminated water from the Bogota River into the Muna basin (Enel sustainability report). Another Italian listed company, Atlantia, has been involved in litigation for violating environmental laws in one of its infrastructural projects. In 2013, the Italian Ministry of the Environment joined the proceedings as a plaintiff in the civil action, jointly claiming with all the defendants damages of around 800 million euros. The issue was the use of 'waste materials' from the soil removed during a tunnel excavation which were mixed with other construction and demolition waste containing dangerous substances to construct new freeway embankments. The claim is that company managers and contractors acted illegally.

Administrative penalties for environmental crimes can also be used to sanction environmental damage. In Italy, any act violating national and European environmental law, which causes serious damage or risk to the environment or to human health, is considered an environmental crime. Environmental crimes can be grouped into five diverse categories: pollution, environmental disaster, trafficking, and abandonment of highly radioactive material, obstruction of environmental damage control, and the failure to decontaminate. Offenders are charged under administrative or a criminal law according to the type of behaviour and severity of the damage or danger. Fines relate to the seriousness of the offence, under Legislative Decree No. 152/2006. For example, in 2014, the Italian utilities company Iren received seven injunctions and a series of fines amounting to 75,000 Euro from the Province of Genoa local government on the basis of reports by ARPA Liguria (the regional agency for environment protection) and other authorities in relation to violations regarding discharges and purification (Iren Sustainability Report). In 2017, the Italian company Leonardo Finmeccanica was fined 6600 Euro for exceeding the permissible levels of wastewater discharge in 2016 (Leonardo Finmeccanica Sustainability Report).

Apart from environmental performance, this study also considers the impact of boards' gender diversity on climate litigation and environmental crime penalties against firms. A firm's BoD is responsible for defining its corporate environmental policies, as part of its responsibility to orient the firm's strategy to manage its environmental impact. Previous studies have examined the relationship between the BoD in terms of its size and independence, and corporate environmental violations and misconduct (Kassinis & Vafeas, 2002; McKendall et al., 1999). However, few studies have examined the relationship between female directors and environmental violations and litigation. Some theoretical approaches (Figure 1 – Framework), including gender socialisation theory and the overconfidence theory, suggest that women might outperform men in decision-making on environmental issues in order to avoid lawsuits (Cumming et al., 2015).

Gender socialisation theory suggests that individual-level differences between men and women lead to differences in firm-level policies, so that gender-diverse boards are less likely to engage in

unethical conduct (Cumming et al., 2015). Gender diversity also facilitates board monitoring of management and protection of shareholder interests more effectively (Fondas & Salsalos, 2000; Hillman & Dalziel, 2003), then Ibrahim et al. (2009) show that female managers are more positive with respect to an ethics issues, this helps to avoid misconduct and litigation.

Environmental litigation often has a third party as plaintiff, such as the local community, as in the Emgesa case noted above. These parties are not formally related to offending firms (Karpoff et al., 2005). Compared to their male counterparts, female directors and Chief Executive Officers (CEOs) are relatively more concerned about the welfare of third-party stakeholders affected by ecologically harmful activities, and are more likely to formulate strategies to avoid environmental violations (Liu, 2018).

The overconfidence theory states that female directors are less likely to run into overconfidence issues than male directors (Chen et al., 2016; Levi et al., 2014). Previous empirical studies have shown that overconfident CEOs and directors are more likely to engage in socially irresponsible actions and misconduct (Tang et al., 2015; Walls et al., 2012). Scholars have studied the role of women directors in mitigation the litigation risk, finding a negative relationship as female executives adopt less risky and less litigation-prone corporate policies (Adhikari et al., 2019).

Levi et al. (2015) also found that female directors are more likely to base their decisions on expert opinion. Moreover, when dealing with potential environmental risks, technical opinions and expert recommendations are important to help executives and boards assess and manage risks. Therefore, female directors' caution in seeking expert opinions reduces the risk of incurring environmental violations (Liu, 2018). Adams and Ferreira (2009) also agree that female directors play an effective role in monitoring a firm's activities; therefore, firms with female directors are less likely to be involved in environmental litigation and penalties.

**H2.** The mandatory introduction of gender quotas in BoDs is negatively related to environmental enforcement actions against firms.

## 3 | METHODS

### 3.1 | Sample selection and content analysis

Our sample consists of firms headquartered in Italy which are required to comply with the gender quota law on BoDs. After removing atypical firms, industry- or governance-specific firms, and firms with missing data, we arrive at a sample of 141 firms. Most listed firms voluntarily choose to report environmental information through separate social, environmental, or sustainability reports, or in their integrated reports. Since 2017, an Italian law (Legislative Decree No.254/2016) implementing European Directive 2014/95/EU 2014 has established mandatory non-financial disclosure (Pizzi et al., 2021; Santamaria et al., 2021). We search 141 firms' websites for the

presence of at least one of these reports, and eliminate firms which do not make environmental disclosure. This reduces the number of firms to 40. The final sample includes 258 firm-year observations for the period 2010–2018.

