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Do corporate governance mechanisms curb the anti-environmental behavior of firms worldwide? An illustration through waste management

Running Title: Corporate governance and waste management

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Abstract

This study investigates whether waste management, including waste generation and recycling, affects firm performance. Using a panel of 14,601 firm-year observations from 41 countries from 2002 to 2019, we find a significantly negative (positive) relationship between waste generation (recycling) and firm performance. Our findings are robust to alternative measures of waste management and firm performance, sub-sample analysis, and alternative econometric specifications. Further, our results are robust to different identification strategies. Finally, our channel analysis shows that the negative (positive) relationship between waste generation (recycling) and firm performance is stronger in firms offering no environmental, social, and governance (ESG) based compensation. However, the relationship varies with the level of firms' environmental orientation, and we observe insensitivity of the relationship regardless of firm-level governance quality. Our study presents important policy implications for regulators and firms.

Keywords: Corporate governance mechanism; waste management; waste production and recycling; unethical business practices.

Availability of data: Authors do not have the right to share data.

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Abstract

Driven by the current surge in environmental and climate issues and the pressure of the government and regulatory bodies on corporations to diminish their carbon trails, this study uniquely examines the impact of distinct corporate governance mechanisms on the level of waste produced on a global sample of firms during 2002-2019. Our findings show that corporate governance mechanisms are important predictors of the level of waste produced by firms worldwide. In particular, the board size, board independence, and sustainability committees are linked to a higher level of waste produced. Conversely, the board gender diversity reduces the waste produced, and CEO duality is not associated with the level of waste produced. Our results are robust to alternate proxies of main variables, potential endogeneity concerns (using propensity score matching, two-stage least squares, and generalized system method of moments technique), and additional analyses. Further analysis shows that larger and gender-diverse boards improve the firm's waste recycling behavior, whereas board independence and the presence of a sustainability committee are negatively related to waste recycling. The study has vital insinuations in developing efficient, ethical regulations and guidelines for corporate boards specifically from the perspective of waste management, environmental protection, and restoration.

Keywords: Corporate governance mechanism; waste management; waste production and recycling; unethical business practices

“Climate change is the single greatest threat to a sustainable future but, simultaneously, addressing the climate challenge presents a golden opportunity to promote prosperity, security, and a brighter future for all.” (Ban Ki-Moon, Former Secretary-General of UN)

1. Introduction

The rapidly growing human population, along with large-scale urbanization and industrialization has caused enormous waste production. According to the global waste management outlook report of the United Nations Environment Programme (UNEP), the best estimate of the current waste production worldwide is approximately two billion tons per annum, and it is expected to grow by 3.4 billion tons (70%) by 2050 if precautionary actions are not taken immediately (Kaza et al., 2018). This ever-increasing size and complexity of waste linked to the industrialized economy pose a serious threat to our ecosystem, and have adverse consequences on climate change, which ultimately affect biodiversity, pollution, and human health (Hantoko et al., 2021). The importance of waste management can also be reflected in the fact that almost half of the 17 sustainable development goals are directly or indirectly associated with this critical issue. The academic research on the environment also suggests that the economic units should focus on sustainable processes that, together with improving efficiency,¹ also provide ways to reduce waste production and achieve a zero-waste environment (Aldieri et al., 2021). While highlighting the importance of waste management, the primary focus of the UNEP report is the “governance” problem that needs to be addressed to establish a sustainable solution that includes the policy and

¹ For instance, recent literature (see Wang et al., 2020) highlights that the productive capacity of water resources in Hubei Province in China has gradually increased by adopting a revised and more sustainable process for water resource ecological footprint. Such adoption shows that the role of technology is inevitable in improving waste management across regions.

regulatory instruments². Further, a firm's investment in sustainable business practices and environmentally friendly policies also depends upon the structure and the governance of the board of directors (Amorelli & García-Sánchez, 2021; Atif et al., 2020; Atif & Ali, 2021; García Martín & Herrero, 2020; García-Sánchez et al., 2019; García-Sánchez et al., 2021; Nadeem, 2020; Nadeem et al., 2020; Nadeem, Gyapong & Ahmed, 2020; Shahab et al., 2020) and on important aspects, such as organizational capital (Nadeem et al., 2021). Hence, this study seeks to investigate the impact of various governance mechanisms on waste management at the corporate board level. Based on a multi-theoretical framework drawn from stakeholder, resource-based, and agency views, it study examines the effect of corporate governance mechanisms, such as board size, board independence, board gender diversity, CEO duality, and board's sustainability committee on waste management.

Theoretically, extant literature provides two general views about governing the firm's waste management practices. First, the stakeholder view suggests that firms should invest in the society they operate in, as it enhances firm value and performance (Donaldson & Preston, 1995; Freeman, 1984). Accordingly, the empirical evidence suggests that socially responsible investments (SRIs) reduce the cost of capital (El Ghouli et al., 2011) and default risk (Atif & Ali, 2021) and improve performance (Albuquerque et al., 2019). Hart and Ahuja (1996) find that "it pays to be green" as fighting pollution is a cost that hurts a firm's competitiveness; by reducing emissions, firms save money, which increases efficiency, and achieves cost advantage. Second, relying on the resource-based view, Russo and Fouts (1997) conclude that environmental performance drives economic performance, especially in high-growth industries. They argue that firms that undertake proactive environmental policies redesign their processes through acquiring

² <https://www.unep.org/resources/report/global-waste-management-outlook>

new technologies, which improves their operational efficiency and helps them achieve waste reduction. Porter (1991) also argues that the positive relation between investment in the environment and performance results from the impact of environmental policies on increasing efficiency and stimulating innovation. He stipulates that investment in the environment is beneficial for firms as pollution symbolizes economic inefficiency, which is reduced through these investments.

Contrarily, the agency theory suggests that investment in society is not a value-maximizing investment but an additional cost that shareholders bear. In *The New York Times* article Friedman (1970) stated that “the social responsibility of business is to increase profits.” The agency view manifests that environmental responsibility is an agency issue and creates problems inside the firm as managers tend to extract private benefits at the cost of shareholders (Krüger, 2015; Masulis et al., 2009). However, stronger corporate governance mechanisms help reduce agency conflicts by aligning management and shareholders’ interests (Guthrie & Parker, 1990).

Using a global sample of listed firms for 2002-2019, we document that corporate governance mechanisms strongly impact waste management. Specifically, we find that board size, board independence, and the presence of a sustainability committee are positively and significantly associated with the level of waste produced. However, female directors are negatively and significantly related to the level of waste produced, while we find no association between the CEO duality and the level of waste produced. Our results also highlight that these relationships are largely persistent for both hazardous and non-hazardous waste and are robust for (i) alternate measures of waste, (ii) alternate sample composition, (iii) alternate model specifications and (iv) for other endogeneity checks. In our additional analysis, we examine

whether corporate governance mechanisms impact the recycling of waste and find that board size and female directors are positively associated with recycling waste. However, board independence and sustainability committee are negatively related to waste recycling, and we find no relationship between CEO duality and waste recycling. Overall, these results establish that corporate governance mechanisms significantly affect the firms' waste management practices.

Consequently, our study contributes to the existing literature in many ways. First, we extend the research that examines the impact of corporate governance mechanisms on firms' environmental policies (Chan et al., 2014; Henriques & Sadosky, 1999; Kassinis & Vafeas, 2006; Nadeem, 2020; Nadeem et al., 2021; Ntim & Soobaroyen, 2013). Studies explore the impact of governance quality on specific environmental policies, such as carbon emission (Palea & Drogo, 2020), green innovation (He & Jiang, 2019), environmental violations (Liu, 2018), and greenhouse gases (Prado-Lorenzo & Garcia-Sanchez, 2010) among others. However, to the best of our knowledge, we are the first to go beyond existing studies to focus on the unexplored issue of waste management and firm-level corporate governance. Consequently, we also contribute to the debate on how a firm's stakeholder orientation and agency conflicts can impact its waste management practices. We investigate waste management separately as it requires a unique firm-level skill set and investments and is governed by different regulations and disclosure criteria (Gendebien et al., 2002; Inglezakis & Moustakas, 2015). For example, waste management requires substantive process improvements (Johnstrone & Hallberg, 2020), which sometimes change the way businesses operate and may be too costly for them. Thus, reducing waste is of substantial interest to stakeholders and the management, and employees within the organization (Hill & Jones, 1992), as it requires extra effort from managers to redesign the complex internal processes and systems (King & Lenox, 2002; Russo & Fouts, 1997). As it can change the way

businesses operate and their cost structure, it is important to address how firm-level governance can impact waste production and recycling. On account of the complexity and cost involved in waste management, the impact of corporate governance characteristics also differs for waste management compared to other environmental issues. For example, we find that board size positively influences waste production. These results contradict the earlier findings that show a negative relation between board size and firm environmental performance (Walls et al., 2012; Lu & Herremans, 2019) and support the agency view highlighted by Jensen (1993) in comparison to the resource provision role of board members. Larger boards are less effective in preventing environmental issues (Kassinis & Vafeas, 2002) such as waste management, specifically, if they are complex and costly to handle. We also find a positive relationship between board independence and waste production, which contradicts the earlier findings that independent directors are stakeholder-oriented and better monitors (Jo & Harjoto, 2011). Our results show that independent directors increase waste production because they are more concerned with shareholder wealth protection. Consequently, they may minimize costly initiatives, such as waste management programs, that involve changing the way firms do their business. The lack of technical knowledge and expertise may also lead independent directors to avoid costly investments in waste reduction initiatives (Brochet & Srinivasan, 2014; Ma & Khanna, 2016; Mittal, 2011).

