Green Strategies and Financial Stability: Unveiling the Impact of Waste Management on Default Risk

Ammar Ali Gull [a,b,*] **, Muhammad Atif** [c] **& Ammad Ahmed** [d]

[a] *De Vinci Higher Education, De Vinci Research Center, Paris, France.*
[b] *International School, Vietnam National University, Hanoi, Vietnam.*
[c] *College of Business and Law RMIT University Melbourne, Australia.*
[d] *College of Business, University of Sharjah, Sharjah, United Arab Emirates*

Abstract

Growing literature focuses on environmental management's positive influence on firm performance; however, the specific link between environmental strategies, particularly waste management, and firm default risk remains unexplored. Our research addresses this gap by empirically examining the relationship between a firm's waste production/recycling practices and its risk of default, using international data spanning 40 countries from 2002 to 2018. Our findings reveal that firms with higher waste generation face increased default risk, whereas those with superior recycling practices exhibit reduced risk. The results hold steady even after accounting for governance mechanisms and the impact of the global financial crisis. We address potential endogeneity issues by employing lagged independent variables, propensity score matching, and a two-stage least squares approach to affirm the robustness of our findings. Our research not only enriches academic discussions on environmental management and corporate risk but also offers practical insights for firms aiming to align environmental and financial objectives.

Keywords: Environmental management; waste management; recycled waste; default risk

[*] *Corresponding author*: Léonard de Vinci Pôle Universitaire, Research Center, 92916 Paris La Défense, France.
Email addresses: A.A Gull (ammarshaukit@gmail.com & ammar_ali.gull@devinci.fr), M. Atif (muhammad.atif@rmit.edu.au), A. Ahmed (ammad.ahmed@sharjah.ac.ae).

1. Introduction

The awareness of environmental issues has increased manyfold in the past two decades, and customers are now stressing the importance of environmental protection. A consumer intelligence provider, Toluna, in a recent survey of 1,000 U.S. consumers, found that 37% of the consumers are actively changing their buying behavior and are willing to pay 5% more for environmentally friendly products (Toluna, 2019). Professor Sir Stephen Holgate, a former member of the Royal Commission on Environmental Pollution, said, "The number and complexity of environmental challenges in our changing world have greatly increased. Examples include the transition to zero carbon, changing environment and zoonotic infectious disease, addressing water pollution, citizen science to monitor and improve the environment, and how to harness and work with the environment to improve health and wellbeing." (The Guardian, 2021)

In an event study, Flammer (2013) finds that shareholders are sensitive to corporations' environmental footprint. More specifically, the author finds that corporations that behave responsibly towards the environment experience a significant increase in their stock prices compared to irresponsible corporations. Global initiatives, such as the Paris Agreement on climate, have also enhanced the shareholders' understanding of rewarding and penalizing firms for their environmentally (ir)responsible behavior. These converging forces suggest a need for rigorous research to identify the impact of firms' increasing efforts in environmental management. A growing body of literature shows the positive impact of environmental management on firm performance (Huang, 2022; Uyar et al., 2022; Li et al., 2020; Yadav et al., 2016). However, the literature is limited when linking specific environmental management strategies and firm-risk factors, i.e., default risk. Understanding the phenomenon of default risk is critical for firm stakeholders, such as investors, creditors, customers, employees, and regulators, as corporate default has devastating consequences.[1] This study addresses the critical gap in understanding how specific environmental management strategies—particularly waste management—affect firms' default risk, a crucial indicator of financial stability.

According to the ‘What a Waste 2.0’ report by the World Bank in 2018, the waste generation rate will outpace the population growth rate by as much as twice by 2050.[2] Poorly managed waste affects society in various ways, including contaminating ocean water, clogging drains, causing flooding, and unknowingly harming animals, accelerating climate change (Alogna & Clifford, 2021; Ackerman & Stanton, 2011).[3] Improved waste management through waste reduction, reuse of products, and recycling activities are considered potential solutions to mitigate the impact of waste on the climate. However, these initiatives largely depend on the policies and practices of major waste generators, i.e., firms with large-scale production of goods and services. Managers may view compliance with environmental regulations as a tradeoff between environmental and economic performance because the costs of environmental management initiatives are more certain and immediate, ultimately reducing firm profitability (Thornton et al., 2003; Christmann, 2000). However, anecdotal literature relates environmental initiatives to lower operating costs, often by reducing or eliminating waste (Alfred & Adam, 2009; Bansal & Roth, 2000).

Firms’ environmental management reflects efforts to minimize the negative impact of

[1] A firm is considered to be in default upon non-payment of contractual commitments to creditor due to liquidity crunch and shaky cash flows (Valta, 2016). Corporate default diminishes productivity through effects on supply chain interruptions and employee turnover, results in momentous legal and administrative costs, destroys shareholders’ value, and adversely affects customer retention and employee well-being (Xu & Zhang, 2009; Jackson & Wood, 2013; Brogaard et al., 2017).
[2] In 2016, solid waste contributed to about 1.6 billion tons of carbon dioxide-equivalent (CO_2-equivalent) greenhouse gas emissions (5 percent of global emissions), which is expected to increase up to 2.6 billion tons of CO_2-equivalent emissions by 2050 (World Bank, 2018).
[3] In 2022, unprecedented and devastating flooding in Pakistan is a recent example of the impact of climate change. Around 33 million people (1 in 7 people in the country) are displaced, 800,000 livestock are killed, and more than 100 bridges collapsed (Red Cross, 2022).

firms' products and services on the environment. Consequently, environmental performance is referred to as a measure of how successful a firm is in minimizing its operational impact on the environment. Prior studies show a positive relationship between firms' environmental management and performance (Busch & Lewandowski, 2018; Endrikat et al., 2014), which reduces the cost of capital (El Ghoul et al., 2018; Chava, 2014) and results in a higher asset value for the given future cash flows. An increase in asset value reduces the likelihood of bankruptcy, increasing the distance to default (Leland & Toft, 1996). Shih et al. (2021) argue that 'dirty firms' (firms with high energy consumption and high pollution levels) are exposed to uncertain environmental regulations; however, with increased environmental performance, these firms can lower the probability of cash flow volatility.

Strong environmental performance may significantly influence a firm's default risk by affecting both market appeal and operational costs. Enhanced environmental practices increase consumer demand, particularly among environmentally conscious customers (Gupta & Ogden, 2009). We argue that firms committed to minimizing environmental waste, recycling, and establishing robust environmental management systems are expanding their market presence and potentially displacing less proactive competitors. This commitment cultivates consumer trust, fostering a stable revenue stream and consequently reducing the likelihood of default. Moreover, adherence to environmental standards, exemplified by accreditations like the Paris Agreement, provides a competitive edge and promotes sustainable waste management, a critical factor in securing long-term market stability and continuous cash flows, thereby mitigating default risk.

Concurrently, the firm's focus on environmental management systems and proactive measures can substantially reduce future liabilities and operational costs (Marrow & Rondinelli, 2002). By minimizing material waste and inefficiency and preempting regulatory requirements, firms align themselves with future environmental standards and establish industry benchmarks (Niu et al., 2012; Helland & Matsuno, 2003; Dean & Brown, 1995). This forward-thinking approach fortifies a firm against potential market barriers and enhances its liquidity through cost savings and improved productivity, further stabilizing its financial position and diminishing the potential risk of default.

This study empirically investigates the linkage between waste production/recycling and firm default risk. We used international archival data from 40 countries from 2002 to 2018. Our findings reveal a compelling link: firms with higher waste generation are significantly more prone to default risk, highlighting the critical importance of robust waste management practices. The reclassification of waste into hazardous and non-hazardous shows no changes to the relationship. In comparison, a firm with higher recycled waste exhibits a lower default risk. Our results remain consistent after controlling for internal governance mechanisms and the global financial crisis (GFC). Next, an additional cross-sectional analysis of firms exhibiting corporate social responsibility (CSR) orientation and corporate governance quality and their classification into sensitive industries and the group of G10 countries show consistent findings.

The relationship between firms' default risk and waste management may face criticism due to potential endogeneity issues. The potential problem may be due to omitted variable bias and reverse causality biasing our main results. For instance, observable and unobservable factors may concurrently affect both waste and default risk. Moreover, it is probable that waste management and default risk can be determined simultaneously: that is, not only does waste management influence default risk, but firms may also adjust waste management practices based on the current exposure to default risk. To address the concern, we implement three strategies. First, we use lagged independent variables to address reverse causality. Second, we use propensity score matching (PSM) to address the self-selection bias. Finally, we apply the two-stage least squares (2SLS) approach to address the potential endogeneity issue using the instrumental variables approach. Our results remain consistent across the three identification strategies.

Our study contributes to the extant literature in several ways. First, the empirical evidence in this study contributes to the ongoing debate on how firms' corporate strategy—more specifically, environmental management—affects default risk. Prior studies have used bond ratings, cost of debt, firm bankruptcies, and covenant violations as proxies for default risk (Hoepner et al., 2016; Jiraporn et al., 2014; Chava, 2014). However, these measures are limited, as they blend the firm's default risk with non-default components such as illiquidity and tax code (Huang & Huang, 2012). In contrast, this study uses distance to default (DTD), a measure derived from structural models, providing a purer reflection of default risk. By developing environmentally focused corporate strategies, our results incentivize firms to go beyond mere regulatory compliance to minimize risk, identifying waste management as a major determinant of default risk.

Second, our study contributes to the knowledge of voluntary environmental disclosure practices, particularly waste disclosure. Prior research has primarily focused on broader environmental, social, and governance (ESG) practices, with limited attention given to waste management despite its significant impact on climate change. Our study fills this gap, responding to recent calls for more research into the dimensions of sustainability (García-Sánchez et al., 2021; Gull et al., 2022a) by investigating how waste management practices specifically affect default risk. The results provide valuable insights for estimating the financial value of waste management initiatives and set a foundation for further research into other environmental management strategies.