Content of the sample was analysed as follows. First, two researchers carefully read the firms' annual reports and selected the text pertaining to the environment. We consider paragraphs relating specifically to the environment and the other parts of the document that refer to it. The researchers next searched the existing literature for quantitative information on GHG and percentage of recycled waste, and then identified parts of text describing litigation or penalties relating to the environment. The same content analysis was then performed by two different researchers who had not seen the results of the first analysis. Finally, two of the authors checked the similarity in the data collected and examined the differences in quantitative information. These authors also examined the description of litigations or penalties, provided examples, and checked the data sample for accuracy. Data collected are not discretionary, given that we collected quantitative information on waste recycling and GHG, and only considered the presence/absence of litigations and penalties. The sample of 258 firm-year observations consists of 240 observations with the voluntary disclosure of GHG information and 196 observations with the voluntary disclosure of recycled waste percentage.

For firms with voluntary environmental disclosures, we download their corporate governance reports online to manually selected governance data, and verify the accuracy of the samples using a process similar to that described above. The procedure to define the percentage of women on the firms' boards, considering their mandatory or voluntary inclusion with the data on the post-regulation implementation, is however more complex. First, we count the number of female directors in a firm on the basis of the names of the board members. Next, we compute the percentage of female directors from the total number of directors in the board. Third, we check whether this percentage is higher or lower than that required by the law. Finally, we compare the dates (day, month and year) of the BoD renewal (when the percentage of women changes) against the date of implementation of the law (12 August 2012). The next section explains how these data are transformed into the variables used in our models. We obtained the data on the firms' financial statements from the Bureau Van Dyck database (Table 1).

### 3.2 | Regression models

We analyse the changes in firms' environmental performance (*Environment*) and the implementation of environmental activities before and after (*Post*) the enforcement of gender quota legislation in the BoD. Using a difference-in-difference design, the treated firms are considered as the *Mandatory Adopters* of gender quota, and the control firms are considered as the voluntary adopters of high percentage of women's representation before gender quota laws were introduced.

**TABLE 1** Sample selection

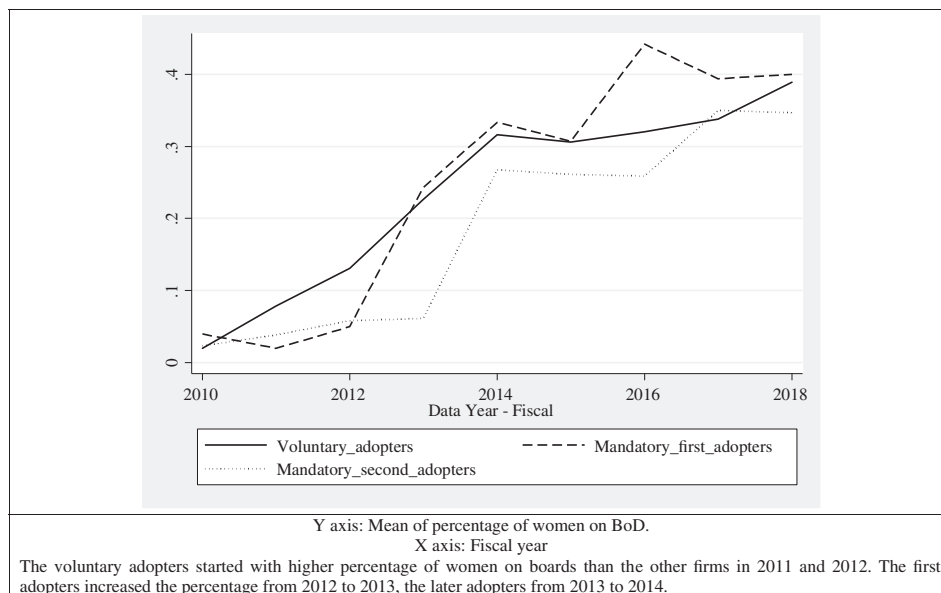
Description	N
Italian companies listed on the Milan Stock Exchange with fiscal year end 31 December	308
Delete: companies in the financial industry	–50
Delete: companies with a two-tier or one-tier system (different from the traditional system)	–4
Delete: companies with missing data on corporate governance and with a BoD engagement term different than 3 years (exceptions related to death, retirement, resignation)	–141
Delete: companies with missing voluntary disclosure about environment information	–101
Total number of companies in the sample	40
Number of firm-year observations (unbalanced sample) for the period 2010–2018	258

$$Environment = \beta_0 + \beta_1 Post * Mandatory Adopters + \beta_n Control variables + fixed effects + e \quad (1)$$

*Environment* is considered both a continuous variable for performance and a dummy variable for implementation of environmental activities, to which we apply an ordinary least square (OLS) method and a logistic regression, respectively. *P*-values are based on asymptotic *z*-statistics using White's (1980) standard error robust to heteroskedasticity. To avoid scale issues, we use the natural logarithm for thousand tons of GHG and the percentage of recycled waste for the total waste generated. Following Lu and Herremans (2019), we were concerned about the possible unobserved heterogeneity in a pooled OLS model, which could lead to a biased and inconsistent OLS estimation (Wooldridge, 2010). However, a Hausman test confirms the choice of fixed effects over random effects. Therefore, our analysis includes industry and year fixed effects.