Second, we also contribute to the waste recycling literature by highlighting the fact that the board size, board independence, gender diversity, and sustainability committee also significantly affect waste recycling. Prior studies mostly focus on waste recycling at the household and country-level (Abbott et al., 2011; Aldieri et al., 2021; Ferrara & Missios, 2012; Wang et al., 2020). However, the issue of waste recycling at the corporate level still warranted

further investigation, and we have tried to address it here. Third, our study contributes to the vast literature on the monitoring role of corporate governance and board-level factors in improving a firm's social performance and reputation (Coffey & Wang, 1998; Huang, 2010; Johnson & Greening, 1999; Nardella et al., 2020; Orazalin & Baydauletov, 2020) by showing that the board level monitoring may enhance the quality of a firm's waste management practices. Altogether, our findings offer useful insights and policy implications for management and other stakeholders involved in refining governance mechanisms and waste management practices. Finally, from the methodological perspective, we analyze the issue at a robust level to reduce estimation bias and address possible alternate explanations that may drive our main conclusions. Specifically, we address the issue of reverse causality, measurement errors, self-selection bias using lagged independent variables, propensity score matching, generalized method of moments (GMM), and two-stage least square regression. Only a handful of studies discuss the robustness and endogeneity issues in detail while examining corporate governance and environmental concerns (see, for example, Liu, 2018).

The remainder of the paper is organized as follows. Section 2 describes the relevant literature and proposes our main hypotheses. Section 3 describes the main sample, data, and empirical model. Section 4 discusses the main results and robustness tests. Section 5 shows the additional analysis and section 6 concludes the paper.

2. Literature review and hypotheses development

2.1 Corporate governance and environmental management

Owing to the increasing demand by various stakeholders, sustainability practices are on the rise in organizations. Accordingly, the research on sustainable business practices is also on the rise as

studies ascertain how and to what extent firms' environmental management practices affect their performance. The studies so far have provided mixed results in this area, with many showing the positive impact of environmental management practices on firm performance. However, they also discuss the possible issues that businesses face due to these sustainable practices (Elsayed & Paton, 2005; Klassen & McLaughlin, 1996; Scholtens, 2008). The evidence suggests an ambiguous but slightly positive relationship between firms' sustainable practices and their financial performance (Margolis et al., 2009). Further, a firm's corporate governance role is substantial as it drives its environmental policies (Endo, 2020; Wall, Berrone, & Phan, 2012). These corporate governance mechanisms include the board of directors, managerial incentives, and the market for corporate control, among others (Kock, Santaló, & Diestre, 2012).

The main objective of corporate governance is to understand and address the demands of various stakeholders. The channel to achieve such an understanding is through stakeholder engagement (Unerman & Bennett, 2004). Thus, firms invest in sustainable practices to show their governance quality, which addresses diverse stakeholders' demands (Bozzolan et al., 2015; Michelon & Parbonetti, 2012; Nadeem, 2020). Existing evidence suggests that corporate governance is positively related to firms' social performance (Chan et al., 2014; Harjoto & Jo, 2011; Jamali et al., 2008; Johnson & Greening, 1999), and stakeholders prefer environmentally friendly business models (Henriques & Sadosky, 1999; Sharma & Henriques, 2005). Governments, suppliers, employees, customers, and media all demand that organizations act environmentally responsible (Aldieri et al., 2021; Bansal & Roth, 2000; Buysse & Verbeke, 2003; Kassinis & Vafeas, 2006).

Theoretically, the stakeholder view encourages firms to allocate resources for environmental issues and focus more on fulfilling the environmental responsibilities (Freeman,

2010). Consequently, strongly governed firms provide higher voluntary disclosures related to the environment and the society (Chan et al., 2014; Mallin et al., 2013; Rankin et al., 2011). The shareholders put higher confidence in boards and the trust management's investment decisions (Chen, 2008; Chen & Chuang, 2009), including those related to waste management. For example, Ntim & Soobaroyen (2013) show that better-governed firms follow environmentally sustainable practices and provide extensive disclosures. These practices may also help firms to build a stronger relationship with stakeholders through trust and reduced transaction costs.

Based on this conjecture, one may expect that firms with strong corporate governance mechanisms in place are more motivated to adopt effective waste management policies. However, the capability of the board members to monitor such policies might also be contextual. Specifically, the agency theory suggests that the monitoring role of the board members is contingent on their responsibilities (Hillman & Dalziel, 2003). They argue that the independent board members and those involved in performing fiduciary duties are likely to be more vigilant in exercising monitoring functions. Therefore, this study focuses on various board-level governance mechanisms and explains how they impact a firm's waste management practices.

2.2 Corporate governance and waste

2.2.1 Board size and waste

In their seminal work on the resource dependence theory, Salancik & Pfeffer (1978) recognize that the board of directors performs a key function in aiding firms with counseling and advice, helping them evaluate information, and providing preferential access to relevant outside resources. A vast literature on the resource dependency theory provides empirical support on the multifarious roles of board members (Hillman et al., 2009; Kirsch, 2018; Kroll et al., 2008;

Withers et al., 2012). Some of these resources are business and industry experts, support specialists, and community influencers (Hillman et al., 2000). Further, firms that require more guidance and counseling, such as those that disclose more information, accomplish superior value through larger boards (Coles et al., 2006). For example, Booth & Deli (1996) highlight that firms with environmental uncertainty generally have larger boards as they provide access to the expertise needed to reduce this uncertainty. It may be due to the presence of specialists on specific resource dependence-related factors, such as environmental issues.

Thus, larger boards may comprise experienced and learned directors who have a better aptitude to manage environmental issues. Further, larger boards are likely to represent more diversity and various ranges of abilities and skillsets; thus, there is a greater probability that some of them have managed or are exposed to an environmental issue, such as waste management. We argue that these directors may further enlighten the other board members about the challenges and opportunities related to environmental issues in general and waste management in particular. Further, they can provide relevant resources, expertise, and access to information needed to overcome such critical concerns. Walls et al. (2012) and Lu & Herremans (2019), among others, find a positive relationship between board size and a firm's environmental performance. Thus, one can expect that through their resource-dependence function, firms with larger boards are more likely to have effective waste management practices. Accordingly, our first hypothesis is as follows:

H1a: *Board size is negatively associated with the level of waste produced.*

On the contrary, the agency theory predicts that the larger boards are less effective due to the lack of coordination in decision making. In one of the seminal works on the agency theory, Jensen (1993) argues that "Keeping boards small can help improve their performance. When

boards get beyond seven or eight people, they are less likely to function effectively, and it becomes easier for the CEO to control the board of directors. Since the possibility for animosity and retribution from the CEO is too great, it is almost impossible for those who report directly to the CEO to participate openly and critically in effective evaluation and monitoring of the CEO” (Jensen, 1993 p. 865). Based on these conjectures, many studies conclude that smaller boards are more effective in both coordination and monitoring, thus improving firm performance as compared to larger boards, which mainly suffer from a lack of communication and coordination between directors, and negatively impact the monitoring function of the board, thereby ultimately affecting the firm performance (Canyon & Peck, 1998; Eisenberg et al., 1998; Liang et al., 2013). This perspective is also relevant for a firm’s environmental performance. Kassinis & Vafeas (2002) show that boards with large sizes are less effective in preventing environmental violations. Larger boards may fail to implement acceptable agendas on the environment because of their lack of coordination and coerciveness; thus, they are not suitable for initiating strategic decisions (Goodstein et al., 1994). Waste management, as a prime environmental issue, needs strategic focus with a participative approach and strong monitoring, which may be challenging in the presence of the larger board. Based on both agency perspectives, our alternate hypotheses related to the relationship between board size and waste management is as follows:

H1b: *Board size is positively associated with the level of waste produced.*

2.2.2 Board independence and waste

Studies suggest that independent directors better monitor management activities and firm performance (Harjoto et al., 2018; Kesner & Johnson, 1990; Nguyen & Nielsen, 2010). Further, board independence also plays an important role in enhancing the information disclosure quality and reducing information asymmetry (Chahine & Filatotchev, 2008). Given the importance of a

firm's environmental policies in improving firm performance (Al-Najjar & Anfimiadou, 2012; Griffin et al., 2020; Prakash, 2001), independent directors should monitor the decisions concerning environmental policies and practices. Indeed, independent directors are more concerned about firms' sustainable practices, and thus, focus more on their environmental and social policies (Gul & Leung, 2004; Ibrahim & Angelidis, 1995; Jo & Harjoto, 2011). Since they emphasize a diverse set of stakeholders, and given their strong stakeholder orientation, we argue that a firm with a higher ratio of independent directors is less likely to generate higher levels of waste. Specifically, independent directors have higher incentives to monitor waste management practices as they are aware of the fact that a firm's environmental performance improves its reputation in the eyes of shareholders, lenders, the government, and the media (Gangi et al., 2020; Johnson & Greening, 1999; Toms, 2002). Further, independent directors also need to protect their standing in the market, by serving the firms in an environmentally friendly manner; hence, they focus more on a broader set of stakeholders.