Third, our study makes a significant contribution by bridging the gap between environmental management and financial risk management. While previous research has largely treated these areas as distinct fields, our findings demonstrate that waste management—a core aspect of environmental management—has direct implications for financial stability, particularly in terms of default risk. By linking these two domains, we provide a more holistic understanding of how sustainability practices can influence a firm's financial health.

This cross-disciplinary contribution is particularly valuable for practitioners. Environmental managers can leverage these insights to advocate for more comprehensive waste management strategies that fulfill environmental goals and strengthen the firm's financial resilience. Similarly, financial risk managers can use these findings to incorporate environmental performance metrics into their risk assessment models, offering a more integrated approach to evaluating a firm's overall risk profile.

The remainder of this study is structured as follows. Section 2 presents theory and hypothesis development. Section 3 discusses the research design. Section 4 reports empirical results and robustness checks. Section 5 concludes the study.

2. Theory and hypothesis

The debate on corporate social responsibility (CSR) has long been polarized, with early critics like Carr (1970) and Friedman (1970) arguing that CSR initiatives, such as implementing a new waste management program, introduce unnecessary costs that could weaken a firm's competitive advantage. This perspective suggests that the resources allocated to environmental initiatives could be seen as a diversion from profit-maximizing activities, potentially harming the firm's financial stability. However, this traditional view has been increasingly challenged by modern theories that highlight the strategic value of CSR and environmental management.

Freeman's (1984) stakeholder theory argues that firms should account for the interests of all stakeholders, not just shareholders. In this context, waste management can be seen as a strategic tool that enhances the firm's reputation and stakeholder relations, which in turn supports long-term financial stability. Jones (1995) extends this idea by suggesting that CSR efforts, including waste management, are instrumental in securing critical resources and stakeholder support, essential for maintaining a firm’s market position and reducing its risk of default.

Porter and Van der Linde’s (1991, 1995a, 1995b) work, particularly the Porter Hypothesis, provides a crucial link between environmental management and competitive advantage. They argue that well-designed environmental regulations can drive innovation, reduce waste, and improve a firm's competitiveness. In line with this hypothesis, effective waste management minimizes the firm’s environmental footprint and enhances operational efficiency, which is crucial for maintaining financial stability. By reducing waste, firms can lower production costs, improve resource efficiency, and ultimately strengthen their market position, thereby reducing the likelihood of financial distress and default.

A growing body of literature has shown support for the Porter Hypothesis, which examines ways in which firms can become more sustainable and its impact on firm financial performance (Zhang, 2021). In particular, recent research has shown how firms can change their business strategy to include environmentally friendly designs, processes, and practices, which leads to significant financial benefits (Uyer et al., 2022; Russo & Harrison, 2005).

The Resource-Based View (RBV), particularly Hart's (1995) natural resource-based view, further reinforces the argument that waste management can be a source of competitive advantage. Hart (1995) suggests that firms that develop capabilities in environmental management, such as waste reduction and recycling, can achieve a sustainable competitive advantage by aligning their operations with environmental sustainability. This alignment reduces costs associated with waste and potential regulatory fines and enhances the firm’s brand value and customer loyalty, leading to more stable revenue streams and a lower risk of default.

The relationship between waste management performance and default risk can be understood through two primary pathways: market-based and cost-based mechanisms. Strong waste management practices enhance a firm's reputation among environmentally conscious consumers, who increasingly demand sustainable products (Gupta & Ogden, 2009). Firms that proactively reduce waste and implement recycling programs can differentiate themselves in the market, thereby expanding their customer base and stabilizing revenue streams. This stability in revenue is crucial for maintaining financial health and reducing default risk. Moreover, firms that meet or exceed environmental standards, such as those set by the Paris Agreement, can secure long-term market positioning, which further mitigates default risk by ensuring consistent demand and cash flows.

From a cost perspective, effective waste management reduces material waste, minimizes inefficiencies, and lowers operational costs, all of which contribute to a more robust financial position. Firms that invest in waste management technologies can preemptively comply with future regulations, avoiding costly penalties and gaining a competitive edge by setting industry benchmarks (Niu et al., 2012; Helland & Matsuno, 2003; Marrow & Rondinelli, 2002). These cost savings and increased productivity enhance the firm's liquidity, directly impacting its ability to meet financial obligations and thereby reducing default risk.

Empirical studies offer mixed findings on the relationship between environmental responsibility and default risk. While some research indicates that environmental concerns correlate with lower credit ratings (Jiraporn et al., 2014; Oikonomou et al., 2014), other studies find no significant link between environmental concerns and default risk (Chava, 2014). These studies often rely on survey-based measures of environmental responsibility, such as CSR and ESG disclosures, which may not fully capture the impact of specific environmental management practices like waste management.

Building on the theoretical framework and empirical evidence, we hypothesize that effective waste management—specifically, the reduction and recycling of waste—can significantly impact a firm's default risk. Firms that generate high levels of waste are likely to face higher costs and greater regulatory scrutiny, increasing their risk of financial distress. Conversely, firms that actively recycle and manage waste efficiently are better positioned to maintain financial stability and lower their default risk. Therefore, we propose the following hypothesis:

H1: Waste generation (recycling) positively (negatively) affects default risk.

3. Research design

3.1. Data sources and sample composition

To examine the impact of waste management on default risk, we combine data from three sources. We collect data on firms' waste management practices (i.e., waste generation and recycling) and corporate governance structure from Thomson Reuters' Asset4, while the firm characteristics are sourced from WorldScope. Default risk data is from the Credit Research Initiative (CRI) database from the Risk Management Institute (RMI) of the National University of Singapore (RMI-CRI). We merge the data from different sources based on the common identifier (i.e., ISIN codes). Following prior studies (e.g., Chen et al., 2015; El Ghoul & Zheng, 2016), we exclude missing firm-year observations and drop small countries from our sample.[4] Our final sample consists of 11,010 firm-year observations across 40 countries from 2002 to 2018.[5]

[4] In our sample, we include countries with at least 20 firm-year observations to ensure representative results.
[5] Our sample period starts from 2002 as the year marks the availability of waste management data.

3.2. Regression variables

3.2.1. Dependent variable

The dependent variable is default risk. We use Merton's (1974) distance-to-default (*DTD*) as a default risk measure. This measure is well-established and extensively used in literature. *DTD* is considered better than accounting-based measures of default risk as it is based on the market credit risk metric (Bharath & Shumway, 2008; Das et al., 2009; Duan et al., 2012; Duan et al., 2018; Hillegeist et al., 2004; Jessen & Lando, 2015; Miao et al., 2018).[6] As in Equation (1), we derive DTD:

$$\mathrm{DTD}_{i,j,c,t} = \frac{\left[\ln\left(\frac{V_{i,j,c,t}}{F_{i,j,c,t}}\right) + \left(\mu_{i,j,c,t} - 0.5\,\sigma^2_{V,i,j,c,t}\right)T_{i,j,c,t}\right]}{\sigma_{V,i,j,c,t} \times \sqrt{T_{i,j,c,t}}} \tag{1}$$

where i, j, c, and t represent firm, industry, country, and year, respectively; $V_{i,j,c,t}$ is the value of assets; $F_{i,j,c,t}$ is the face value of debt; $\mu_{i,j,c,t}$ is an estimate of the expected annual return of the firm's assets; $\sigma_{V,i,j,c,t}$ is the volatility of asset values and $T_{i,j,c,t}$ is set to one year. We hypothesize that the distance to default is inversely related to a firm's default risk, i.e., the greater the value of the distance to default, the lower the default risk.[7]

We use an alternative proxy to measure default risk to test the robustness, i.e., the credit default swap (*CDS*) spread. CDS are credit derivatives that enable the transmission of a firm's default risk between two parties for a pre-set period. Usually, the supplier proposes the purchaser insurance covering the default of a primary bond issued by the firm (the reference firm). In case of the reference firm default, the supplier is obliged to purchase the bond at its face value from the purchaser. The purchaser pays a quarterly premium to have that insurance, referred to as the CDS spread, and is priced as an annualized percentage of the insured estimated value. Hence, in fact,

[6] Market-based measures of default risk address the concern of accounting-based measures as they reflect the forward-looking nature of the market and expectations of a firm's future cash flows (Beaver et al., 2005).

[7] Refer to Bharath and Shumway (2008) and Duan et al. (2012) for details on distance to default estimation.

the CDS spread represents the price of default risk (Das et al., 2009). The higher the value of the default risk of the reference firm, the higher the CDS spread.

3.2.2. Independent variable

The independent variable of interest is waste management, which includes waste generation and recycling of waste. Following prior studies (e.g., Gull et al., 2022a, b), we measure waste as the natural logarithm of the total volume of waste generated (*WASTE*), which includes both hazardous and non-hazardous waste (in tons). We also focus on the aspects of firms' waste that were ignored in extant literature (Benjamin et al., 2020), i.e., waste recycling (*RECYCLED_WASTE*) measured as the ratio of recycled waste to total waste generated. We further classify the waste generation into subcomponents, i.e., hazardous waste (*H_WASTE*) and non-hazardous waste (*NH_WASTE*). We measure *H_WASTE* and *NH_WASTE* as the natural logarithm of the hazardous and non-hazardous waste produced in tons, respectively.[8] In addition, we employ two measures of waste for robustness, i.e., the ratio of the total waste to total assets (*WASTE/ASSETS*) and the ratio of the total waste to sales (*WASTE/SALES*).