For the environmental performance indicator in terms of GHG emissions, we follow Haque (2017) and Luo et al. (2013) using the natural logarithm of total GHG emissions (in tons), with higher GHG emissions indicating a poor performance. With respect to GHG emissions, we include GHG data with three scopes: Scope 1, Scope 2 and Scope 3. Scope 1 covers direct emissions from company-owned or controlled sources, including fuel combustion on sites such as gas boilers, fleet vehicles and air-conditioning leaks. Scope 2 covers indirect emissions generated by purchased electricity, steam, heating and cooling consumed by the reporting companies. Scope 3 includes all other indirect emissions that occur in a company's value chain, from sources that it does not own or control.

*Post* is an indicator variable, which is equal to one in the year when the gender quota regulation becomes effective for the firms under analysis. Because we analyse a staggered implementation among firms, different firms have *Post* = 1 in different years. Following Lu and Herremans (2019) we use propensity score matching to examine the causality in the relationship between environmental performance and gender diversity. Our method controls for concurrent



**FIGURE 2** Staggered adoption of mandatory gender quotas among firms

but unrelated market-wide events, and should prevent results from being spuriously driven by other economic shocks or institutional changes (Leuz & Wysocki, 2016). In order to comply with the gender quota law, firms follow staggered adoption during BoD renewals. In Italy, BoDs are renewed every 3 years, usually between March and May. Thus, companies renewing their BoDs between March and May 2012 were required to show a minimum of 20% women on their boards at the first renewal after 12 August 2012. Companies renewing their BoDs between March and May 2013 (or 2014) were required to show a minimum of 20% women on their boards at the end of 2013 (or 2014). Therefore,  $Post = 1$  for mandatory first adopters in 2013, later adopters in 2014, and so on.

In order to differentiate voluntary from mandatory adopters of the gender quota law, the indicator variable *Mandatory Adopters* is equal to zero when a firm has a pre-regulation quota for women's board representation that is higher than the percentage mandated by law. This was used by Ahern and Dittmar (2012) as an exogenous instrument. Unlike voluntary adopters, mandatory adopters change gender quota only because it is mandatorily required by law.

Figure 2 explains the staggered adoption of the gender quota in Italy. It represents the average number of women on BoD as a percentage of total number of directors in the board. This shows that voluntary adopters started with a higher percentage of women on BoDs than the other firms did in 2011 and 2012. The first adopters increased the gender quota only from 2012 to 2013, and the later adopters only from 2013 to 2014. Figure 2 clearly shows the period of the highest increase when the legislation came into force.

Appendix A explains the coding of these variables. On the basis of previous quantitative research, we use the following control variables (Bianco et al., 2015; Méndez & García, 2007): BoD characteristics (size, percentage of independent members and executives), CEO and Chair characteristics (age, duality and gender), and firm characteristics (firm size, leverage, profitability and growth). Prior literature

identifies these as drivers of firms' environmental performance (Cordeiro et al., 2020; González-Benito & González-Benito, 2006). For example, Walls et al. (2012) studied board characteristics, such as independence, size and diversity, and found that more independent, larger, and less diverse boards are associated with low environmental performance.

## 4 | RESULTS

### 4.1 | Descriptive statistics and correlation matrix

Table 2 shows the descriptive statistics. The amount of GHG displays high variability (standard deviation), with median emissions of 266,000 tons, very different from the mean (8196). These data are consistent with the average of about 215,000 GHG tons reported by Luo et al. (2013). The percentage of recycled waste shows an average higher than 50%, indicating the importance given to it. Litigation is frequent among 12.8% of the sample, while penalties are frequent among 20.2% firms.

The descriptive statistics on firms' social and environmental reports show respectively a frequency of only 1.9% and 2.7%, indicating that they are not commonly used by firms, and they disappear completely after 2016 and 2017. On the other hand, the sustainability report is the most frequent (82.2%) and it is used even after the introduction of the non-financial report in 2017. Additionally, 0.62% samples use an integrated report.

Mandatory adopters that only increased women's BoD representation above 20% after the implementation of the regulation constitute 62.8% of the sample. From 2010 to 2018 staggered adoption leads to one period showing to have a post period in the 63.2% of the sample.

The average membership size of BoD is 11. On average firms, have six independent members (52.5%) and 10 meetings per year. CEOs have an average age of 56 years, and 21.7% of the sample hold