Contrarily, some studies also show that the concentration of independent directors is negatively related to firm performance. For example, Agrawal & Knoeber (1996) find a negative relationship between board independence and firm performance. Moreover, board independence is also shown to be negatively associated with the firm's social and environmental performance. The greater board independence signals shareholders' wealth protection, thus minimizing a firm's philanthropic initiatives (Coffey & Wang, 1998; Haniffa & Cooke, 2005). This situation may be due to the several deficiencies concerning the involvement of independent directors on the corporate boards, primarily related to their expertise and knowledge of company affairs, among others (Brochet & Srinivasan, 2014; Ma & Khanna, 2016; Mittal, 2011). Accordingly, board independence may compromise stakeholder orientation, and thus, may result in higher

levels of waste. Thus, keeping in view the contrasting views, we propose two competing hypotheses regarding the relationship between board independence and waste management as follows:

***H2a:** Board independence is negatively associated with the level of waste produced.*

***H2b:** Board independence is positively associated with the level of waste produced.*

2.2.3 Board gender diversity and waste

We propose two parallel views for the relationship between the presence of female directors on the board and waste management. First, based on the ethicality principle, female directors are supposed to be more ethical in their business decisions as compared to their male counterparts, and thus, reduce unethical business practices, such as earnings management (Gull et al., 2018), corporate fraud (Cumming et al., 2015), and environmental violations (Liu, 2018) among others. Among these aspects are the sustainable and environmentally friendly business practices that enhance a firm's environmental and sustainable performance (Atif et al., 2020; Glass et al., 2016), environmental, social, and economic value creation (Nadeem, Gyapong & Ahmed, 2020), and environmental innovation (Nadeem et al., 2020). This situation is because female directors are stakeholder-oriented and prefer long-term profits over short-term losses (Matsa & Miller, 2011, 2013). The fact that the higher presence of female directors on the board is related to higher CSR performance (Bear et al., 2010; McGuinness et al., 2017) validates their stakeholder orientation and approach towards community and social welfare.

Further, studies provide evidence that female directors are better at monitoring than their male counterparts and they tend to reduce information asymmetry by joining committees with monitoring functions, including audit and corporate governance (Abad et al., 2017; Adams &

Ferreira, 2009; Chen et al., 2016). Female directors enhance board communication with outsiders and increase the disclosure quality (Gul et al., 2011), which helps in reducing the information asymmetry. Hence, waste reduction in the presence of female directors may indicate that they adopt sustainable and environmentally friendly business practices due to their higher level of stakeholder orientation. We argue that because of their higher level of stakeholder orientation and green nature, female directors indulge in business practices and process improvements, which include waste reduction, and hypothesize the following:

H3: *The presence of female directors on the board is negatively associated with the level of waste produced.*

2.2.4 CEO duality and waste

CEO duality refers to the situation where the CEO also holds the chairmanship of the board of directors. CEO duality is linked to agency problems due to the concentration of power in one hand, which creates information asymmetry among board members and the CEO (Villiers et al., 2011). Empirical evidence suggests that this excessive power may create an opportunistic behavior where the CEO-chair promotes his agendas in the board meetings at the cost of the firm, thus reducing the monitoring function of the board (Finkelstein & D'aveni, 1994; Kelton & Yang, 2008). The CEO duality is mostly detrimental to firm value as it has adverse consequences on corporate governance, which results in investment efficiency (Aktas et al., 2019), thereby promoting managerial entrenchment and reduced firm performance (Fama & Jensen, 1983; Jensen, 1993; Lorsch & Young, 1990). Owing to its strong powers, CEO duality results in short-termism, wherein the CEO dominates the meetings with short-term objectives instead of strategic directions, such as investment in environmental issues (García Martín & Herrero, 2020; Villiers et al., 2011). On account of this short-termism and opportunistic behavior, CEO duality is

negatively related to a firm's social performance. For example, Webb (2004) find a negative relationship between CEO-duality and a firm's social responsibility. Giannarakis et al. (2014) also confirm that CEO/Chairman duality adversely impacts a firm's social performance. Arguably, CEO duality may result in the absence of effective waste management practices; we, therefore, expect a positive relationship between CEO duality and the levels of waste produced and propose the following hypothesis:

H4: CEO duality is positively related to the level of waste produced.

2.2.5 CSR committee and waste

To meet corporate sustainability goals and stakeholder orientation, most companies now form sustainability committees as a corporate governance mechanism to manage the firm's environmental performance, perceived risks, and related opportunities (Michals, 2009; Peters & Romi, 2015). Studies suggest that the presence of a sustainability committee is linked to better environmental performance. Rodrigue et al. (2013) analyze whether sustainability committees impact a firm's environmental disclosure quality or have a symbolic representation. They find that such a committee emphasizes reputation concerns and litigation risk more, and thus, affects the firm's sustainable environmental practices to some extent. Contrastingly, Liao et al. (2015) and Peters and Romi (2015) show that the presence of the CSR and environmental committees positively impacts a firm's environmental performance. Our objective is to examine whether such a committee enhances the effectiveness of a firm's waste management practices and expect that the stakeholder-orientated nature of the CSR committee will result in sustainable processes and waste reduction. It leads to our last hypothesis:

H5: The presence of a CSR committee is negatively associated with the level of waste produced.

3. Research methodology

3.1 Data and sample

We collect data on different proxies of waste, financial, and governance variables from two renowned databases, that is, (a) ASSET4 and (b) WorldScope, for the global sample of listed firms for 2002-2019. We use the waste data from ASSET4 because this database has been widely used in environmental studies (Nadeem et al., 2020; Nadeem, Gyapong & Ahmed, 2020), and scholars argue that ASSET4 specializes in providing objective, relevant, auditable, and systematic ESG information (Cheng, Iannou & Serafeim, 2014). Our sample period begins in 2002 and ends in 2019, as this is the time period in which maximum data on firm-level waste generation becomes accessible. Our initial sample consists of 19,408 firm-year observations. After screening data for missing observations, our final sample comprises 17,443 firm-year observations from 43 countries between 2002 and 2019. Moreover, to mitigate the impact of outliers, we winsorize all continuous variables at the 1% and 99% levels. Table 1 shows the detailed sample distribution and averages of key variables by year (see Panel A) and by country (see Panel B). Panel A shows that the level of waste produced is above the mean value of 10 (logged value) over the sample years, which is critical given the severity of the climate and ecological issues. Moreover, Panel B shows that Russian Federation, Canada, and India are the top three countries, whereas New Zealand, Argentina, and the Philippines are the bottom three countries based on the level of waste produced in our sample (based on the mean value).

INSERT TABLE 1 ABOUT HERE

3.2 Measurement of main variables

3.2.1 Waste management

Our key outcome variable is the total waste (*WASTE*), the natural log of the total waste produced in tons by a firm. For robustness/additional analyses, we also include five alternate measures of

our key outcome variable (i.e., *WASTE*) and replace them in Equations (1)-(5) as the dependent variable. These are (i) hazardous waste (*H_WASTE*) calculated as the natural log of the total hazardous waste produced in tons, (ii) non-hazardous waste (*NH_WASTE*) calculated as natural log of the total non-hazardous waste produced in tons, (iii) waste-assets ratio (*WASTE/ASSETS*) calculated as the ratio of the total waste in tons to total assets, (iv) waste-sales ratio (*WASTE/SALES*) calculated as the ratio of the total waste in tons to total sales and (v) recycled waste (*R_WASTE*) calculated as the ratio of the recycled waste to total waste produced. All these proxies of waste are calculated following the previous work (see Benjamin et al., 2020) except recycled waste (*R_WASTE*) because they do not focus on this aspect of waste management practices.

3.2.2 Corporate governance mechanisms

Corporate governance mechanisms are key predictors of different firm-level policy decisions. We focus on five such governance mechanisms due to their importance in affecting its environmental performance. These are (i) board size (*B_SIZE*) measured as the natural log of the number of directors on the board, (ii) board independence (*B_IND*) measured as the proportion of independent directors on the board, (iii) board gender diversity (*F_PRO*) measured as the proportion of female directors on the board, (iv) CEO duality (*DUAL*), which is a dummy variable equal to 1 if the CEO and chairman positions are not separate and 0 otherwise, and (v) CSR committee (*CSR_COM*) measured as dummy variable equal to 1 if the firm has a CSR committee and 0 otherwise.