3.2.3. Control variables

Following previous studies, we include firm-level control variables in our baseline regression model to control for other effects on firm default risk (Goyal & Wang, 2013; Hsu et al., 2015; Brogaard et al., 2017; Nadarajah et al., 2021). These variables include the natural logarithm of total assets (*SIZE*), the ratio of net profit to total assets (*ROA*), the ratio of total debt to total assets (*LEVERAGE*), the ratio of current assets to current liabilities (*CURRENT_RATIO*), the ratio of property plant and equipment to total assets (*TANGIBILITY*), the ratio of sales to total assets

[8] Hazardous waste poses considerable threats to health or the environment and includes the following characteristics: being ignitable (e.g., flammable), oxidizing, corrosive, toxic, and radioactive. Non-hazardous waste is not related to injury or infections to human beings (e.g., paper, wood, scrap metals, tailings, and plastics).

(*SALES/ASSETS_RATIO*), and Tobin's Q (*TOBINSQ*), measured as ratio of sum of market capitalization and total assets minus the book value of shareholders equity divided by total assets (Chiang et al., 2015). We also control for governance characteristics of firms, including board size (*B_SIZE*) measured as the natural logarithm of the total number of directors, board independence (*B_IND*) measured as the proportion of independent directors, board gender diversity (*F_PRO*) measured as the proportion of female directors on the board, separation of the CEO and board chair role (*SEPARATE*), and global financial crisis (*GFC*) measured as a dummy variable equaling 1 for the time period 2007–2009, and 0 otherwise. Table 1 in the Appendix summarizes the definitions and sources of the variables used in our study, including those used in the robustness checks and additional analyses.

3.3. Baseline regression model

To examine the potential impact of waste management on firm default risk, we estimate the following baseline regression model:

$$DR_{ijct+1} = \beta_0 + \beta_1 WM_c + \beta_2 Controls_{ijct} + \psi_j + \omega_t + \omega_c + \varepsilon_{ijct+1}, \quad (2)$$

where *DR* represents the dependent variable, default risk (*DTD*). *WM* refers to our variables of interest, *WASTE* and *RECYCLED_WASTE*. *Controls* consist of firm-level characteristics. To account for industry-wide, yearly fluctuations, and country differences in default risk, industry (ψ_j), year (ω_t), and country-fixed effects (ω_c) are included in our baseline regression model. In addition, to avoid potential issues arising from outliers, all continuous variables are winsorized at the 1st and 99th percentiles. Finally, *t*-statistics are computed based on robust standard errors clustered at the firm-level.

4. Empirical results

4.1. Summary statistics

Table 1 shows sample distribution (i.e., *DTD* and *WASTE*) by country and year. Panel A shows that the highest number of firm-years in our sample are from Japan (2,320), followed by the United States (1,183) and the United Kingdom (1,135). The mean value of *WASTE* across the sample countries ranges from 7.398 (New Zealand) to 14.573 (Russian Federation), which is consistent with prior studies (Gull et al., 2022a, b). The highest (lowest) value of *DTD* is 7.688 (2.854), which is similar to prior studies (e.g., Atif & Ali, 2021). Panel B reveals a steady increase in firm years over the sample period. The average value of *WASTE* shows a decrease starting in the year 2015. Notably, *DTD* shows higher default risk during the global financial crisis years (2008 and 2009) and a mixed trend post-financial crisis.

Table 2 presents statistics for all the variables (mean, standard deviation, and three quartiles [p25, p50, and p75]). The average value of *DTD* is 5.833. The variables related to waste show an average value of 11.025 (*WASTE*), 8.209 (*H_WASTE*), 10.962 (*NH_WASTE*), and 63.309 (*RECYCLED_WASTE*). Concerning control variables, Table 2 shows average values, including 17.741 average firm size (*SIZE*), 6.219 return on assets (*ROA*), 0.253 leverage (*LEVERAGE*), 1.687 current ratio (*CURRENT_RATIO*), 0.220 tangibility (*TANGIBILITY*), 0.834 sales to asset ratio (*SALES/ASSETS_RATIO*), and 1.637 Tobin's Q (*TOBINS Q*). These statistics are comparable to those reported in extant literature (e.g., Nadarajah et al., 2022; Atif & Ali, 2021; Gull et al., 2022a, b).

[Insert Table 1 here]

[Insert Table 2 here]

Table 3 shows the correlation among variables used in the regression model. The correlation between waste (*WASTE*, *H_WASTE*, *NH_WASTE*) and default risk (*DTD*) is negative (-0.166, -0.096, -0.158), suggesting that waste generation increases default risk. Moreover, the correction between *RECYCLED_WASTE* and *DTD* is positive, as anticipated. These correlation coefficients show early signs of the predicted relationship. All the variables have a correlation coefficient under the tolerance limit (0.70), which suggests that multicollinearity is not an issue in our analysis.

[Insert Table 3 here]

4.2. Baseline regression results

Table 4 presents the baseline regression results. In Column 1, we regress *DTD* on the full set of firm-level characteristics with country, industry, and year-fixed effects. The coefficient on *WASTE* is negative (-0.067) and significant at the 1% level, indicating that waste generation leads to higher default risk. The economic significance of our findings is also important. For instance, an increase in *WASTE* by one (sample) standard deviation (see Table 2) increases the *DTD* by approximately 0.032 [*WASTE* (-0.067) × 2.849/ *DTD* (5.833)]. These findings support our hypothesis. Column 2 shows the relationship between recycled waste (*RECYCLED_WASTE*) and default risk. The coefficient on *RECYCLED_WASTE* is positive (0.006) and statistically significant at the 1% level, suggesting that higher levels of waste recycling are associated with lower default risk, thus supporting our hypothesis. In terms of economic significance, an increase in *RECYCLED_WASTE* by one (sample) standard deviation (see Table 2) decreases the *DTD* by approximately 0.030 [*WASTE* (0.006) × 29.466/ *DTD* (5.833)]. We further disentangle the waste into hazardous (*H_WASTE*) and non-hazardous waste (*NH_WASTE*) and report results in Columns 3–4. Our results indicate that both types of waste generation lead to higher default risk. We also note that all firm-level controls are significant at the 5% level and are mostly consistent with prior studies. For instance, we find higher default risk for firms with higher leverage (Goyal & Wang, 2013). Our results also show positive, as well as significant coefficients, for *SIZE* (Goyal & Wang, 2013), *TOBINQ* (Hsu et al., 2015), and *TANGIBILITY* (Atif & Ali, 2021). In general, the findings are consistent with the literature that demonstrates the positive effects of environmental initiatives on firms and society (e.g., Mishra & Suar, 2010; Gull et al., 2022a). Our findings also support the Porter Hypothesis by providing empirical evidence on sustainability initiatives and positive firm outcomes (Zhang, 2021).

[Insert Table 4 Here]

4.3. Robustness checks

We carry out various robustness checks of our main results, such as using additional control variables, alternative samples and model specifications, and alternative measures of default risk and waste management.

First, we explore whether corporate governance monitoring mechanisms impact the relationship between waste management and default risk. We use four measures to measure internal governance monitoring. Following prior studies (e.g., Harford et al., 2008; Brogaard et al., 2017; Atif & Ali, 2021), we use board size (*B_SIZE*) as a standard measure of the board, board independence (*B_IND*), female directors (*F_PRO*), and chairperson duality (*SEPARATE*). The results in Panel A of Table 5 show that waste generation (waste recycling) increases (decreases) default risk across four columns.

Second, we test whether these results are driven by the global financial crisis (*GFC*). Extant studies (e.g., Lins et al., 2017; Saeed et al., 2022) argue that the primary goal of firms during this crisis was to survive rather than to pursue environmentally friendly initiatives that require financial resources. Our study period also includes the global financial crisis period (i.e., 2007–2009), which may have a bearing on our findings. We, therefore, follow Mättö and Niskanen (2019) and re-estimate our equation (2) after including *GFC*, which is a dummy variable set equal to 1 for years 2007–2009 and 0 otherwise. The results in Columns 1, 3, and 4 suggest that the GFC period increases default risk to some extent. However, our results on *WASTE* (*RECYCLED_WASTE*) and *DTD* in Panel B are consistent with the main findings.

Third, one may argue that firms' default risk is related to their CSR initiatives. To address the concern, we divide our sample into high and low CSR firms using the Asset4 CSR performance score. Firms with a CSR score above the sample median are categorized as high CSR (*High-CSR*) firms, and the rest of the firms are categorized as low CSR (*Low-CSR*) firms. The results of this analysis, reported in Panel C of Table 5, are also largely consistent with those reported in Table 4 for both subsamples (i.e., *High-CSR* and *Low-CSR*), suggesting that the relationship between waste (recycling) and default risk is independent of firms' level of CSR orientation.

Four, we explore whether the firm-level corporate governance quality has any impact on the relationship between waste management and default. We divide our sample into firms with high and low corporate governance quality using the corporate governance performance score from Asset4. Firms with a corporate governance score above the sample median are categorized as high corporate governance (*High-CG*) firms, and the rest of the firms as low corporate governance (*Low-CG*) firms. The results in Panel D of Table 5 are qualitatively similar to those reported in Table 4 for both subsamples (i.e., *High-CG* and *Low-CG*), implying that the association between waste (recycling) and default risk is not subject to a firm's level of corporate governance quality.