**TABLE 2** Descriptive statistics

Variables environment	N	Mean	Std. Dev.	25% percentile	Median	75% percentile
<b>Performance</b>						
GHG (thousands tons)	240	8191	24,697	38	266	2372
GHG (logarithm)	240	5.895	2.689	3.623	5.583	7.771
Recycled waste	196	0.588	0.261	0.365	0.605	0.815
<b>Enforcement</b>						
Litigation	258	0.128	0.335	0.000	0.000	0.000
Penalty	258	0.202	0.402	0.000	0.000	0.000
<b>Type of disclosure</b>						
Non-financial declaration	258	0.070	0.255	0.000	0.000	0.000
Social report	258	0.019	0.138	0.000	0.000	0.000
Sustainability report	258	0.822	0.384	1.000	1.000	1.000
Environmental report	258	0.027	0.163	0.000	0.000	0.000
Integrated report	258	0.062	0.242	0.000	0.000	0.000
<b>Gender, governance, firm</b>						
Mandatory adopters	258	0.628	0.484	0.000	1.000	1.000
Post	258	0.632	0.483	0.000	1.000	1.000
<b>BoD size (number of members)</b>						
BoD size (number of members)	258	11	3	9	12	13
BoD size (logarithm)	258	2.388	0.284	2.197	2.485	2.565
<b>BoD independence (number of members)</b>						
BoD independence (number of members)	258	6	3	4	6	7
<b>BoD independence (percentage)</b>						
BoD independence (percentage)	258	0.525	0.176	0.385	0.538	0.667
<b>BoD meeting (number)</b>						
BoD meeting (number)	258	10	4	7	10	13
<b>CEO age</b>						
CEO age	258	56	8	51	56	62
<b>CEO duality</b>						
CEO duality	258	0.217	0.413	0.000	0.000	0.000
<b>Firm size (million euros)</b>						
Firm size (million euros)	258	18,941	38,886	1116	4769	12,782
<b>Firm size (logarithm)</b>						
Firm size (logarithm)	258	8.291	1.841	7.017	8.470	9.456
<b>Leverage</b>						
Leverage	258	0.354	0.146	0.248	0.313	0.464
<b>Sales Growth</b>						
Sales Growth	258	0.028	0.137	-0.033	0.030	0.090
<b>ROA</b>						
ROA	258	0.057	0.038	0.035	0.056	0.071

a chair position. These results show that the firms' characteristics are coherent with the existing literature on Italian listed firms.

Table 3 shows the correlation matrix for the chosen variables. BoD size and the number of meetings have the highest correlation coefficients. However, the results hold even after removing these variables. Moreover, the variance inflation factor shows no problems of multicollinearity.

## 4.2 | Regression results

Figure 3 shows a univariate analysis of the time trend of environmental performance and enforcement for voluntary adopters, mandatory first adopters and later adopters. In Figure 3, the top-left square depicts the median of the logarithm of GHG emissions by year. Voluntary adopters started with lower GHG emission than the other firms;

however, they do not see further decrease after the regulation. The first adopters decrease GHG once the gender quota law is in force, specifically from 2014; later adopters show a higher reduction once the gender quota law is in force, but from 2016. The results indicate that GHG emissions decrease due to the mandatory implementation of gender quota regulation.

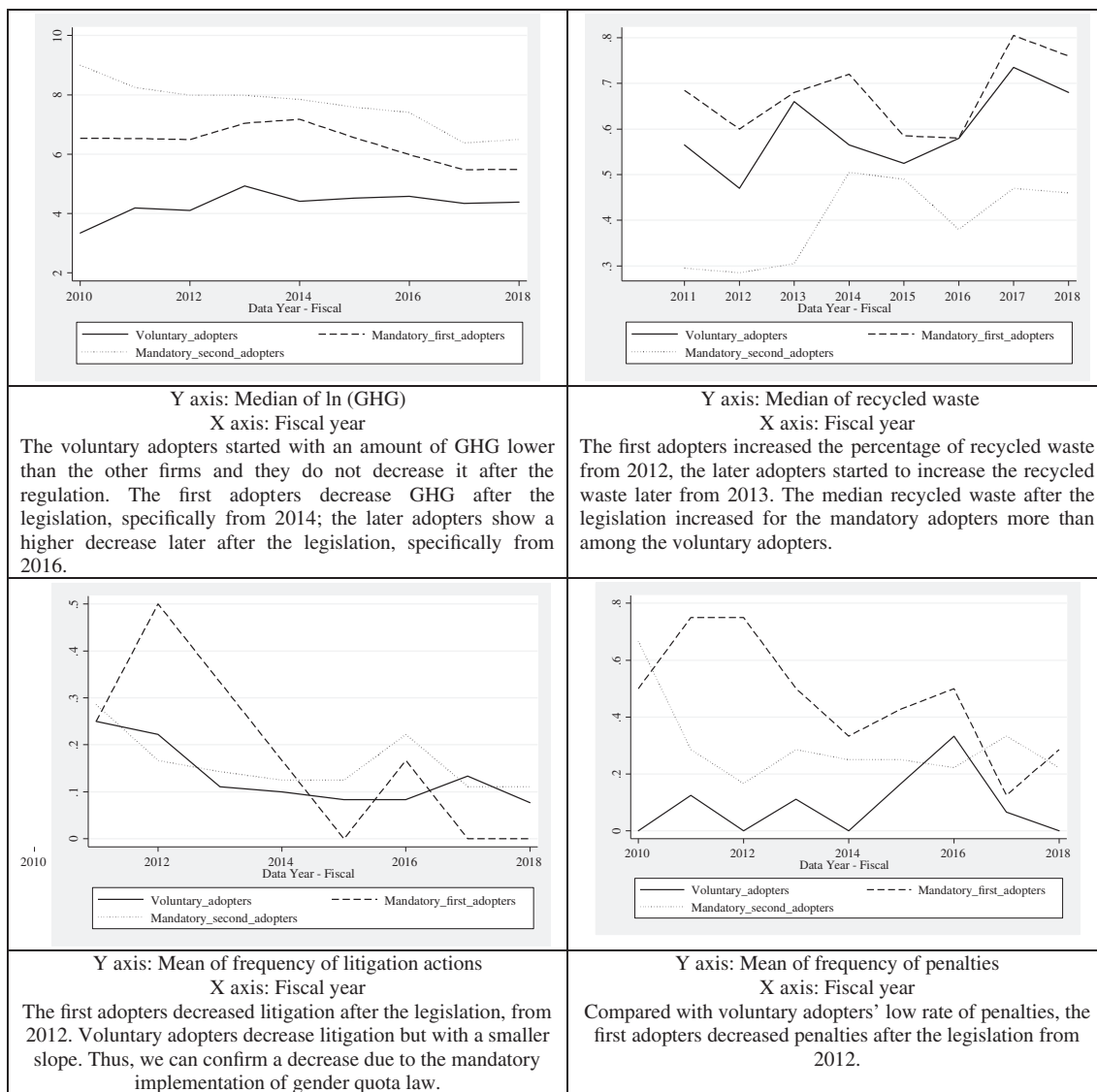
In Table 4, the first regression shows regression results for GHG emissions with a multivariate analysis. Before the gender quota law came into force, mandatory adopters had higher GHG emissions than voluntary adopters (positive regression coefficient of 1.030, significant with a  $p$ -value  $<0.001$ ), but post legislation, these firms show a higher reduction in GHG emissions than voluntary adopters (coeff.  $-0.556$ ,  $p$ -value 0.084). This result confirms that increasing women's board membership by law has a positive effect on reducing GHG emissions, supporting H1. The multivariate model, which controls for all the other determinants and the difference-in-difference method