3.3 Empirical models

The key objective of this study is to empirically explore how certain corporate governance mechanisms influence the level of waste produced by the sample firms. Following in the

footsteps of prior studies (Atif & Ali, 2021; Cheng, Iannou & Serafeim, 2014; Nadeem et al., 2020), we use pooled Ordinary Least Squares (*OLS*) while controlling for different firm-level characteristics and including industry, year, and country fixed effects as our empirical methodology. Including such fixed effects ensures that the results are driven by simple correlation and cater for the causation effect. Particularly, to empirically examine the relationship between corporate governance mechanisms and the level of waste produced, we develop our baseline models using pooled *OLS* regressions as follows:

$$WASTE_{i,t} = b_0 + \beta_1 B_SIZE_{i,t} + \sum \beta_n Controls_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$WASTE_{i,t} = b_0 + \beta_1 B_IND_{i,t} + \sum \beta_n Controls_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$WASTE_{i,t} = b_0 + \beta_1 F_PRO_{i,t} + \sum \beta_n Controls_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$WASTE_{i,t} = b_0 + \beta_1 DUAL_{i,t} + \sum \beta_n Controls_{i,t} + \varepsilon_{i,t} \quad (4)$$

$$WASTE_{i,t} = b_0 + \beta_1 CSR_COM_{i,t} + \sum \beta_n Controls_{i,t} + \varepsilon_{i,t} \quad (5)$$

where *WASTE* represents our main dependent variable and *B_SIZE*, *B_IND*, *F_PRO*, *DUAL*, and *CSR_COM* are different corporate governance mechanisms used as independent variables.³ To test H1, we focus on the coefficient β_1 of Equation (1). If board size increases (decreases) the level of waste produced, then the coefficient on *B_SIZE* (β_1) should be positive (negative) and significant. To test H2, we focus on the coefficient β_1 of Equation (2). If board independence increases (decreases) the level of waste produced, then the coefficient on *B_IND* (β_1) should be positive (negative) and significant. To test H3, we focus on the coefficient β_1 of Equation (3). If the presence of female directors on board increases (decreases) the level of waste produced, then

³ These variables are defined under section 3.2 and Appendix A.

the coefficient on *F_PRO* (β_1) should be positive (negative) and significant. To test H4, we focus on the coefficient β_1 of Equation (4). If CEO duality increases (decreases) the level of waste produced, then the coefficient on *DUAL* (β_1) should be positive (negative) and significant. To test H5, we focus on the coefficient β_1 of Equation (5). If the presence of a sustainability committee decreases (increases) the level of waste produced, then the coefficient on *CSR_COM* (β_1) should be negative (positive) and significant.

Moreover, *Controls* depicts a vector of firm-level control variables which can affect our baseline empirical model. Particularly, these variables are research and development (*R&D*), profitability (*ROA*), Tobin's Q (*TQ*), loss (*LOSS*), cash holdings (*CASH*), financial leverage (*LEVERAGE*), and firm size (*SIZE*). We also control the industry, country, and year fixed effects in all the regression models. All these variables are defined in Appendix A.

4. Empirical findings and discussions

4.1 Descriptive statistics

Table 2 reports the summary statistics for the level of waste produced, corporate governance indicators, and the control variables employed in this study. The mean of the key outcome variable, that is, total waste (*WASTE*), is 10.613. In terms of corporate governance mechanisms, the mean values of board size (*B_SIZE*), board independence (*B_IND*), board gender diversity (*F_PRO*), CEO duality (*DUAL*), and CSR committee (*CSR_COM*) are 2.377, 0.532, 0.152, 0.589 and 0.791, respectively.

INSERT TABLE 2 ABOUT HERE

Table 3 presents the correlation results and variance inflation factor (*VIF*) for the key variables. In particular, the values in the correlation results are below the threshold of 0.50, and

VIF values are also below 3, which shows that there is no issue of multicollinearity in our data. Particularly, our main outcome variable (*WASTE*) has a significant correlation (at the 1% significance level) with corporate governance indicators, for example, *B_SIZE* (0.108), *B_IND* (0.038), *F_PRO* (-0.041), *DUAL* (-0.025), and *CSR_COM* (0.129) which is largely consistent with the results of our main regression analysis.

INSERT TABLE 3 ABOUT HERE

4.2 Baseline results: corporate governance mechanisms and waste

Table 4 presents the OLS regression results of Equations (1) to (5) for the impact of corporate governance mechanisms (i.e., *B_SIZE*, *B_IND*, *F_PRO*, *DUAL*, and *CSR_COM*) on the level of waste produced (*WASTE*) while including a set of control variables, industry, country, and year fixed-effects. Columns (1-6) show the results for OLS estimations. In column (1), we examine the impact of board size (*B_SIZE*) on the level of waste produced (*WASTE*) and found a strong positive coefficient (i.e., 0.289 at the 1% significance level) in the presence of all control variables and fixed-effects. Similarly, we find a strong positive impact of board independence (*B_IND*) in column (2) (i.e., 0.174 at the 5% significance level) and a strong adverse impact of female directors (*F_PRO*) in column (3) (i.e., -0.353 at 5% significance) on the level of waste produced (*WASTE*). In column (4), although we find a negative coefficient for CEO duality (*DUAL*), we did not see a strong significance. In column (5), we find a strong positive effect of the sustainability committee (*CSR_COM*) on the level of waste produced (*WASTE*). After running separate regressions, we include all corporate governance mechanisms in column (6) and find consistent results.

In terms of control variables, research and development (*R&D*), Tobin's Q (*TQ*), and cash

holdings (*CASH*) are negatively associated with the level of waste produced (*WASTE*), whereas return on assets (*ROA*), firm size (*SIZE*) and loss (*LOSS*) positively impact the level of waste produced (*WASTE*).

INSERT TABLE 4 ABOUT HERE

The results provide strong support for our key hypotheses. First, a strong positive coefficient of board size (*B_SIZE*) on the level of waste produced (*WASTE*) shows that larger board size increases the waste level and thus provides support for our first hypothesis (i.e., H1b). Theoretically, this finding agrees with the agency perspective (Jensen, 1993), which argues that small boards are associated with enhanced performance, and large boards are linked with deteriorated performance due to lack of communication and coordination between directors; consequently, firm performance suffers (Canyon & Peck, 1998; Eisenberg et al., 1998; Liang et al., 2013). Empirically, our finding extends the previous literature (Kassinis & Vafeas, 2002, among others), which shows that large boards are linked with increased environmental violations. In relevance to business strategy and environment, waste management is a critical firm-level issue that demands effective monitoring and coordination to curtail the drastic effects of waste produced efficiently. However, if there are more members on the board, it will negatively impact the effectiveness of the board's functioning.

Second, a statistically significant and positive coefficient of board independence (*B_IND*) on the level of waste produced (*WASTE*) shows that the concentration of independent directors on the board is positively linked with the waste level produced and thus provide support for our second hypothesis (i.e., H2b). Theoretically, these results align with the view that independent directors are linked to reduced board effectiveness (Agrawal & Knoeber, 1996). Further, the

results highlight the fact that contrary to the established view that independent directors are stakeholder-oriented, the independent directors are more concerned with shareholder wealth protection, and thus, avoid costly initiatives, such as waste management. This finding extends the previous literature (Coffey & Wang, 1998; Haniffa & Cooke, 2005), which shows that independent boards are linked with reduced environmental performance due to the proclivity of independent directors to focus more on shareholder's wealth protection at the expense of the firm's philanthropic outlook. Thus, greater board independence leads to a poor focus on stakeholders, and consequently, firms' engagement in environmentally unfriendly activities, such as waste production, increases.

Third, a statistically significant and negative coefficient of board gender diversity (*F_PRO*) on the level of waste produced (*WASTE*) shows that the concentration of female directors on the board is negatively linked with the level of waste produced. The finding supports our third hypothesis (i.e., H3). Theoretically, these results align with the notion that females are more ethical, compassionate, and philanthropic in decision making (Cumming et al., 2015; Gull et al., 2018; Liu, 2018) and at monitoring the management (Abad et al., 2017; Adams & Ferreira, 2009; Chen et al., 2016). Female directors' stakeholder orientation forces them to reduce waste production as they concentrate on long-term profits over short-term losses (Matsa & Miller, 2011, 2013). Women directors care for the community and social welfare (Bear et al., 2010), and focus on environmentally friendly business practices; thus, they engage in practices that benefit the society. One such policy is waste reduction. Empirically, we complement the growing literature on the positive side of female directors with relevance to their pro-environmental behavior and improved governance practices (Bear et al., 2010; Gul et al., 2011; Matsa & Miller, 2011, 2013; McGuinness et al., 2017). Overall, these results show that females are more inclined

towards responsible investment due to their philanthropic orientation and proclivity towards a green economy; consequently, they support those business practices that reduce the level of waste produced.

Additionally, we do not find support for our last two hypotheses. The results for the impact of CEO duality (*DUAL*) on the level of waste produced (*WASTE*) are not significant, which leads to the rejection of the fourth hypothesis (i.e., H4). Nevertheless, the negative relation reveals that CEO duality reduces waste production, which aligns with the quiet life hypothesis of Bertrand and Mullainathan (2003). Accordingly, powerful CEOs (as in the case of those with dual power of chairman of the board and CEO) are less vulnerable to career concerns, and hence, do not bother about short-term objectives. They rather enjoy a quiet life by investing in environmental issues and are engaged in sustainable practices to satisfy all stakeholders (Cespa and Cestone, 2007; Walls and Berrone, 2017). Thus, they may be inclined to invest in environmentally friendly activities, such as waste reduction. As we do not find significant results for H4, we invite researchers to dig deep into this issue by examining how and why CEO duality would reduce a firm's waste production. Similarly, a statistically significant and positive coefficient of sustainability committee (*CSR_COM*) on the level of waste produced (*WASTE*) shows that the presence of a CSR committee increases the level of waste produced, which does not support our fifth hypothesis. Thus, H5 is rejected. Overall, these results contribute to the limited literature, which shows that the formation of a CSR committee is often symbolic. Its scope is limited to avoid reputational risks and litigation, and it does not contribute to a firm's sustainability level and transparency (Rankin et al., 2011; Rodrigue et al., 2013; Rupley et al., 2012). Eberhardt-Toth (2017) shows that the mere formation of the CSR committee does not guarantee efficacy; its composition and specific attributes drive its performance. The limited

scope and composition complexity result in a deviation from the stakeholders' orientation, thus leading to increased waste production.