Five, extant literature (Boiral & Heras-Saizarbitoria, 2017) show that the industry in which the firm operates matters when it comes to stakeholders' scrutiny. For example, regulators and stakeholders place more focus on the scrutiny of firms operating in environmentally sensitive industries than those in non-sensitive industries. This, in turn, implies that the relationship between waste management and default risk may vary due to the nature of the industry, as firms in sensitive industries are more likely to be concerned regarding environmental issues, e.g., waste management. To examine this postulate, we form a subsample based on firms belonging to environmentally sensitive and non-sensitive industries.[9] Panel E in Table 5 presents the results of the re-estimated analysis. We find that *WASTE* (*RECYCLED_WASTE*) is negatively (positively) associated with *DTD* for firms operating in environmentally sensitive industries. Conversely, *WASTE* (*RECYCLED_WASTE)* has an insignificant (significant) effect on the default risk of firms operating in environmentally non-sensitive industries. In a nutshell, our results concur with the extant literature (Boiral & Heras-Saizarbitoria, 2017; Nadeem et al., 2020). These findings suggest that stakeholders penalize firms in sensitive industries with higher waste than those in non-sensitive industries, as the default risk is higher in such industries.

Six, our sample includes G10 countries where environmental management is highly regulated. To ensure that our findings are not driven by the inclusion of those G10 countries in the sample, we divide our sample into G10 and non-G10 countries. We re-estimate equation (2) to examine the association between waste management and default risk. Panel F in Table 5 presents findings suggesting that the level of waste generated (recycled) is negatively (positively) associated with default risk in both subsamples. Hence, our results are not driven by the inclusion of G10 countries and are generalizable across countries.

[9]We classify firms into environmentally sensitive and non-sensitive industries based on prior studies (e.g., Cho et al., 2010; Nadeem et al., 2020). Following prior studies (e.g., Cho et al., 2010; Nadeem et al., 2020), sensitive industries include agricultural, chemical, forestry, fishing and mining, metal, petroleum, and construction, while remaining industries are considered non-sensitive.

Seven, under Panel G in Table 5, we perform an alternate sample analysis as our sample is dominated by firm-year observations from three countries: Japan (2,320 observations), the United Kingdom (1,135 observations), and the United States (1,183 observations). Collectively, 42% of the sample firm years belong to these countries. To ensure that our main findings are not driven by the presence of these countries in our sample, we re-estimate equation (2). The results are comparable to our main findings (i.e., Table 4), proving that any specific sample composition does not drive our results.

Finally, to test whether our results are subject to measurement errors and specific proxies test variables, we follow extant research (Benjamin et al., 2020; Shahab et al., 2022; Gull et al., 2022a, b). We use waste-to-assets ratio (*WASTE/ASSETS*) and waste-to-sales ratio (*WASTE/SALES*) as alternative measures of waste management to perform this analysis. Moreover, we use credit default swap (*CDS*) spread as an alternative proxy for default risk. Our results in Panel H of Table 5 (Columns 1–2) show that the coefficients on the alternative measures of default risk (i.e., *CDS*) remain consistent with our main findings. The results in Columns 3 and 4 (i.e., *WASTE/ASSETS* and *WASTE/SALES*) are similar to those reported in Table 4. Hence, our findings are not subject to measurement errors.

[Insert Table 5 here]

4.4. Endogeneity testing

This section addresses the potential endogeneity bias arising from self-selection bias and reverse causality. We address the concern in three different ways. First, to address reverse causality, we use lagged independent variables that help control the reverse causality problem (Harjoto & Jo, 2015; Luo & Bhattacharya, 2009). Second, we perform propensity score matching (PSM) to address the self-selection bias. Third, we implement an instrumental variable approach, two-stage least squares (2SLS), to address the potential endogeneity issue of waste management.

4.4.1. Lagged independent variables

To address reverse causality, we estimate alternative specifications of equation (2). Specifically, we examine the influence of waste management in the previous years using a one-year lag and a two-year lag of independent variables on the default risk (*DTD*) in the current year. We report the results in Columns 1–2 (one-year lag) and Columns 3–4 (two-year lag) in Table 6. Our findings indicate that *WASTE (RECYCLED_WASTE)* is negatively (positively) related to *DTD*, suggesting that the prior year's waste management affects the current year's default risk. These findings suggest that causation runs from waste management to default risk, not vice versa.

[Insert Table 6 here]

4.4.2. Propensity score matching

We execute two-step propensity score matching (PSM) following extant literature (see, e.g., Chen et al., 2017; Atif et al., 2021). First, we create treatment variables, i.e., *WASTE_DUMMY* and *RECYCLED_DUMMY*, each taking the value of 1 where the sample average is above the industry average and 0 otherwise. We consider the firms to be part of the treatment group if the sample average is above the industry average, while the rest of the firms are part of the control group. We then estimate the predicted value of implementing effective waste management practices by estimating the probit regressions for both dummy variables on the same control variables used in equation (2).[10] This process results in propensity scores for the firm-year observations. Second, we compose two identical subsamples based on the treatment and control

[10] The matching is based on nearest neighbor approach with the caliper distance at 1%.

groups.

We perform tests to confirm that matching is executed appropriately. First, we execute probit regressions using *WASTE_DUMMY* and *RECYCLED_DUMMY* as dependent variables on pre- and post-matched samples. The results are reported in Columns 1–2 (*WASTE_DUMMY*) and Columns 4–5 (*RECYCLED_DUMMY*)) of Table 7 (Panel A), respectively. The regression shows that several firm-level variables are associated with *WASTE_DUMMY* and *RECYCLED_DUMMY*, while post-matched regression reports that no control variable is significantly associated. This, in turn, demonstrates that the PSM is performed accurately. Second, we conduct a post-matched univariate analysis to confirm the comparability of the two groups (treatment and control) and to ensure that the two groups are similar. Panel B of Table 7 documents that, based on mean differences, the two groups are identical, which confirms that the matching procedure is accurate.

Finally, we re-estimate equation (2) by using a matched sample. Our findings in Table 7 (Columns 3 and 6), are consistent with the main analysis (Table 4). This confirms the waste (recycling of waste) negatively (positively) affects default risk.

[Insert Table 7 here]

4.4.3. Instrumental variable approach

Finally, we use the instrumental variable approach, which requires an instrument that is correlated with the endogenous variable but should not have an absolute influence on the dependent variable (i.e., default risk), except through the endogenous variable (Kennedy, 2003, p. 159). Following extant research (e.g., Benjamin et al., 2020; Gull et al., 2022b), our instruments are one-year lagged values (*L.WASTE* and *L.RECYCLED_WASTE*) and the industry average of total waste produced and recycled (*WASTE_IA* and *RECYCLED_WASTE_ IA*). We posit that both instruments meet the exclusion criterion by (not) being correlated with the (dependent variables, i.e., *DTD*) and the relevance condition, which is: after controlling for the control variables, the instrument correlates with *WASTE (RECYCLED_WASTE)*.

We report results from the first-stage regression in Columns 1 and 3 of Table 8. The dependent variables in the first stage are *WASTE* and *RECYCLED_WASTE*, respectively. We control for all the variables specified in equation (2), including industry, year, and country-fixed effects. The coefficients for both instrumental variables (*WASTE_IA*, *RECYCLED_WASTE_IA*, *L.WASTE*, and *L.RECYCLED_WASTE*) are positively significant at the 1% level. The diagnostic tests, i.e., the under-identification test (Kleibergen-Paap rk LM statistic), and weak identification tests (Cragg-Donald Wald F statistic and Kleibergen-Paap rk Wald F statistic) also support the instruments. The Hansen *J*-statistic also suggests that our instruments are valid. Columns 2 and 4 of Table 8 report second-stage estimates while controlling for the predicted values of *WASTE* and *RECYCLED_WASTE* from the first stage. The results indicate a negative (positive) and statistically significant (at the 1% level) coefficient on *WASTE* (*RECYCLED_WASTE*). Therefore, we can conclude that waste generation (recycling) increases (decreases) default risk.

[Insert Table 8 Here]

4.5 Exploring channel

In Table 4, we find that waste management influences the default risk. To further investigate the probable channels through which waste management impacts default risk, we perform an analysis based on the financial performance of firms. Prior literature (Atif et al., 2021; Gull et al., 2022b) suggests that environmental initiatives improve firms' financial performance. Waste management (i.e., waste generation and recycling) is likely to impact default risk through firms' performance. A higher level of waste generation is likely to increase firms' costs because of the higher use of raw materials, waste in the production process, and potential liabilities and penalties from regulators. Consequently, production costs will decrease, resulting in a liquidity crunch, which may negatively impact financial performance. Moreover, waste generation alerts potential consumers who are environmentally aware to avoid the purchase of products and services of such firms, resulting in unstable cash flows for firms that affect the risk of default.

To empirically examine this channel, we create two new variables, i.e., *WASTE X ROA* and *RECYCLED_WASTE X ROA*, which are the interaction terms between waste, waste recycling, and firms' financial performance, respectively. We use *ROA* as the dependent variable (Columns 1 and 3) and re-estimate equation (2). The results of this analysis, as reported in Columns 1–4 of Table 9, demonstrate that the relationship between *ROA* and *WASTE* (Column 1) is negative but positive for *RECYCLED_WASTE* and *ROA* (Column 3). The coefficients on interaction terms (Columns 2 and 4) *WASTE X ROA* (*RECYCLED_WASTE X ROA*) is negative (positive) for *DTD*, suggesting that waste management practices affect default risk through financial performance.

[Insert Table 9 Here]

5. Conclusion

This study investigates the impact of environmental management, particularly waste management, on firms' default risk. By addressing a critical gap in the literature, we aimed to clarify how specific environmental initiatives can influence a firm's financial stability. Our primary objective was to examine the relationship between waste management performance and default risk, and to provide empirical evidence that would contribute to both academic research and practical applications in corporate strategy and risk management.

The findings of this research clearly demonstrate that waste management, as a significant component of environmental management, plays a crucial role in determining a firm's default risk.