TABLE 3 Correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 GHG	1.000														
2 Recycled waste	-0.251	1.000													
3 Litigation	0.171	-0.014	1.000												
4 Penalty	0.445	-0.198	0.242	1.000											
5 Mandatory adopters	0.333	-0.019	0.007	0.207	1.000										
6 Post	-0.113	0.133	-0.117	0.003	0.127	1.000									
7 BoD size	0.097	-0.044	-0.037	0.064	-0.091	-0.088	1.000								
8 BoD independence	0.321	0.052	0.283	0.245	0.154	0.094	-0.053	1.000							
9 BoD meeting	0.152	0.078	0.190	0.317	0.039	0.088	-0.050	0.421	1.000						
10 CEO age	-0.033	0.156	-0.058	-0.021	0.057	-0.064	0.005	0.065	-0.006	1.000					
11 CEO duality	-0.239	0.043	-0.174	-0.194	0.152	-0.066	-0.299	-0.314	-0.164	0.168	1.000				
12 Firm size	0.738	0.013	0.278	0.408	0.130	-0.102	0.238	0.431	0.384	0.052	-0.381	1.000			
13 Leverage	-0.050	-0.186	-0.194	-0.114	-0.060	0.081	0.020	-0.315	-0.271	-0.159	0.131	-0.266	1.000		
14 Sales growth	-0.059	0.042	0.039	0.031	-0.004	-0.079	0.130	-0.045	0.075	0.033	0.056	0.007	-0.007	1.000	
15 ROA	-0.254	-0.086	-0.008	-0.102	-0.167	0.004	0.066	-0.053	-0.076	0.035	0.012	-0.058	0.268	0.183	1.000



**FIGURE 3** Graphical representation of the results of a univariate analysis

with a staggered adoption, indicates that the change in GHG emission levels is driven by the change in female representation on BoD, due to the gender quota law coming into force.

In Figure 3, the top-right square shows the median of logarithm of recycled waste by year. The first adopters increased the percentage of recycled waste from 2012, whereas the later adopters started to increase the recycled waste later from 2013. Additionally, after the implementation of the gender quota law, mandatory adopters showed a greater increase in the median recycled waste than the voluntary adopters did.

In Table 4, the second regression shows the regression results for recycled waste with a multivariate analysis. Mandatory adopters had a lower percentage of recycled waste than voluntary adopters (negative regression coefficient of  $-0.136$ , significant with a  $p$ -value  $0.011$ ) before the gender quota law. However, post legislation they have a higher increase of recycled waste than

voluntary adopters (coeff.  $0.107$ ,  $p$ -value  $0.053$ ). These results also confirm that the increase of women's representation in the BoD by law has a positive effect on the percentage of recycled waste, verifying H1. Therefore, we can infer from this model that the change in recycling is driven by the change in female representation on BoD, as result of the legislation.

In Figure 3, the bottom-left square shows the mean frequency of litigation by year. For the first adopters, the frequency of litigation decreased after the law came into force in 2012. The frequency of litigation also decreased for voluntary adopters, but with a smaller slope, which indicates that the mandatory implementation of gender quota law leads to a decrease in environmental litigations for firms.