4.3 Corporate governance and sub-components of the level of waste

Further, our main outcome variable (*WASTE*) is the sum of both hazardous and non-hazardous waste. Hazardous waste is more dangerous for humans' health and for the environment and ecology than non-hazardous waste. Therefore, it might be possible that companies are not producing more hazardous waste, and our main results are driven by the level of non-hazardous waste produced by the sample firms. Therefore, to further strengthen our arguments, we investigate the impact of corporate governance indicators on the sub-components of waste.

Panel A and B of Table 5 presents the regression results of our baseline regression for the impact of corporate governance mechanisms (i.e., *B_SIZE*, *B_IND*, *F_PRO*, *DUAL*, and *CSR_COM*) on the two sub-components of the waste (earlier, we use the total level of waste produced) while including a set of control variables, along with the industry, country, and year fixed-effects. Particularly, these two sub-components are (a) hazardous waste (*H_WASTE*) measured as the natural log of the total hazardous waste produced in tons and (b) non-hazardous waste (*NH_WASTE*) measured as the natural log of the total non-hazardous waste produced in tons.

Panel A shows the results for hazardous waste (*H_WASTE*), and Panel B shows the results for non-hazardous waste (*NH_WASTE*). Particularly, the results for sub-components are similar to the findings in Table 4, such as board size (*B_SIZE*), board independence (*B_IND*), and sustainability committees (*CSR_COM*) are positive, whereas board gender diversity (*F_PRO*) is negatively associated with the hazardous and non-hazardous waste. This result

provides additional support to our proposed hypotheses. Moreover, CEO duality (*DUAL*) is negative and significant at 10% only in Panel B (in the case of non-hazardous waste). The results for control variables are also consistent with the baseline results. Overall, the findings support the notion that distinct corporate governance mechanisms are influential in a firm's environmental inclination and a firm's tendency to increase or decrease the level of waste produced.

INSERT TABLE 5 HERE

Additionally, these results are linked with some key policy implications. First, considering the results, firms globally should strive to enhance the competencies and skills of the managers (both at the board level and in top management teams) with a keen interest and inclination towards sustainability practices, such as waste management and recycling. Second, our findings highlight that the presence of females at the managerial level has become crucial to yield sustainable and long-term commitment to the policies of environmental restoration. Overall, these findings point out important policy insinuations for firms worldwide, who may consider devising their policies with a keen focus on a sustainable revival of the environment and effective waste management, besides the monitoring of managers. Moreover, the findings have practical implications for those associated with the environmental management discipline. Particularly, as governments and the general public are becoming more keenly aware of the critical issues arising from how individuals and corporations use their environment, this study provides novel evidence on how firms can cope with the mounting problems of waste generation and environmental deterioration worldwide through improving internal governance structure. Finally, our findings are of interest to the environmental managers and outside stakeholders anxious about sustainable deployment, use of environmental resources, and effective

management of harmful wastes.

4.4 Robustness analyses: Corporate governance and alternate measures of waste

To further support our baseline regression results, we introduce alternate measures of our predictors and outcome variables, which ensure that our results are consistent with the main proxies and different alternative measures of employed key variables. Panels A and B of Table 6 present the robustness test results for our baseline regression (i.e., Equations 1-5). In robustness tests, we employ two additional proxies of waste. These proxies are (a) waste-assets ratio (*WASTE/ASSETS*), defined as the ratio of the total waste in tons to total assets, and (b) waste-sales ratio (*WASTE/SALES*), termed as the ratio of the total waste in tons to total sales.

Columns (1-6) of Panels A and B show the results for the first alternate proxy, that is, waste-assets ratio (*WASTE/ASSETS*), and the second alternate proxy, that is, waste-sales ratio (*WASTE/SALES*), respectively. While including control variables and fixed effects, the results remain consistent with the baseline results. The coefficients of different corporate governance mechanisms are statistically and economically significant in all models presented in Table 6. The use of alternate proxies reaffirms the notion that the corporate governance indicators are important determinants of the level of waste produced.

INSERT TABLE 6 HERE

4.5 Endogeneity tests

Till now, the baseline findings and robustness results show that the corporate governance indicators are either positively (board size, board independence, CSR committee) or negatively (board gender diversity) associated with the level of waste produced. Nevertheless, these results may be motivated by omitted variables or reverse causality (endogeneity concerns). For example,

both corporate governance indicators and the level of waste produced may be affected by similar unobservable common variables. To curtail such issues, we use the following techniques.

4.5.1 Propensity score matching (PSM)

First, we employ the propensity score matching (*PSM*) technique (Rosenbaum and Rubin, 1983). In particular, *PSM* is a nonparametric procedure that does not undertake any type of association between the predictors and the outcome variable. To conduct *PSM*, we compute the industry averages for corporate governance mechanisms (e.g., the board size, board independence and board gender diversity) and create a dummy for each predictor based on the cut-off value of the industry average. We then use these dummy variables in the first stage of *PSM* by using the nearest neighbour matching technique within common support and without replacement, employing a caliper distance of 0.01 and one-to-one matching. Thus, each treatment in a given year is matched with a unique control in the same year. Our matched sample provided us with matched pairs of treatment and controlled firm-year observations. Panel A of Table 7 presents the results for the relationship between corporate governance indicators and the level of waste produced based on the matched sample.

Columns (1-5) report the regression results for the matched sample. The dependent variable is our main proxy of waste (i.e., *WASTE*), and the independent variables are the corporate governance mechanisms (i.e., *B_SIZE*, *B_IND*, *F_PRO*, *DUAL* and *CSR_COM*). Our main results remain the same after using the *PSM* technique, too, reiterating a strong relationship between corporate governance indicators and the level of waste produced.

4.5.2 Lagged independent variables approach

Second, one might argue that some of our findings seem to point to correlation of the variables

more than causation. For example, an increase in the waste generation may lead to the creation of sustainability committees and not the other way around. To tackle such concerns, we employed the “lagged independent variables approach” and included the lagged values of our main variables and re-run the baseline regressions while controlling for industry, year and country fixed effects.

Panel B of Table 7 shows the results for the relationship between corporate governance mechanisms and the level of waste produced, using *lagged independent variables approach*. Our main findings are unchanged after running baseline regressions with *lagged independent variables approach*, reaffirming a strong relationship between corporate governance indicators and the level of waste produced. The results using this technique highlight that our findings do not merely represent correlation but causation as well.

4.5.3 Two-stage least squares (2SLS) estimation

Third, we use an instrumental variable (*IV*) approach by employing a two-stage least square (*2SLS*) technique to curtail the potential endogeneity concerns. A valid instrument for our set of predictor variables (i.e., corporate governance indicators) must meet (i) the validity condition that it has a high correlation with the predictors and (ii) the exclusion condition that it is not correlated with the residuals from the baseline equation (1). We follow related studies (Nadeem, 2020; Nadeem et al., 2020; Shahab et al., 2021) and use the industry averages and lagged values of corporate governance mechanisms as two instruments.⁴

Columns (1-5) of Panel C show the results of the endogeneity test for the relationship between corporate governance mechanisms and the level of waste produced, using the *2SLS* technique.

⁴ For brevity, the results of the logit regressions of *PSM* and first stage results of *2SLS* regressions are not reported. However, these unreported results are available upon request.

Our main findings hold after running *2SLS* with two *IVs*, reaffirming a strong relationship between corporate governance indicators and the level of waste produced. Additionally, the test of over-identification suggests that our instruments are valid as the *Sargan (P-value)* is insignificant in all specifications.

4.5.4 System generalized methods of the moment (GMM)

Finally, we employ the system generalized method of moments (*GMM*) approach following the previous studies (Gull et al., 2018; Nekhili et al., 2020; Roodman, 2009) to address the issue of endogeneity. Panel D presents the results for system *GMM*, where we include the outcome variable (i.e., *WASTE*) at the lagged year and re-run the baseline regression. The results for the corporate governance indicators are similar to the main results. Moreover, the results for the control variables are also consistent in the presence of industry, country and year fixed-effects. In addition, we report the standard tests of system *GMM* at the bottom of Panel D. In particular, the test statistic for the Arellano-Bond test estimator, i.e., *AR-(2)* and Hansen test, are not significant, which is consistent with the conditions of the system *GMM* (Roodman, 2009).

INSERT TABLE 7 HERE

4.6 Additional analyses

4.6.1 Excluding dominating countries

As the largest proportion of the sample comes from US, UK, and Japanese firms, one might argue that our baseline results are driven by the inclusion of these countries in the sample, and thus, the results can be termed as biased. To avoid this potential sampling bias, we exclude the firm-years belonging to these countries and re-estimate the main regressions (i.e., equation 1-5). Panel A of Table 8 presents the results for this analysis. It is evident from the results reported in

Panel A that even after removing observations for the above-mentioned countries, our main predictions remain the same with strong statistical and economic significance. Overall, these results reassert the notion that firm's tendency to enhance or reduce waste production is highly dependent on the corporate governance mechanism.