Specifically, our results show that higher levels of waste production are associated with increased default risk, while effective waste recycling practices contribute to a reduction in this risk. This relationship holds true across various sample classifications and remains robust after controlling for factors such as internal governance mechanisms and the effects of the Global Financial Crisis (GFC). Additionally, our analysis identifies firm performance as a key channel through which waste management practices influence default risk.

The contributions of this study are threefold. First, it provides a comprehensive framework that links waste management practices with default risk, expanding the understanding of how environmental performance can influence financial outcomes. Second, it contributes to the literature on voluntary environmental disclosures by highlighting the significant impact of waste management on firms' future financial prospects. Finally, this study bridges the gap between environmental management and financial risk management, offering actionable insights for both scholars and practitioners.

The practical implications of this study are significant for corporate managers, investors, and policymakers. For corporate managers, the results emphasize the importance of integrating waste management strategies into broader corporate risk management frameworks. By prioritizing waste reduction and recycling initiatives, firms can enhance their environmental performance and mitigate financial risks, including the risk of default. This suggests that environmental sustainability should be viewed not merely as a regulatory requirement but as a strategic imperative that contributes to the long-term financial resilience of the firm. For investors, the findings provide a compelling case for considering environmental performance, particularly waste management practices, as a key factor in investment decisions. Firms with strong waste management practices may offer more stable returns and lower financial risk, making them more attractive investment opportunities. Policymakers can also draw important insights from this study. The evidence suggests that promoting stricter environmental regulations, particularly around waste management, could have broader economic benefits by enhancing the financial stability of firms. Encouraging firms to adopt best practices in waste management could be an effective strategy for reducing the likelihood of financial crises, particularly in industries with significant environmental impacts.

Despite the robust findings, we acknowledge the limitations of this study, particularly regarding the generalizability of the results. The voluntary nature of waste disclosures and varying environmental regulations across different institutional settings may affect the applicability of our findings in other contexts. Future research should aim to explore these relationships in more specific institutional environments and examine other dimensions of environmental management that could influence financial risk.

References

Ackerman, F., & Stanton, E. A. (2011). *The Last Drop: Climate Change and the Southwest Water Crises*. Stockholm Environment Institute US.

Alfred, A. M., & Adam, R. F. (2009). Green management matters regardless. *Academy of Management Perspectives*, *23*(3), 17-26.

Alogna, I., & Clifford, E. (2021). Climate Change Litigation: Comparative and International Perspectives. Accessed from: https://www.researchgate.net/profile/Ivano-Alogna/publication/340455320_Climate_Change_Litigation_Comparative_and_International_Perspectives/links/5e8afe3e92851c2f5282e24e/Climate-Change-Litigation-Comparative-and-International-Perspectives.pdf

Atif, M., & Ali, S. (2021). Environmental, social and governance disclosure and default risk. *Business Strategy and the Environment, 30*(8), 3937-3959.

Atif, M., Alam, M. S., & Hossain, M. (2020). Firm sustainable investment: Are female directors greener? *Business Strategy and the Environment*, *29*(8), 3449–3469.

Atif, M., Hossain, M., Alam, M. S., & Goergen, M. (2021). Does board gender diversity affect renewable energy consumption? *Journal of Corporate Finance, 66*, 101665.

Bansal, P., & Roth, K. (2000). Why companies go green: A model of ecological responsiveness. *Academy of Management Journal*, *43*(4), 717-736.

Beaver, W. H., McNichols, M. F., & Rhie, J. W. (2005). Have financial statements become less informative? Evidence from the ability of financial ratios to predict bankruptcy. *Review of Accounting Studies, 10*(1), 93-122.

Benjamin, S. J., Regasa, D. G., Wellalage, N. H., & M Marathamuthu, M. S. (2020). Waste disclosure and corporate cash holdings. *Applied Economics*, *52*(49), 5399–5412.

Bharath, S. T., & Shumway, T. (2008). Forecasting default with the Merton distance to default model. *The Review of Financial Studies*, *21*(3), 1339-1369.

Bharath, S. T., & Shumway, T. (2008). Forecasting default with the Merton distance to default model. *Review of Financial Studies*, *21*(3), 1339-1369.

Boiral, O., & Heras-Saizarbitoria, I. (2017). Managing biodiversity through stakeholder involvement: Why, who, and for what initiatives? *Journal of Business Ethics*, *140*(3), 403–421.

Bouslah, K., Kryzanowski, L., & M'Zali, B. (2013). The impact of the dimensions of social performance on firm risk. *Journal of Banking & Finance, 37*(4), 1258-1273.

Boyer, K. K., & McDermott, C. (1999). Strategic consensus in operations strategy. *Journal of Operations Management*, *17*(3), 289-305.

Brogaard, J., Li, D., & Xia, Y. (2017). Stock liquidity and default risk. *Journal of Financial Economics*, *124*(3), 486-502.

Busch, T., & Lewandowski, S. (2018). Corporate carbon and financial performance: A meta-analysis. *Journal of Industrial Ecology*, *22*(4), 745-759.

Carr, A. Z. (1970). Can an executive afford a conscience. *Harvard Business Review*, *48*(4), 58.

Chava, S. (2014). Environmental externalities and cost of capital. *Management Science*, *60*(9), 2223-2247.

Chen, J., Leung, W. S., Goergen, M., 2017. The impact of board gender composition on dividend payouts. *Journal of Corporate Finance, 43*, 86-105.

Chen, Y., Dou, P. Y., Rhee, S. G., Truong, C., & Veeraraghavan, M. (2015). National culture and corporate cash holdings around the world. *Journal of Banking & Finance*, *50*, 1-18.

Cho, C. H., Roberts, R. W., & Patten, D. M. (2010). The language of US corporate environmental disclosure. *Accounting, Organizations and Society, 35*(4), 431–443.

Christmann, P. (2000). Effects of “best practices” of environmental management on cost advantage: The role of complementary assets. *Academy of Management journal*, *43*(4), 663-680.

Das, S. R., Hanouna, P., & Sarin, A. (2009). Accounting-based versus market-based cross-sectional models of CDS spreads. *Journal of Banking & Finance*, *33*(4), 719-730.

Dean, T. J., & Brown, R. L. (1995). Pollution regulation as a barrier to new firm entry: Initial evidence and implications for future research. *Academy of Management Journal*, *38*(1), 288-303.

Duan, J. C., Kim, B., Kim, W., & Shin, D. (2018). Default probabilities of privately held firms. *Journal of Banking & Finance, 94*, 235-250.

Duan, J. C., Sun, J., & Wang, T. (2012). Multiperiod corporate default prediction—a forward intensity approach. *Journal of Econometrics*, *170*(1), 191-209.

El Ghoul, S., & Zheng, X. (2016). Trade credit provision and national culture. *Journal of Corporate Finance, 41*, 475–501.

El Ghoul, S., Guedhami, O., Kim, H., & Park, K. (2018). Corporate environmental responsibility and the cost of capital: International evidence. *Journal of Business Ethics*, *149*(2), 335-361.

Endrikat, J., Guenther, E., & Hoppe, H. (2014). Making sense of conflicting empirical findings: A meta-analytic review of the relationship between corporate environmental and financial performance. *European Management Journal*, *32*(5), 735-751.

Flammer, C. (2013). Corporate social responsibility and shareholder reaction: The environmental awareness of investors. *Academy of Management Journal*, *56*(3), 758-781.

Freeman, R. E. 1984. Strategic management: A stake holder approach. Boston: Pitm

Friedman, M. 1970. The social responsibility of business is to increase its profits. New York Times Magazine, September 13

García-Sánchez, I. M., Gallego-Álvarez, I., & Zafra-Gómez, J. L. (2021). Do independent, female and specialist directors promote eco-innovation and eco-design in agri-food firms? *Business Strategy and the Environment*, *30*(2), 1136-1152.

Goyal, V. K., & Wang, W. (2013). Debt maturity and asymmetric information: Evidence from default risk changes. *Journal of Financial and Quantitative Analysis*, *48*(3), 789-817.

Gull, A. A., Atif, M., & Hussain, N. (2022a). Board gender composition and waste management: Cross-country evidence. *The British Accounting Review*, 101097.

Gull, A. A., Atif, M., Ahsan, T., & Derouiche, I. (2022b). Does waste management affect firm performance? International evidence. *Economic Modelling*, *114*, 105932.

Gupta, S., & Ogden, D. T. (2009). To buy or not to buy? A social dilemma perspective on green buying. *Journal of Consumer Marketing*.

Hanna, M. D., & Newman, W. R. (1995). Operations and environment: an expanded focus for TQM. *International Journal of Quality & Reliability Management*.

Harjoto, M. A., & Jo, H. (2015). Legal vs. normative CSR: Differential impact on analyst dispersion, stock return volatility, cost of capital, and firm value. *Journal of Business Ethics, 128*(1), 1-20.

Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, *20*(4), 986-1014.

Hart, S. L., & Dowell, G. (2011). Invited editorial: A natural-resource-based view of the firm: Fifteen years after. *Journal of Management*, *37*(5), 1464-1479.

Helland, E., & Matsuno, M. (2003). Pollution abatement as a barrier to entry. *Journal of Regulatory Economics*, *24*(2), 243-259.

Hillegeist, S. A., Keating, E. K., Cram, D. P., & Lundstedt, K. G. (2004). Assessing the probability of bankruptcy. *Review of Accounting Studies, 9*(1), 5-34.

Hoepner, A., Oikonomou, I., Scholtens, B., & Schröder, M. (2016). The effects of corporate and country sustainability characteristics on the cost of debt: An international investigation. *Journal of Business Finance & Accounting, 43*(1-2), 158-190.

Hsu, P. H., Lee, H. H., Liu, A. Z., & Zhang, Z. (2015). Corporate innovation, default risk, and bond pricing. *Journal of Corporate Finance, 35*, 329-344.