The first regression in Table 5 shows regression results on environmental litigation using a multivariate analysis. In the post legislation period, mandatory adopters show a greater reduction in litigation than voluntary adopters (coefficient  $-1.522$ ;  $p$ -value  $0.053$ ). It can be



	GHG		Recycled waste	
	Estimate	p-value	Estimate	p-value
<b>Post*Mandatory adopters</b>	<b>-0.556</b>	<b>0.084</b>	<b>0.107</b>	<b>0.053</b>
Mandatory adopters	1.030	0.000	-0.136	0.011
BoD size	0.146	0.728	0.160	0.085
BoD independence	0.264	0.663	0.059	0.665
BoD meeting	-0.029	0.392	-0.010	0.091
CEO age	0.004	0.810	0.005	0.016
CEO duality	0.100	0.778	0.073	0.198
Firm size	1.347	0.000	-0.081	0.000
Leverage	6.372	0.000	-0.402	0.003
Sales growth	1.034	0.193	-0.017	0.889
ROA	-16.320	0.000	-0.959	0.056
Intercept	-6.588	0.000	0.636	0.034
Industry fixed effects	included		included	
Year fixed effects	included		included	
Type of disclosure fixed effects	included		included	
Adjusted R <sup>2</sup>	0.726		0.272	
Number of observations	240		196	

Note: P-values are based on asymptotic z-statistics using White's (1980) standard error robust to heteroskedasticity. See Appendix A for variable definitions. The analysis is run for the subsample with voluntary quantitative disclosures for GHG (first regression) and for recycled waste (second regression).

	Litigation		Penalty	
	Estimate	p-value	Estimate	p-value
<b>Post*Mandatory Adopters</b>	<b>-1.522</b>	<b>0.053</b>	<b>-0.261</b>	<b>0.763</b>
Mandatory adopters	0.831	0.338	2.122	0.005
BoD size	-1.497	0.255	1.431	0.169
BoD independence	4.587	0.028	-2.958	0.070
BoD meeting	-0.022	0.801	0.191	0.021
CEO age	-0.018	0.673	-0.036	0.379
CEO duality	-	-	-0.209	0.810
Firm Size	0.097	0.699	1.196	0.000
Leverage	-3.262	0.294	1.596	0.424
Sales Growth	-0.417	0.820	0.642	0.694
ROA	-21.150	0.042	-0.704	0.933
Intercept	-10.964	0.016	-31.026	0.000
Industry fixed effects	included		included	
Year fixed effects	included		included	
Type of disclosure fixed effects	included		included	
Pseudo R <sup>2</sup>	0.403		0.438	
Number of observations	230		230	

Note: P-values are based on asymptotic z-statistics using White's (1980) standard error robust to heteroskedasticity. See Appendix A for variable definitions. Eighteen observations were dropped automatically by the logistic regression model because the type of disclosure fixed effects perfectly predicts failure.

**TABLE 4** Regression analysis of environmental performance

**TABLE 5** Regression analysis of environmental enforcement

thus inferred that the change in the frequency of litigation is driven by a change in women's representation in compliance with the law, which confirms H2.

In Figure 3, the bottom-left square shows the mean frequency of penalties by year. Compared with the low penalty rates for voluntary adopters, the frequency of penalties showed a decrease for first adopters only after the legislation was implemented, showing a univariate indication of a decrease in penalties due to the mandatory implementation of gender quota legislation.

The second regression in Table 5 shows the regression results for penalties using a multivariate analysis. The results are not statistically robust at multivariate level. Therefore, although the gender quota law contributed towards the reduction of GHG emissions, the increase in recycled waste, and the reduction in environmental litigations, we do not have enough evidence to support its role in reducing penalties, and H2 is only partially confirmed.

### 4.3 | Robustness

To check the robustness of our results, we use a generalised difference-in-difference method following Jacobson et al. (1993). For this, we repeat the analysis including the interactions of the treatment indicator (*Mandatory Adopters*) with the full set of year fixed effects instead of the post-legislation indicator. The estimated coefficients for the interactions capture the difference between the mandatory adopters and the voluntary adopters for each year in our sample period, to separate the effects that can be attributed to the legislation. The untabulated results show robust results for GHG emissions.

In addition, we change the regression model from an OLS to a Tobit regression for waste. Given that recycled waste figures are disclosed in the sustainability and other types of reports as percentages, the Tobit regression model is set up with the lower limit at 0 and the upper limit at 1. The untabulated results are robust and show the regression coefficient of the interaction *Mandatory Adopters\*Post* equal to 0.111, with a *p*-value of 0.035.

The evidence from the literature shows a positive impact of women's presence in the boardroom on firms' sustainability policies (Nadeem et al., 2017) and environmental policies, moderated by their characteristics in terms of their likelihood of causing pollution. This shows that increasing firms' gender diversity has a high impact on their environmental performance, especially for firms in polluting sectors (Li et al., 2017). Similar results on the impact of gender diversity are observed by Lu and Herremans (2019), who find that board gender diversity is associated with better environmental performance in industries with higher environmental impact than in those with lower environmental impact, for whom the effect is not as significant. The previous literature investigates the differences in the impact of gender diversity on environmental performance among industry types. For example, Al-Qahtani and Elgharbawy (2020) divide the less carbon-intensive industries (e.g., information technology, telecommunication, consumer staples, consumer discretionary, health care and financial) from carbon-intensive industries (e.g., industrial, energy, utilities and materials). Cordeiro et al. (2020) make a similar distinction

based on specific standard industry classification (SIC) codes for industries. We repeat the analysis by dropping the industry fixed effects variable and adding it as a control dummy variable for the presence of firms in a high-polluting industry following the classification scheme used by Delmas and Toffel (2008). A 'dirty' industrial sector variable takes the value 1 if the firm belongs to an industry that can be considered as high-polluting and 0 if considered otherwise (Cordeiro et al., 2020; González-Benito & González-Benito, 2006). The untabulated results are robust, and the adjusted R square does not increase significantly, unlike the control variable for high pollution, which is statistically significant. However, the results related to our hypotheses are qualitatively the same as those of the main analysis.