4.6.2 Corporate governance and waste recycling

Finally, we examine whether corporate governance mechanisms affect the level of waste recycled too. Waste recycling is a significant aspect of sustainability and climate management. However, this aspect has not received much attention from business strategy and environment scholars. We, therefore, go beyond existing studies (Atif et al., 2020; Atif & Ali, 2021; García Martín & Herrero, 2020; García-Sánchez et al., 2021; Nadeem, 2020; Nadeem et al., 2020, among others) and examine whether board-level corporate governance mechanisms are associated with the waste recycling and can lead to effective management of the waste produced (both hazardous and non-hazardous). To perform this analysis, we employ an additional outcome variable, i.e., recycled waste (*R_WASTE*) defined as the ratio of the recycled waste to total waste produced and re-estimate the main regression. Panel B of Table 8 shows the results for the impact of corporate governance mechanisms on waste recycling while including control variables and fixed-effects as in Table 4.

The results show that (a) board size and board gender diversity are positively associated with the level of waste recycled, and (b) boards independence and the presence of a CSR committee are negatively associated with the level of waste recycled. In essence, these findings are opposite to the baseline results reported in Table 4, where we investigate the impact of corporate governance mechanisms on the level of waste produced. Overall, these findings reaffirm the notion that firm's waste management behavior is dependent on the corporate

governance mechanism.

INSERT TABLE 8 HERE

5. Conclusion

Over the recent years, global climate issues, environmental deterioration, ecological concerns, and depletion of the ozone layer have emerged as major concerns not only at the country level, but much of the blame has been on the firms and multinational corporations (MNCs). Firms across the world are engaged in massive production to meet the global demands of the increasing population, but such production is associated with an immense level of waste production (including both hazardous and non-hazardous waste). However, to date, the business strategy and environment literature is silent on how firm-level corporate governance mechanisms are linked with waste. Accordingly, while contributing towards the business strategy and environment literature, we employ multi-theoretical perspectives and examine the impact of different corporate governance mechanisms, namely board size, board independence, board gender diversity, CEO duality and the presence of a sustainability (CSR) committee on the level of waste produced and recycled by firms across the world.

This study contributes to the previous literature on business strategy and environment in the following unique ways. First, contrary to previous studies (Chan et al., 2014; He & Jiang, 2019; Henriques & Sadosky, 1999; Kassinis & Vafeas, 2006; Liu, 2018; Ntim & Soobaroyen, 2013), examining the impact of corporate governance mechanisms on specific environment aspect, e.g., carbon emissions, green innovations, and environmental violations, we bring forth a new consequence of corporate governance, i.e., the waste. Second, we further explore the impact of different corporate governance mechanisms on the level of waste recycled at the firm level,

which is previously missing in the business strategy and environment literature. Third, we highlight the significance of the monitoring role of the corporate board and corporate governance mechanisms in restoring and protecting the environment through effective waste management.

Our findings have several policies and monitoring implications. One important implication of our study is that firms at the global level must augment the proficiencies and capabilities of the board and top management in line with the effective execution of sustainable and environmental policies on one hand and reduction of waste production and enhancement of waste recycling on the other hand. Further, our findings depict that the involvement of women at the management level is essential to ensure environmental protection and commitment to effective waste management as they are more philanthropic and compassionate in decision-making (Cumming et al., 2015; Liu, 2018). Overall, this study provides useful insights and policy recommendations for the firm's management and multiple stakeholders to effectively monitor the board actions (whether they are in line with ecological protection or not) and implement the sustainable development goals in relevance to waste management.

Though our novel findings are substantial and robust, there are a few limitations that need to be explicitly recognized (which may become future research directions for academicians and researchers). Firstly, as there are a few studies on waste management because of data limitations related to the level of waste produced by the firms hence, there is a need to further develop and maintain the record of the type-wise waste produced by the firms in line with the directions of sustainable development goals (SDGs). Lastly, we have relied on some main indicators of corporate governance; future studies can develop an integrated index of corporate governance with more indicators and examine its impact on the level of waste produced.

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Table 1: Sample distribution by year and country

Panel A: Sample distribution by year							
<i>Year</i>	<i>N</i>	<i>WASTE</i>	<i>B_SIZE</i>	<i>B_IND</i>	<i>F_PRO</i>	<i>DUAL</i>	<i>CSR_COM</i>
2002	57	10.797	2.403	0.566	0.071	0.579	0.193
2003	86	11.269	2.364	0.646	0.082	0.547	0.256
2004	156	10.766	2.395	0.504	0.079	0.583	0.282
2005	291	10.903	2.412	0.519	0.089	0.567	0.347
2006	330	10.861	2.410	0.511	0.096	0.552	0.427
2007	409	10.976	2.386	0.608	0.107	0.553	0.496
2008	528	10.967	2.373	0.592	0.102	0.525	0.655
2009	684	10.879	2.382	0.560	0.103	0.539	0.806
2010	1,022	10.775	2.402	0.487	0.101	0.527	0.841
2011	1,132	10.706	2.408	0.504	0.114	0.549	0.860
2012	1,234	10.737	2.418	0.500	0.123	0.543	0.870
2013	1,319	10.694	2.403	0.511	0.133	0.533	0.864
2014	1,408	10.623	2.395	0.509	0.148	0.626	0.834
2015	1,522	10.569	2.386	0.521	0.161	0.624	0.809
2016	1,653	10.506	2.372	0.534	0.173	0.615	0.797
2017	1,873	10.417	2.352	0.545	0.184	0.619	0.794
2018	1,973	10.384	2.338	0.553	0.195	0.618	0.811
2019	1,766	10.463	2.330	0.562	0.210	0.635	0.860
All Years	17,443	10.613	2.377	0.532	0.152	0.589	0.791

Panel B: Sample distribution by country							
<i>Country</i>	<i>N</i>	<i>WASTE</i>	<i>B_SIZE</i>	<i>B_IND</i>	<i>F_PRO</i>	<i>DUAL</i>	<i>CSR_COM</i>
<i>ARGENTINA</i>	36	8.257	2.559	0.320	0.074	0.667	0.806
<i>AUSTRALIA</i>	627	11.361	2.118	0.740	0.210	0.930	0.828
<i>AUSTRIA</i>	92	10.623	2.561	0.700	0.185	1.000	0.685
<i>BELGIUM</i>	175	10.428	2.491	0.476	0.198	0.834	0.726
<i>BRAZIL</i>	361	11.159	2.332	0.322	0.082	0.670	0.762
<i>CANADA</i>	693	12.490	2.333	0.791	0.177	0.749	0.909
<i>CHILE</i>	130	10.081	2.196	0.219	0.055	0.777	0.623
<i>CHINA</i>	284	11.264	2.341	0.381	0.107	0.757	0.465
<i>COLOMBIA</i>	101	8.863	2.097	0.495	0.122	0.921	0.683
<i>CZECH REPUBLIC</i>	11	10.583	2.385	0.042	0.111	0.818	0.455
<i>DENMARK</i>	175	9.737	2.352	0.476	0.227	0.971	0.840
<i>FINLAND</i>	267	10.552	2.041	0.828	0.273	0.873	0.689
<i>FRANCE</i>	895	10.708	2.564	0.519	0.269	0.347	0.801
<i>GERMANY</i>	601	11.042	2.685	0.398	0.216	0.879	0.799
<i>GREECE</i>	48	9.616	2.603	0.357	0.092	0.188	0.938
<i>HONG KONG</i>	548	10.168	2.322	0.403	0.106	0.595	0.611
<i>HUNGARY</i>	24	10.184	2.998	0.424	0.093	0.458	0.958
<i>INDIA</i>	251	11.628	2.499	0.521	0.088	0.490	0.908
<i>INDONESIA</i>	61	11.369	1.851	0.412	0.062	1.000	0.885
<i>IRELAND</i>	20	9.833	2.428	0.659	0.183	1.000	0.750
<i>ISRAEL</i>	31	10.210	2.389	0.435	0.171	0.871	0.871
<i>ITALY</i>	364	10.311	2.592	0.585	0.223	0.857	0.783
<i>JAPAN</i>	2,765	10.638	2.443	0.197	0.040	0.601	0.833
<i>MALAYSIA</i>	149	8.541	2.243	0.499	0.198	0.926	0.946
<i>MEXICO</i>	126	11.378	2.715	0.447	0.103	0.413	0.841
<i>NETHERLANDS</i>	310	10.672	2.079	0.854	0.220	0.987	0.758
<i>NEW ZEALAND</i>	32	7.424	1.958	0.823	0.255	1.000	0.781
<i>NORWAY</i>	149	10.269	2.178	0.550	0.372	0.919	0.664
<i>PERU</i>	25	9.750	2.279	0.307	0.068	0.760	0.720
<i>PHILIPPINES</i>	70	8.446	2.307	0.324	0.079	0.557	0.771
<i>POLAND</i>	100	10.735	2.153	0.331	0.196	0.990	0.500
<i>PORTUGAL</i>	75	10.215	2.613	0.392	0.103	0.520	0.907
<i>RUSSIAN FEDERATION</i>	239	14.052	2.419	0.369	0.060	0.707	0.473
<i>SOUTH AFRICA</i>	384	10.878	2.495	0.588	0.234	0.458	0.974
<i>SOUTH KOREA</i>	554	10.307	2.234	0.559	0.012	0.561	0.883
<i>SPAIN</i>	443	9.679	2.606	0.476	0.159	0.510	0.738
<i>SWEDEN</i>	322	10.555	2.391	0.599	0.296	0.512	0.748
<i>SWITZERLAND</i>	438	9.744	2.180	0.632	0.138	0.573	0.660
<i>TAIWAN</i>	571	9.008	2.312	0.285	0.080	0.278	0.870
<i>THAILAND</i>	179	9.863	2.630	0.465	0.105	0.430	0.927
<i>TURKEY</i>	109	10.568	2.506	0.294	0.107	0.578	0.670
<i>UNITED KINGDOM</i>	1,674	10.471	2.268	0.593	0.167	0.894	0.834
<i>UNITED STATES</i>	2,934	10.610	2.376	0.833	0.198	0.171	0.771
All Countries	17,443	10.613	2.377	0.532	0.152	0.589	0.791

Note: Table 1 reports the sample distribution and average of main variables by country and year. The final sample consists of 17,443 firm-year observations from 43 countries between 2002 and 2019.