Huang, D. Z. X. (2022). Environmental, social and governance factors and assessing firm value: valuation, signalling and stakeholder perspectives. *Accounting & Finance*, *62*, 1983-2010.

Huang, J. Z., & Huang, M. (2012). How much of the corporate-treasury yield spread is due to credit risk? *The Review of Asset Pricing Studies*, *2*(2), 153-202.

Jackson, R. H., & Wood, A. (2013). The performance of insolvency prediction and credit risk models in the UK: A comparative study. *The British Accounting Review, 45*(3), 183-202.

Jessen, C., & Lando, D. (2015). Robustness of distance-to-default. *Journal of Banking & Finance, 50*, 493-505.

Jiraporn, P., Jiraporn, N., Boeprasert, A., & Chang, K. (2014). Does corporate social responsibility (CSR) improve credit ratings? Evidence from geographic identification. *Financial Management*, *43*(3), 505-531.

Jung, J., Herbohn, K., & Clarkson, P. (2018). Carbon risk, carbon risk awareness and the cost of debt financing. *Journal of Business Ethics*, *150*(4), 1151-1171.

Kabir, M. N., Rahman, S., Rahman, M. A, & Anwar, M. (2021). Carbon emissions and default risk: International evidence from firm-level data. *Economic Modelling, 103*, 105617.

Karagozoglu, N., & Lindell, M. (2000). Environmental management: testing the win-win model. *Journal of Environmental Planning and Management*, *43*(6), 817-829.

Kennedy, P. (2003) A guide to econometrics (5th ed), Blackwell Publishing, Oxford, UK.

Klassen, R. D., & McLaughlin, C. P. (1996). The impact of environmental management on firm performance. *Management Science*, *42*(8), 1199-1214.

Leland, H. E., & Toft, K. B. (1996). Optimal capital structure, endogenous bankruptcy, and the term structure of credit spreads. *The Journal of Finance, 51*(3), 987-1019.

Li, Z., Liao, G., & Albitar, K. (2020). Does corporate environmental responsibility engagement affect firm value? The mediating role of corporate innovation. *Business Strategy and the Environment*, *29*(3), 1045-1055.

Lins, K. V., Servaes, H., & Tamayo, A. (2017). Social capital, trust, and firm performance: The value of corporate social responsibility during the financial crisis. *The Journal of Finance*, *72*(4), 1785–1824.

Luo, X., & Bhattacharya, C. B. (2006). Corporate social responsibility, customer satisfaction, and market value. *Journal of Marketing*, *70*(4), 1-18.

Mättö, M., & Niskanen, M. (2019). Religion, national culture and cross-country differences in the use of trade credit: Evidence from European SMEs. *International Journal of Managerial Finance.*

McGuire, J. B., Sundgren, A., & Schneeweis, T. (1988). Corporate social responsibility and firm financial performance. *Academy of Management Journal, 31*(4), 854-872.

Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of Finance, 29*(2), 449-470.

Miao, H., Ramchander, S., Ryan, P., & Wang, T. (2018). Default prediction models: The role of forward-looking measures of returns and volatility. *Journal of Empirical Finance*, *46*, 146-162.

Morrow, D., & Rondinelli, D. (2002). Adopting corporate environmental management systems: Motivations and results of ISO 14001 and EMAS certification. *European Management Journal*, *20*(2), 159-171.

Nadarajah, S., Duong, H. N., Ali, S., Liu, B., & Huang, A. (2021). Stock liquidity and default risk around the world. *Journal of Financial Markets* (forthcoming).

Nadeem, M., Bahadar, S., Gull, A. A., & Iqbal, U. (2020). Are women eco-friendly? Board gender diversity and environmental innovation. *Business Strategy and the Environment*, *29*(8), 3146–3161.

Niu, Y., Dong, L. C., & Chen, R. (2012). Market entry barriers in China. *Journal of Business Research*, *65*(1), 68-76.

Oikonomou, I., Brooks, C., & Pavelin, S. (2014). The effects of corporate social performance on the cost of corporate debt and credit ratings. *Financial Review*, *49*(1), 49-75.

Porter, M. E., & Van der Linde, C. (1991). Green competitiveness. *Scientific American*, *264*(4), 168.

Porter, M. E., & Van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, *9*(4), 97-118.

Porter, M. E., & Van der Linde, C. 1995b. Green and competitive: Ending the stalemate. *Harvard Business Review*, *73*(5): 120–134

Pun, K. F. (2006). Determinants of environmentally responsible operations: a review. *International Journal of Quality & Reliability Management*.

Red Cross. (2022). Flooding in Pakistan: the latest news. Accessed from: https://www.redcross.org.uk/stories/disasters-and-emergencies/world/climate-change-and-pakistan-flooding-affecting-millions

Rojšek, I. (2001). From red to green: Towards the environmental management in the country in transition. *Journal of Business Ethics*, *33*(1), 37-50.

Russo, M. V., & Harrison, N. S. (2005). Organizational design and environmental performance: Clues from the electronics industry. *Academy of Management Journal*, *48*(4), 582-593.

Saeed, A., Gull, A. A., Rind, A. A., Mubarik, M. S., & Shahbaz, M. (2022). Do socially responsible firms demand high-quality audits? An international evidence. *International Journal of Finance & Economics*, *27*, 2235–2255.

Shahab, Y., Gull, A. A., Rind, A. A., Sarang, A. A. A., & Ahsan, T. (2022). Do corporate governance mechanisms curb the anti-environmental behavior of firms worldwide? An illustration through waste management. *Journal of Environmental Management*, *310*, 114707.

Shih, Y. C., Wang, Y., Zhong, R., & Ma, Y. M. (2021). Corporate environmental responsibility and default risk: Evidence from China. *Pacific-Basin Finance Journal*, *68*, 101596.

Smith, N. C. (2014). *Morality and the market (Routledge Revivals): Consumer pressure for corporate accountability*. Routledge.

Sun, W., & Cui, K. (2014). Linking corporate social responsibility to firm default risk. *European Management Journal*, *32*(2), 275-287.

The Guardian. (2021). Should we reinstate royal commission to monitor pollution? Accessed from: https://www.theguardian.com/environment/2021/dec/31/should-we-reinstate-royal-commission-to-monitor-pollution

Thornton, D., Kagan, R. A., & Gunningham, N. (2003). Sources of corporate environmental

performance. *California Management Review*, *46*(1), 127-141.
Toluna. (2019). Toluna 2019 Sustainability Report: Consumers Hold Brands Responsible. Accessed from: https://www.greenlodgingnews.com/toluna-2019-sustainability-report-consumers-hold-brands-responsible/
Uyar, A., Kuzey, C., Gerged, A. M., & Karaman, A. S. (2022). Research and development intensity, environmental performance, and firm value: Unraveling the nexus in the energy sector worldwide. *Business Strategy and the Environment*.
Valta, P. (2016). Strategic default, debt structure, and stock returns. *Journal of Financial and Quantitative Analysis*, *51*(1), 197-229.
World Bank. (2018). What a Waste 2.0. Accessed from: https://datatopics.worldbank.org/what-a-waste/
Xu, M., & Zhang, C. (2009). Bankruptcy prediction: The case of Japanese listed companies. *Review of Accounting Studies*, *14*(4), 534-558.
Yadav, P. L., Han, S. H., & Rho, J. J. (2016). Impact of environmental performance on firm value for sustainable investment: Evidence from large US firms. *Business Strategy and the Environment*, *25*(6), 402-420.
Zhang, D. (2021). Green credit regulation induced R&D and green productivity: Revisiting the Porter Hypothesis. *International Review of Financial Analysis*, *75*, 101723.

Appendix 1: Definition of variables

Variable name	Symbol	Definition	Source
Dependent variable:			
Distance to default	*DTD*	Annual average of the distance to default based on the stock based on stock price variability.	RMI_NUS
Independent variables:			
Waste	*WASTE*	Natural log of the total waste produced in tonnes.	Asset4
Waste recycling	*RECYCLED_WASTE*	The ratio of recycled waste to total waste produced.	Asset4
Hazardous waste	*H_WASTE*	Natural log of the total hazardous waste produced in tonnes.	Asset4
Non-hazardous waste	*NH_WASTE*	Natural log of the total non-hazardous waste produced in tonnes.	Asset4
Control variables:			
Firm size	*SIZE*	Natural log of total assets.	WorldScope
Return on assets	*ROA*	Net profit/loss divided by total assets.	WorldScope
Financial leverage	*LEVERAGE*	The ratio of total debt to total assets.	WorldScope
Liquidity	*CURRENT_RATIO*	The ratio of current assets to current liabilities.	WorldScope
Assets tangibility	*TANGIBILITY*	Plant property and equipment are divided by total assets.	WorldScope
Sales	*SALES/ASSETS_RATIO*	The ratio of sales to total assets.	WorldScope
Tobin's Q	*TOBINS Q*	The ratio of the sum of market capitalization and total assets minus the book value of shareholders' equity divided by total assets.	WorldScope
Additional control variables:			
Board size	*B_SIZE*	Natural log of the number of directors on the board.	Asset4
Board independence	*B_IND*	The proportion of independent directors on the board.	Asset4
Board gender diversity	*F_PRO*	The proportion of female directors on the board.	Asset4
CEO-chair separation	*SEPARATE*	The dummy variable coded 1 if the CEO and chairman positions are separate and 0 otherwise.	Asset4
Global financial crisis	*GFC*	The dummy variable coded 1 for global financial crisis time period (i.e., 2007–2009) and 0 for rest of the sample years (i.e., 2002–2006 and 2010–2018).	Authors' calculation
Alternate measures:			
Credit default swap spread	*CDS*	Credit derivatives that allow the transfer of the firm's default risk between two agents for a predetermined time period.	RMI_NUS
Waste to assets ratio	*WASTE/ASSETS*	The ratio of total waste to total assets.	Asset4 & WorldScope
Waste to sales ratio	*WASTE/SALES*	The ratio of total waste to sales.	Asset4 & WorldScope