## 5 | DISCUSSION AND CONCLUSION

Our results confirm that the mandatory introduction of gender quota in BoDs is negatively related to GHG emissions and positively related to the amount of recycled waste and thus to firms' overall environmental performance. Therefore, a higher presence of women directors due to gender quota legislation influences the decision-making process related to environmental questions due to women's commitment to this issue (de Villiers et al., 2011; Diamantopoulos et al., 2003; Haque, 2017; Mainieri et al., 1997), and women's acceptance of roles related to the environment and their sustainability skills (Kim & Starks, 2016). This confirms the validity of upper echelons and resource dependence theories in the field of gender diversity in BoDs and environmental decision-making, in other words that female directors provide firms with valuable resources, which can influence its decision-making process and improve environmental performance.

The existing literature describes mixed results regarding the impact of gender diverse boards on the increase in climate and GHG disclosure (Ben-Amar et al., 2017; Hollindale et al., 2019; Liao et al., 2015), the lack of significant GHG disclosures (Prado-Lorenzo & Garcia-Sanchez, 2010) and the increase in GHG performance (Haque, 2017). Cucari et al. (2018) interpret differences in results as reflecting the low representation of women on BoD in some countries. Adding nuance to these mixed results, we show that the implementation of gender quota limitations with a high percentage of women on BoD seen in mandatory adopters is the main determinant of firms' GHG performance, compared to voluntary adapters and firms in the pre-implementation period with a low female representation. Our results also confirm that gender diversity positively impacts waste reduction, which is an indicator of firms' environmental innovation (Burkhardt et al., 2020; Nadeem et al., 2020). Particularly, a coercive approach through gender quota regulation of BoD helps contributes towards increasing waste recycling.

We also confirm that the higher presence of women directors, as required by the law, influences firms' decision-making process related to unethical environmental conduct. We provide evidence for gender socialisation and overconfidence theories that women's concerns regarding third-party stakeholders (Liu, 2018), their attention to experts' opinions (Levi et al., 2015), and propensity to avoid overconfidence in decision-making (Chen et al., 2016; Levi et al., 2014) lead



to a reduction in environmental violations that result in litigation. Italy implemented a regulatory action towards a quota of at least 20% female directors during the first renewal of a company's BoD. This action created a threshold higher than in other countries and a requirement regulated by a law with a staggered implementation depending on the renewal of the BoD. Our contribution is in favour to the coercive approach through a gender quota on BoD. We show that regulatory actions in favour of the increase of female directors could bring to several benefits. Board with gender quota decisions reflect also women-specific experiences, knowledge, and values. The characteristics of women towards socialisation and participation, their sustainability skills and attention to environmental risks, their concern about the welfare of third-party stakeholders brings to a better environmental performance and a reduction of environmental violations. We contribute to the role of female board members in reducing GHG emissions and improving waste recycling arguing that prior results may be due to the low representation of women on boards or to the use of an enabling, Laissez-Faire approach. It is the coercive approach that creates the positive association with environmental performance.

However, our study has some limitations. For instance, our sample is only based on voluntary environmental disclosures by firms in Italy. Future research could include additional samples from other countries with gender quota legislation in order to increase the sample size. Further steps could be taken to investigate the voluntary disclosures of non-listed Italian firms. Additionally, this study does not focus on critical mass theory (i.e., Ben-Amar et al., 2017) because, as we can see from descriptive statistics, boards in Italy are relatively small (mean 11 members) and the 20% required by the law frequently does not reach the minimum of three required by critical mass theory. Future research could therefore usefully consider investigating other indicators to measure performance and provide further evidence on the decision-making process and related theories.

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## APPENDIX A. Variable definitions