Table 2: Summary statistics

Variables	Obs.	Mean	SD	Minimum	P25	Median	P75	Maximum
<i>WASTE</i>	17,443	10.613	2.915	4.082	8.691	10.462	12.270	19.187
<i>B_SIZE</i>	17,443	2.377	0.311	1.386	2.197	2.398	2.565	3.045
<i>B_IND</i>	17,443	0.532	0.279	0.000	0.316	0.546	0.778	1.000
<i>F_PRO</i>	17,443	0.152	0.130	0.000	0.000	0.133	0.250	0.471
<i>DUAL</i>	17,443	0.589	0.492	0.000	0.000	1.000	1.000	1.000
<i>CSR_COM</i>	17,443	0.791	0.407	0.000	1.000	1.000	1.000	1.000
<i>R&D</i>	17,443	0.023	0.051	0.000	0.000	0.001	0.026	1.849
<i>ROA</i>	17,443	5.601	7.088	-64.020	2.130	4.960	8.610	35.340
<i>TQ</i>	17,443	1.601	1.010	0.632	1.019	1.257	1.806	9.215
<i>LOSS</i>	17,443	0.092	0.289	0.000	0.000	0.000	0.000	1.000
<i>CASH</i>	17,443	0.120	0.111	0.000	0.043	0.089	0.162	0.900
<i>LEVERAGE</i>	17,443	0.259	0.164	0.000	0.138	0.248	0.362	0.909
<i>SIZE</i>	17,443	17.835	2.648	10.735	15.790	17.379	19.837	23.867
Note:	All	variables		are	defined	in		Appendix.

Table 3: Correlation matrix

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	VIF
1. WASTE	1.000													--
2. B_SIZE	0.108*	1.000												1.14
3. B_IND	0.038*	-0.176*	1.000											1.38
4. F_PRO	-0.041*	0.033*	0.413*	1.000										1.33
5. DUAL	-0.025*	-0.103*	-0.070*	0.003	1.000									1.04
6. CSR_COM	0.129*	0.110*	0.058*	0.107*	-0.016	1.000								1.05
7. R&D	-0.129*	-0.049*	0.047*	-0.029*	-0.124*	-0.024*	1.000							1.21
8. ROA	-0.027*	-0.060*	0.091*	0.068*	-0.029*	-0.020*	0.039*	1.000						2.10
9. TQ	-0.130*	-0.108*	0.160*	0.127*	-0.071*	-0.025*	0.236*	0.548*	1.000					1.70
10. LOSS	0.052*	-0.053*	0.021*	-0.022*	0.012	0.007	0.057*	-0.529*	-0.132*	1.000				1.51
11. CASH	-0.153*	-0.106*	-0.088*	-0.143*	-0.059*	-0.060*	0.342*	0.137*	0.238*	0.008	1.000			1.26
12. LEVERAGE	0.079*	0.084*	0.055*	0.021*	-0.031*	0.015	-0.150*	-0.140*	-0.106*	0.067*	-0.235*	1.000		1.09
13. SIZE	0.078*	0.243*	-0.381*	-0.327*	-0.026*	0.113*	-0.034*	-0.137*	-0.264*	-0.085*	-0.012	0.003	1.000	1.39

Note: All variables are as defined in Appendix.

* demonstrates statistical significance at the 1% level.

Table 4: Corporate governance and waste

Variables	WASTE					
	OLS					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>B_SIZE</i>	0.289*** (5.45)					0.298*** (5.56)
<i>B_IND</i>		0.174** (2.13)				0.224*** (2.72)
<i>F_PRO</i>			-0.353** (-2.32)			-0.502*** (-3.28)
<i>DUAL</i>				-0.018 (-0.55)		-0.016 (-0.48)
<i>CSR_COM</i>					0.361*** (9.76)	0.354*** (9.56)
<i>R&D</i>	-7.581*** (-22.73)	-7.648*** (-22.89)	-7.615*** (-22.81)	-7.620*** (-22.82)	-7.608*** (-22.85)	-7.611*** (-22.86)
<i>ROA</i>	0.005* (1.86)	0.005* (1.81)	0.005* (1.90)	0.005* (1.86)	0.005* (1.69)	0.005* (1.74)
<i>TQ</i>	-0.069*** (-3.66)	-0.066*** (-3.49)	-0.063*** (-3.36)	-0.066*** (-3.50)	-0.070*** (-3.74)	-0.071*** (-3.77)
<i>LOSS</i>	0.145** (2.49)	0.140** (2.41)	0.142** (2.45)	0.142** (2.44)	0.135** (2.33)	0.138** (2.37)
<i>CASH</i>	-1.085*** (-7.26)	-1.110*** (-7.42)	-1.124*** (-7.50)	-1.102*** (-7.36)	-1.063*** (-7.12)	-1.080*** (-7.23)
<i>LEVERAGE</i>	-0.144 (-1.48)	-0.150 (-1.53)	-0.154 (-1.58)	-0.147 (-1.51)	-0.141 (-1.45)	-0.150 (-1.54)
<i>SIZE</i>	0.818*** (66.66)	0.837*** (71.83)	0.845*** (72.54)	0.841*** (72.77)	0.815*** (68.92)	0.792*** (62.18)
<i>Intercept</i>	-0.331 (-0.20)	-0.246 (-0.14)	-0.219 (-0.13)	-0.021 (-0.01)	0.207 (0.12)	-0.633 (-0.37)
<i>N</i>	17,443	17,443	17,443	17,443	17,443	17,443
<i>Industry</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Adj. R²</i>	0.636	0.636	0.636	0.636	0.638	0.639
<i>F-statistics</i>	234	233.5	233.5	233.4	235.4	229.3

Note: T-statistics are reported in parentheses. *, **, *** denote statistical significance at the 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix.

Table 5: Corporate governance and sub-components of waste**Panel A:** Corporate governance and hazardous waste

Variables	<i>H_WASTE</i>					
	<i>OLS</i>					
	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>	<i>Model 4</i>	<i>Model 5</i>	<i>Model 6</i>
<i>B_SIZE</i>	0.235** (2.13)					0.228* (1.95)
<i>B_IND</i>		0.467*** (3.16)				0.845*** (5.15)
<i>F_PRO</i>			-0.760*** (-2.59)			-1.027*** (-3.48)
<i>DUAL</i>				-0.061 (-1.00)		-0.070 (-1.05)
<i>CSR_COM</i>					0.499*** (7.21)	0.498*** (6.57)
<i>Controls</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	8,899	8,899	8,899	8,899	8,899	8,899
<i>Industry</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Adj. R²</i>	0.481	0.487	0.372	0.487	0.490	0.377
<i>F-statistics</i>	65.48	67.09	72.28	66.95	67.74	70.11

Panel B: Corporate governance and non-hazardous waste

Variables	<i>NH_WASTE</i>					
	<i>OLS</i>					
	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>	<i>Model 4</i>	<i>Model 5</i>	<i>Model 6</i>
<i>B_SIZE</i>	0.172* (1.91)					0.170* (1.90)
<i>B_IND</i>		0.263** (2.13)				0.299** (2.39)
<i>F_PRO</i>			-0.667** (-2.45)			-0.836*** (-3.75)
<i>DUAL</i>				-0.099* (-1.95)		-0.091* (-1.79)
<i>CSR_COM</i>					0.485*** (8.50)	0.481*** (8.40)
<i>Controls</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	9,349	9,349	9,349	9,349	9,349	9,349
<i>Industry</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Adj. R²</i>	0.612	0.615	0.402	0.615	0.618	0.619
<i>F-statistics</i>	115.5	117	85.85	117	118.3	115.2

Note: T-statistics are reported in parentheses. *, **, *** denote statistical significance at the 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix.