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

Table 1: Sample distribution by country and year

Panel A: Sample distribution by country

Country	N	*WASTE*	*DTD*	*Country*	N	*WASTE*	*DTD*
ARGENTINA	23	9.010	2.854	*JAPAN*	2,320	10.852	5.427
AUSTRALIA	392	12.307	6.429	*MALAYSIA*	117	8.556	9.162
AUSTRIA	71	11.036	5.405	*MEXICO*	89	11.815	7.666
BELGIUM	101	10.722	5.670	*NETHERLANDS*	196	11.039	6.196
BRAZIL	213	11.540	4.773	*NEW ZEALAND*	24	7.398	7.688
CANADA	527	13.036	5.391	*NORWAY*	116	10.826	4.979
CHILE	82	11.203	6.942	*PHILIPPINES*	46	8.416	5.753
CHINA	70	12.125	4.738	*POLAND*	70	12.309	3.867
COLOMBIA	59	9.839	6.481	*PORTUGAL*	53	11.101	4.995
DENMARK	139	10.296	7.817	*RUSSIAN FEDERATION*	146	14.573	4.020
FINLAND	234	10.563	5.646	*SOUTH AFRICA*	133	10.763	5.848
FRANCE	693	10.951	5.834	*SOUTH KOREA*	397	10.860	4.408
GERMANY	488	11.601	5.551	*SPAIN*	278	10.441	5.618
GREECE	36	9.929	2.937	*SWEDEN*	141	10.636	5.814
HONG KONG	301	10.063	5.690	*SWITZERLAND*	305	10.284	8.287
HUNGARY	21	10.349	4.079	*TAIWAN*	189	9.681	5.476
INDIA	197	11.797	5.782	*THAILAND*	67	10.073	5.893
INDONESIA	43	11.878	6.206	*TURKEY*	51	10.177	4.075
ISRAEL	28	10.172	5.692	*UNITED KINGDOM*	1,135	10.929	5.977
ITALY	236	11.180	5.084	*UNITED STATES*	1,183	10.813	6.886
				All countries	11,010	11.025	5.833

Panel B: Sample distribution by year

Year	N	*WASTE*	*DTD*	*Year*	N	*WASTE*	*DTD*
2002	32	11.160	4.774	*2011*	796	11.079	5.457
2003	61	11.306	4.837	*2012*	845	11.055	5.339
2004	110	11.063	6.688	*2013*	912	11.060	6.164
2005	200	11.230	7.740	*2014*	975	11.018	6.592
2006	235	11.115	6.931	*2015*	1,024	10.959	6.042
2007	364	11.362	6.738	*2016*	1,110	10.915	5.277
2008	475	11.369	4.095	*2017*	1,244	10.819	6.776
2009	589	11.221	3.090	*2018*	1,310	10.886	6.467
2010	728	11.078	5.214	All years	11,010	11.025	5.833

Table 1 reports the distribution of the sample by country and year. The final sample consists of 11,010 firm-year observations from forty countries between 2002 and 2018.
All variables are defined in Appendix 1.

Table 2: Descriptive statistics

Variables	Observations	Mean	Standard deviation	Minimum	1st quartile	Median	3rd quartile	Maximum
DTD	11,010	5.833	2.849	-0.819	3.763	5.337	7.481	14.257
WASTE	11,010	11.025	2.794	4.082	9.219	10.840	12.657	19.187
H_WASTE	5,630	8.209	3.038	-0.545	6.384	8.210	10.130	16.483
NH_WASTE	5,761	10.962	3.107	3.784	8.970	10.665	12.771	19.588
RECYCLED_WASTE	7,701	63.309	29.466	0.010	42.900	70.000	88.450	100.000
SIZE	11,010	17.741	2.692	11.279	15.646	17.213	19.847	23.867
ROA	11,010	6.219	6.750	-64.020	2.950	5.400	8.930	35.340
LEVERAGE	11,010	0.253	0.156	0.000	0.141	0.244	0.350	0.690
CURRENT_RATIO	11,010	1.687	1.177	0.264	1.042	1.403	1.944	17.884
TANGIBILITY	11,010	0.343	0.220	0.001	0.170	0.302	0.486	0.919
SALES/ASSETS_RATIO	11,010	0.834	0.490	0.031	0.495	0.754	1.054	2.619
TOBINS Q	11,010	1.637	1.019	0.632	1.053	1.314	1.839	9.215

All variables are defined in Appendix 1.

Table 3: Correlation matrix

Variables		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1.	*DTD*	1.000											
2.	*WASTE*	-0.166*	1.000										
3.	*H_WASTE*	-0.096*	0.618*	1.000									
4.	*NH_WASTE*	-0.158*	0.976*	0.524*	1.000								
5.	*RECYCLED_WASTE*	0.034*	-0.111*	-0.171*	-0.178*	1.000							
6.	*SIZE*	-0.116*	0.179*	0.231*	0.168*	0.194*	1.000						
7.	*ROA*	0.448*	-0.125*	-0.084*	-0.150*	-0.011	-0.148*	1.000					
8.	*LEVERAGE*	-0.258*	0.079*	-0.001	0.012	-0.061*	0.064*	-0.191*	1.000				
9.	*CURRENT_RATIO*	0.195*	-0.080*	-0.037*	-0.013	-0.009	-0.069*	0.107*	-0.387*	1.000			
10.	*TANGIBILITY*	-0.096*	0.339*	0.224*	0.312*	-0.218*	0.105*	-0.122*	0.242*	-0.130*	1.000		
11.	*SALES/ASSETS_RATIO*	-0.033*	-0.076*	-0.016	-0.087*	0.138*	-0.092*	0.137*	-0.205*	-0.104*	-0.242*	1.000	
12.	*TOBINS Q*	0.490*	-0.215*	-0.183*	-0.205*	-0.001	-0.233*	0.586*	-0.148*	0.092*	-0.158*	0.173*	1.000

All variables are as defined in Appendix 1.
* shows significance at the 0.05 level

Table 4: Waste management and debt default

Variables	(1) *DTD*	(2) *DTD*	(3) *DTD*	(4) *DTD*
WASTE	-0.067***			
	(-7.50)			
RECYCLED_WASTE		0.006***		
		(7.03)		
H_WASTE			-0.031***	
			(-2.73)	
NH_WASTE				-0.061***
				(-5.66)
SIZE	0.314***	0.206***	0.255***	0.297***
	(17.48)	(10.36)	(10.27)	(12.53)
ROA	0.071***	0.067***	0.075***	0.075***
	(19.77)	(15.41)	(14.88)	(15.28)
LEVERAGE	-4.223***	-4.438***	-4.045***	-4.100***
	(-29.86)	(-26.14)	(-20.11)	(-20.52)
CURRENT_RATIO	0.258***	0.201***	0.140***	0.142***
	(13.90)	(8.23)	(5.12)	(5.31)
TANGIBILITY	0.623***	0.552***	0.432***	0.470***
	(5.67)	(4.37)	(2.83)	(3.13)
SALES/ASSETS_RATIO	-0.838***	-1.118***	-0.983***	-0.885***
	(-17.56)	(-19.80)	(-14.16)	(-13.15)
TOBINS Q	1.013***	1.104***	1.082***	1.036***
	(40.65)	(37.34)	(32.05)	(31.47)
Intercept	-7.893***	-8.576***	-7.453***	-7.826***
	(-12.74)	(-4.36)	(-9.40)	(-9.13)
Observations	11,010	7,701	5,630	5,761
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Adj. R^2	0.556	0.574	0.572	0.566
F-stat	194.8	147.2	108.5	108.2

This table presents regression results for the relationship between waste management and debt default using various measures of waste and recycling in columns 1-4. *, **, and *** represent significance at 0.1, 0.05, and 0.01 levels, respectively.
T statistics are given in the parentheses.
All variables are as defined in Appendix 1.

Table 5: Robustness analysis

Panel A: Waste management and debt default after controlling for board structure

Variables	**(1)** ***DTD***	**(2)** ***DTD***	**(3)** ***DTD***	**(4)** ***DTD***
WASTE	-0.064***			
	(-7.15)			
RECYCLED_WASTE		0.006***		
		(6.63)		
H_WASTE			-0.060***	
			(-5.62)	
NH_WASTE				-0.030***
				(-2.66)
Observations	11,010	7,701	5,761	5,630
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Adj. R^2	0.562	0.581	0.575	0.580
F-stat	189.4	143.4	106.1	106.1

Panel B: Waste management and debt default after controlling for the global financial crisis period (i.e., 2007–2009)

Variables	**(1)** ***DTD***	**(2)** ***DTD***	**(3)** ***DTD***	**(4)** ***DTD***
WASTE	-0.067***			
	(-7.50)			
RECYCLED_WASTE		0.006***		
		(7.03)		
H_WASTE			-0.061***	
			(-5.66)	
NH_WASTE				-0.031***
				(-2.73)
GFC	-0.858**	0.922	-0.813	-0.792
	(-2.48)	(0.49)	(-1.31)	(-1.56)
Observations	11,010	7,701	5,761	5,630
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Adj. R^2	0.556	0.574	0.566	0.572
F-stat	194.8	147.2	108.2	108.5