Variables	Definitions																																		
<i>Dependent variables</i>																																			
Environmental performance																																			
GHG	<p>Natural logarithm of the total emissions of GHG in air, measured in thousands tons</p> <table border="1"> <thead> <tr> <th>Emission of CO2E (Ton)</th> <th>2012</th> <th>2011</th> </tr> </thead> <tbody> <tr> <td>Scope I</td> <td>232.302</td> <td>204.466</td> </tr> <tr> <td>Scope II</td> <td>339.838</td> <td>371.067</td> </tr> <tr> <td>Scope III</td> <td>503.403</td> <td>471.601</td> </tr> </tbody> </table> <p>Leonardo Finmeccanica, Sustainability report 2012, page 87. In our data, this example is coded as the natural logarithm of (232.302 + 339.838 + 503.403) for 2012.</p>	Emission of CO2E (Ton)	2012	2011	Scope I	232.302	204.466	Scope II	339.838	371.067	Scope III	503.403	471.601																						
Emission of CO2E (Ton)	2012	2011																																	
Scope I	232.302	204.466																																	
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Recycled waste	<p>Recycled waste/total waste</p> <table border="1"> <thead> <tr> <th rowspan="2">Method of Waste Disposal (Tons)</th> <th colspan="3">2018</th> <th colspan="3">2017</th> </tr> <tr> <th>Dangerous</th> <th>Non-dangerous</th> <th>Total</th> <th>Dangerous</th> <th>Non-dangerous</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>Recycled*</td> <td>28</td> <td>172</td> <td>200</td> <td>17</td> <td>107</td> <td>124</td> </tr> <tr> <td>Waste disposal site/Waste Dump</td> <td>0.1</td> <td>41</td> <td>41.1</td> <td>1</td> <td>38</td> <td>39</td> </tr> <tr> <td>Total</td> <td>28.1</td> <td>213</td> <td>241.1</td> <td>18</td> <td>145</td> <td>163</td> </tr> </tbody> </table> <p>*Data are showed based on the document that certifies the effective weight of waste produced during the year. The company receives this document after 30 April of the following reporting year. El Tower, Sustainability report 2012, page 87. In our data, this example is coded <math>200/241.1 = 0.8295</math> for 2018. Note: this is a voluntary disclosure. The division between dangerous and non-dangerous is not frequent in our sample.</p>	Method of Waste Disposal (Tons)	2018			2017			Dangerous	Non-dangerous	Total	Dangerous	Non-dangerous	Total	Recycled*	28	172	200	17	107	124	Waste disposal site/Waste Dump	0.1	41	41.1	1	38	39	Total	28.1	213	241.1	18	145	163
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Environmental enforcement																																			
Litigation	<p>1 if the company has a civil litigation related to an environment issue; 0 otherwise In 2013 the Italian Ministry of the Environment and other defendants were the plaintiffs in a civil action against Atlantia who used dangerous materials from a tunnel excavation to construct new freeway embankments. Atlantia, Integrated reporting 2013, page 128 In our data, this example is coded as 1 for 2013: the presence of a civil litigation related to an environment issue for the company</p>																																		
Penalty	<p>1 if the company has received a penalty related to an environment issue; 0 otherwise The Province of Genoa, on the basis of the Regional agency for environment protection and other competent authorities' investigations, issued Iren fines for a total of 75,000 euro in relation to its alleged violations regarding discharges and purification. Iren, Sustainability report 2014, page 162 In our data, this example is coded 1 for 2014: the presence of a penalty related to an environment issue for the company</p>																																		
Type of disclosure																																			
Social report	1 if the firm's environmental disclosure is reported in this type of report; 0 otherwise																																		
Environmental report	1 if the firm's environmental disclosure is reported in this type of report; 0 otherwise																																		
Sustainability report	1 if the firm's environmental disclosure is reported in this type of report; 0 otherwise																																		
Integrated report	1 if the firm's environmental disclosure is reported in this type of report; 0 otherwise																																		
Non-financial disclosure report	1 if the firm's environmental disclosure is reported in this type of report; 0 otherwise This report was initiated in 2017, thus our sample only uses it for 2017 and 2018																																		

(Continues)





Variables	Definitions
<b>Gender</b>	
Test variables to identifies firms	
Mandatory adopters	1 if the firm had a gender quota lower than the that defined by the regulation (20%) before the implementation of the regulation, 0 otherwise; i.e., if the firm as a voluntary adopters had a higher gender quota also before the mandatory regulation.
Test variables to identifies periods	
Post	1 if in the year of analysis the firm has its BoD renewed after 12 August 2012; 0 otherwise
Variables in the graphs	
Voluntary adopters	1 if the firm as a voluntary adopters had a higher gender quota before the mandatory regulation; 0 otherwise
Mandatory first adopters	1 if the firm renewed the BoD for the first time after 12 August 2012 in the year 2013; 0 otherwise, that is if the firm renewed the BoD for the first time after 12 August 2012 in the year 2014 (later adopters), 2015 (third adopters) and so on
Mandatory later adopters	1 if the firm renewed the BoD for the first time after 12 August 2012 in the year 2014; 0 otherwise
<b>Governance</b>	
BoD size	Natural logarithm of the number of members in the BoD
BoD independence	Number of independent directors / number of members in the BoD
BoD meeting	Number of meetings in a year
CEO age	Year of birth - Current year
CEO duality	1 if CEO is also Chair; 0 otherwise
<b>Firm</b>	
Firm size	Natural logarithm of total assets
Leverage	Equity / total assets
Sales Growth	(sales t - sales t-1)/sales t-1
ROA	Operating profit / total assets
<b>Robustness</b>	
High pollution industry	1 if the firms is on a heavily polluting industry, based on their share of toxic chemical emissions reported to the U.S. EPA's Toxic Release Inventory program and included pulp, paper, and paperboard mills (SIC 26); chemical and allied products (SIC 28); petroleum refining (SIC 29); primary metals manufacturing (SIC 33); machinery manufacturing (SIC 35); electrical/electronics (SIC 36); automotive (SIC 37); and electric utilities (SIC 49) (Delmas and Toffel (2008)); 0 otherwise