Table 6: Corporate governance and alternative measures of waste
Panel A: Corporate governance and waste to assets ratio

Variables	WASTE/ASSETS					
	OLS					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>B_SIZE</i>	0.012*** (3.51)					0.013*** (3.82)
<i>B_IND</i>		0.015*** (3.12)				0.018*** (3.64)
<i>F_PRO</i>			-0.032*** (-3.58)			-0.041*** (-4.53)
<i>DUAL</i>				-0.001 (-0.33)		-0.001 (-0.42)
<i>CSR_COM</i>					0.022*** (9.90)	0.021*** (9.76)
<i>Controls</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	17,443	17,443	17,443	17,443	17,443	17,443
<i>Industry</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Adj. R²</i>	0.679	0.679	0.679	0.679	0.681	0.681
<i>F-statistics</i>	282.8	282.8	282.8	282.5	284.9	277.3

Panel B: Corporate governance and waste to sales ratio

Variables	WASTE/SALES					
	OLS					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>B_SIZE</i>	0.010*** (2.81)					0.011*** (3.14)
<i>B_IND</i>		0.014*** (2.92)				0.017*** (3.37)
<i>F_PRO</i>			-0.035*** (-3.83)			-0.043*** (-4.66)
<i>DUAL</i>				0.000 (0.14)		0.000 (0.03)
<i>CSR_COM</i>					0.020*** (9.09)	0.020*** (9.01)
<i>Controls</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	17,443	17,443	17,443	17,443	17,443	17,443
<i>Industry</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Adj. R²</i>	0.677	0.677	0.678	0.677	0.679	0.679
<i>F-statistics</i>	280.5	280.5	280.7	280.3	282.3	274.7

Note: T-statistics are reported in parentheses. *, **, *** denote statistical significance at the 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix.

Table 7: Controlling for endogeneity**Panel A:** Propensity score matching (PSM)

Variables	WASTE				
	OLS				
	Model 1	Model 2	Model 3	Model 4	Model 5
<i>B_SIZE</i>	0.186*** (2.95)				
<i>B_IND</i>		0.210** (2.20)			
<i>F_PRO</i>			-0.456** (-2.47)		
<i>DUAL</i>				-0.018 (-0.53)	
<i>CSR_COM</i>					0.292*** (6.85)
<i>Controls</i>	Yes	Yes	Yes	Yes	Yes
<i>N</i>	13,442	13,414	11,536	14,326	7,294
<i>Industry</i>	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes
<i>Country</i>	Yes	Yes	Yes	Yes	Yes
<i>Adj. R²</i>	0.641	0.647	0.647	0.620	0.602
<i>F-statistics</i>	201.3	206.3	177.4	192.8	87.73

Panel B: Lagged independent variables approach

Variables	WASTE					
	OLS					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>B_SIZE</i> _(t-1)	0.307*** (5.41)					0.327*** (5.71)
<i>B_IND</i> _(t-1)		0.205** (2.35)				0.267*** (3.03)
<i>F_PRO</i> _(t-1)			-0.414** (-2.51)			-0.567*** (-3.42)
<i>DUAL</i> _(t-1)				-0.002 (-0.05)		0.002 (0.05)
<i>CSR_COM</i> _(t-1)					0.321*** (8.05)	0.315*** (7.90)
<i>Controls</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	14,221	14,221	14,221	14,221	14,221	14,221
<i>Industry</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Adj. R²</i>	0.655	0.655	0.655	0.654	0.656	0.657
<i>F-statistics</i>	210.5	209.9	209.9	209.8	211.3	205.9

Panel C: Two stage least squares (2SLS) estimates

Variables	WASTE				
	2SLS				
	Model 1	Model 2	Model 3	Model 4	Model 5
<i>B_SIZE</i>	0.382*** (5.23)				
<i>B_IND</i>		0.247** (2.34)			
<i>F_PRO</i>			-0.476** (-2.42)		
<i>DUAL</i>				-0.005 (-0.12)	
<i>CSR_COM</i>					0.437*** (8.18)
<i>Controls</i>	Yes	Yes	Yes	Yes	Yes
<i>N</i>	14,221	14,221	14,221	14,221	14,221
<i>Industry</i>	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes
<i>Country</i>	Yes	Yes	Yes	Yes	Yes
<i>Adj. R²</i>	0.657	0.657	0.657	0.657	0.658
<i>F-statistics</i>	238.8	238.6	238.6	238.4	240.2
<i>Sargan (p-value)</i>	0.837	0.720	0.168	0.320	0.657

Panel D: The system generalized method of moments (GMM) approach

Variables	WASTE				
	GMM				
	Model 1	Model 2	Model 3	Model 4	Model 5
<i>B_SIZE</i>	0.284** (2.16)				
<i>B_IND</i>		0.286* (1.96)			
<i>F_PRO</i>			-0.420*** (-2.62)		
<i>DUAL</i>				0.062 (1.63)	
<i>CSR_COM</i>					0.085** (2.05)
<i>Controls</i>	Yes	Yes	Yes	Yes	Yes
<i>N</i>	14,221	14,221	14,221	14,221	14,221
<i>Industry</i>	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes
<i>Country</i>	Yes	Yes	Yes	Yes	Yes
<i>Arellano–Bond test AR(2) (p-value)</i>	0.431	0.409	0.405	0.416	0.415
<i>Hansen test (p-value)</i>	0.215	0.562	0.359	0.277	0.413

Note: T-statistics are reported in parentheses. *, **, *** denote statistical significance at the 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix.

Table 8: Additional analysis
Panel A: Excluding US, UK, and Japan

Variables	WASTE					
	OLS					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>B_SIZE</i>	0.313*** (4.11)					0.437** (2.07)
<i>B_IND</i>		0.293*** (2.90)				0.299 (1.13)
<i>F_PRO</i>			-0.574** (-2.27)			-0.821* (-1.74)
<i>DUAL</i>				-0.054 (-1.20)		-0.114 (-0.91)
<i>CSR_COM</i>					0.498*** (9.68)	0.767*** (6.19)
<i>Controls</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	10,070	10,070	10,070	10,070	10,070	10,070
<i>Industry</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Adj. R²</i>	0.656	0.655	0.449	0.655	0.658	0.458
<i>F-statistics</i>	154.4	154.2	114.8	154.1	156.3	19.74

Panel B: Corporate governance and waste recycling

Variables	R_WASTE					
	OLS					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>B_SIZE</i>	0.058*** (6.55)					0.053*** (5.88)
<i>B_IND</i>		-0.062*** (-4.52)				-0.055*** (-4.00)
<i>F_PRO</i>			0.050** (1.98)			0.055** (2.15)
<i>DUAL</i>				0.001 (0.19)		0.004 (0.82)
<i>CSR_COM</i>					0.010 (1.55)	0.010 (1.52)
<i>Controls</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	12,356	12,356	12,356	12,356	12,356	12,356
<i>Industry</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Adj. R²</i>	0.316	0.315	0.314	0.314	0.314	0.317
<i>F-statistics</i>	44.94	44.68	44.50	44.45	44.48	43.82

Note: T-statistics are reported in parentheses. *, **, *** denote statistical significance at the 1%, 5%, and 10% levels, respectively. All variables are defined in Appendix.

Appendix: Definition of variables

Variable name	Symbol	Definition	Source
Dependent variable:			
Total Waste	<i>WASTE</i>	Natural log of the total waste produced in tons.	Asset4
Independent variables:			
Board size	<i>B_SIZE</i>	Natural log of the number of directors on the board.	Asset4
Board independence	<i>B_IND</i>	The proportion of independent directors on the board.	Asset4
Board gender diversity	<i>F_PRO</i>	The proportion of female directors on the board.	Asset4
CEO duality	<i>DUAL</i>	Dummy variable coded 1 if the CEO and chairman positions are not separate and 0 otherwise.	Asset4
CSR committee	<i>CSR_COM</i>	Dummy variable coded 1 if firm has a CSR committee and 0 otherwise.	Asset4
Control variables:			
Research and development	<i>R&D</i>	The ratio of research and development expenditure to sales.	WorldScope
Profitability	<i>ROA</i>	Net profit/loss divided by total assets.	WorldScope
Tobin's Q	<i>TQ</i>	The ratio of the sum of market capitalization and total assets minus the book value of shareholders' equity divided by total assets.	WorldScope
Loss	<i>LOSS</i>	Dummy variable coded 1 if firm reported loss in current year and 0 otherwise.	WorldScope
Cash holdings	<i>CASH</i>	The ratio of cash and short-term investments to total assets.	WorldScope
Financial leverage	<i>LEVERAGE</i>	The ratio of a firm's total debt to total assets.	WorldScope
Firm size	<i>SIZE</i>	Natural log of total assets.	WorldScope
Alternate measures of dependent variable:			
Hazardous waste	<i>H_WASTE</i>	Natural log of the total hazardous waste produced in tons.	Asset4
Non-hazardous waste	<i>NH_WASTE</i>	Natural log of the total non-hazardous waste produced in tons.	Asset4
Waste-assets ratio	<i>WASTE/ASSETS</i>	The ratio of the total waste in tons to total assets.	Asset4 & Worldscope
Waste-sales ratio	<i>WASTE/SALES</i>	The ratio of the total waste in tons to total sales.	Asset4 & Worldscope
Recycled waste	<i>R_WASTE</i>	The ratio of the recycled waste to total waste produced.	Asset4

Note: All continuous variables are winsorized at bottom 1% and top 99% levels.