Panel C: Waste management and debt default: The role of CSR orientation

	High-CSR		***Low-CSR***	
	(1)	**(2)**	**(3)**	**(4)**
Variables	***DTD***	***DTD***	***DTD***	***DTD***
WASTE	-0.080***		-0.032**	
	(-7.22)		(-2.03)	
RECYCLED_WASTE		0.008***		0.002*
		(7.29)		(1.70)
Observations	7,037	5,089	3,973	2,612
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Adj. R^2	0.568	0.579	0.547	0.628
F-stat	133.4	100.9	69.46	38.01

Panel D: Waste management and debt default: The role of firm-level corporate governance quality

	High-CG		***Low-CG***	
	(1)	**(2)**	**(3)**	**(4)**
Variables	***DTD***	***DTD***	***DTD***	***DTD***
WASTE	-0.077***		-0.048***	
	(-6.42)		(-3.52)	
RECYCLED_WASTE		0.007***		0.005***
		(5.94)		(3.82)
Observations	6,000	4,235	5,010	3,466
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Adj. R^2	0.574	0.591	0.544	0.570
F-stat	116.4	88.24	85.08	66.69

Panel E: Waste management and debt default: The role of industry nature

	Sensitive industries		***Non-sensitive industries***	
	(1)	**(2)**	**(3)**	**(4)**
Variables	***DTD***	***DTD***	***DTD***	***DTD***
WASTE	-0.101***		0.035	
	(-8.94)		(1.20)	
RECYCLED_WASTE		0.004***		0.005**
		(3.14)		(2.19)
Observations	5,051	3,515	5,959	4,186
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Adj. R^2	0.569	0.593	0.574	0.588
F-stat	103.71	79.78	101.65	75.25

Panel F: Waste management and debt default: using a subsample of G10 and Non-G10 countries

	G10 countries		***Non-G10 countries***	
	(1)	**(2)**	**(3)**	**(4)**
Variables	***DTD***	***DTD***	***DTD***	***DTD***
WASTE	-0.082***		-0.029**	
	(-7.04)		(-2.00)	
RECYCLED_WASTE		0.006***		0.008***
		(5.25)		(5.50)
Observations	7,325	5,248	3,685	2,453
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Adj. R^2	0.567	0.585	0.552	0.582
F-stat	235	181.5	76.72	60.94

Panel G: Waste management and debt default: excluding US, UK, and Japanese firms

	(1)	**(2)**	**(3)**	**(4)**
Variables	***DTD***	***DTD***	***DTD***	***DTD***
WASTE	-0.080***			
	(-7.14)			
RECYCLED_WASTE		0.008***		
		(7.37)		
H_WASTE			-0.047***	
			(-3.58)	
NH_WASTE				-0.062***
				(-4.91)
Observations	6,274	4,204	4,301	4,377
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Adj. R^2	0.551	0.568	0.559	0.552
F-stat	114	83.51	82.26	81.34

Panel H: Waste management and debt default using alternate measures of debt default and waste

	(1)	**(2)**	**(3)**	**(4)**
Variables	***CDS***	***CDS***	***DTD***	***DTD***
WASTE	0.571***			
	(2.91)			
RECYCLED_WASTE		-0.040**		
		(-2.55)		
WASTE/ASSETS			-1.333***	
			(-8.81)	
WASTE/SALES				-1.253***
				(-8.70)
Observations	10,796	7,569	11,010	11,010

Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Adj. R^2	0.216	0.224	0.558	0.558
F-stat	43	31.74	194.2	194.2

This table presents robustness using panels A-H.*, **, and *** represent significance at 0.1, 0.05, and 0.01 levels, respectively.
T statistics are given in parentheses.
All variables are as defined in Appendix 1.

Table 6: Waste management and debt default using lagged independent variables approach

	One-year lag		*Two-year lag*	
	(1)	**(2)**	**(3)**	**(4)**
Variables	***DTD***	***DTD***	***DTD***	***DTD***
WASTE	-0.079***		-0.080***	
	(-7.72)		(-7.13)	
RECYCLED_WASTE		0.006***		0.006***
		(6.04)		(5.74)
SIZE	0.344***	0.213***	0.344***	0.217***
	(17.03)	(9.62)	(15.67)	(8.93)
ROA	0.067***	0.063***	0.066***	0.068***
	(16.32)	(12.97)	(14.82)	(12.41)
LEVERAGE	-4.247***	-4.549***	-4.229***	-4.618***
	(-26.57)	(-23.80)	(-24.14)	(-21.96)
CURRENT_RATIO	0.270***	0.211***	0.281***	0.205***
	(12.84)	(7.54)	(11.54)	(6.39)
TANGIBILITY	0.514***	0.408***	0.505***	0.375**
	(4.16)	(2.88)	(3.76)	(2.41)
SALES/ASSETS_RATIO	-0.859***	-1.160***	-0.929***	-1.259***
	(-15.77)	(-17.90)	(-15.60)	(-17.56)
TOBINS Q	1.107***	1.161***	1.177***	1.173***
	(38.61)	(34.86)	(36.68)	(31.27)
Intercept	-8.527***	-10.568***	-5.657***	-8.933***
	(-11.15)	(-5.26)	(-5.64)	(-4.10)
Observations	8,714	6,146	7,297	5,120
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Adj. R^2	0.570	0.583	0.584	0.593
F-stat	165.7	123.8	149.4	109.1

This table presents regression results for one-year and two-year lagged independent variables and waste management/recycling in columns 1-4.*, **, and *** represent significance at 0.1, 0.05, and 0.01 levels, respectively.
T statistics are given in parentheses.
All variables are as defined in Appendix 1.

Table 7
Panel A: Waste management and debt default using propensity score matched sample

	(1)	(2)	(3)	(4)	(5)	(6)
	Pre-match probit	**Post-match probit**	**PSM pooled**	**Pre-match probit**	**Post-match probit**	**PSM pooled**
Variables	***WASTE_DUMMY***		***DTD***	***RECYCLED _DUMMY***		***DTD***
WASTE			-0.073***			
			(-6.41)			
RECYCLED_WASTE						0.007***
						(6.85)
SIZE	0.353***	-0.024	0.338***	0.028**	0.002	0.217***
	(29.09)	(-1.57)	(13.85)	(2.02)	(0.14)	(9.34)
ROA	0.002	-0.001	0.065***	-0.002	0.002	0.063***
	(0.74)	(-0.16)	(13.48)	(-0.50)	(0.43)	(12.34)
LEVERAGE	-0.043	-0.067	-4.290***	0.070	0.166	-4.549***
	(-0.43)	(-0.55)	(-23.25)	(0.58)	(1.20)	(-22.57)
CURRENT_RATIO	-0.019	-0.008	0.273***	0.012	-0.006	0.175***
	(-1.43)	(-0.48)	(11.10)	(0.70)	(-0.32)	(6.19)
TANGIBILITY	0.519***	0.039	0.520***	-0.000	-0.073	0.393**
	(6.97)	(0.43)	(3.67)	(-0.00)	(-0.70)	(2.56)
SALES/ASSETS_RATIO	0.167***	-0.013	-0.705***	-0.122***	0.047	-1.157***
	(4.94)	(-0.30)	(-11.23)	(-2.97)	(0.94)	(-16.11)
TOBINS Q	-0.065***	-0.007	1.164***	0.031	-0.028	1.225***
	(-3.42)	(-0.27)	(32.17)	(1.46)	(-1.09)	(33.35)
Intercept	-8.676***	0.284	-7.744***	-1.817***	0.149	-6.606***
	(-15.82)	(0.39)	(-7.06)	(-3.68)	(0.15)	(-4.64)
Observations	10,769	6,476	6,476	7,507	5,324	5,324
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2			0.553			0.590
Pseudo R^2	0.121	0.003		0.067	0.004	
F-stat			118.9			120.5
Chi^2	1763	26		678	31	

Panel B: Post-matched sample univariate analysis

	WASTE (N=6,476)				***RECYCLED_WASTE (N=5,324)***			
Variables	**Treated**	**Control**	**Mean differences**	**t-statistics**	**Treated**	**Control**	**Mean differences**	**t-statistics**
SIZE	17.983	18.081	-0.098	-1.510	18.056	18.044	0.012	0.160
ROA	5.876	5.870	0.006	0.040	6.017	6.009	0.008	0.040
LEVERAGE	0.256	0.258	-0.003	-0.690	0.257	0.251	0.006	1.500

CURRENT_RATIO	1.653	1.649	0.004	0.160	1.684	1.722	-0.038	-1.260
TANGIBILITY	0.353	0.355	-0.002	-0.350	0.324	0.326	-0.002	-0.310
SALES/ASSETS_RATIO	0.825	0.822	0.003	0.230	0.837	0.835	0.002	0.190
TOBINS Q	1.545	1.543	0.002	0.080	1.618	1.631	-0.013	-0.470

This table presents regression results for the relationship between waste management and debt default using Propensity Score Matching (PSM). Panel A presents the results of PSM regressions on the matched sample. Panel B presents the univariate mean comparisons between treatment and control firms' characteristics and their corresponding t-statistics. *WASTE_DUMMY* and *RECYCLED _DUMMY* take the value 1 if the firm has produced and recycled waste more than the industry-year average and 0 otherwise.

*, **, and *** represent significance at 0.1, 0.05, and 0.01 levels, respectively.

T statistics are given in parentheses.

All variables are as defined in Appendix 1.

Table 8: Waste management and debt default using two-stage least squares (2SLS) regression

	1st Stage	2nd Stage	1st Stage	2nd Stage
	(1)	**(2)**	**(3)**	**(4)**
Variables	***WASTE***	***DTD***	***RECYCLED_WASTE***	***DTD***
WASTE_IA (RECYCLED_WASTE_ IA)	0.107***		0.391***	
	(21.93)		(16.51)	
L.WASTE (L.RECYCLED_WASTE)	0.893***		0.682***	
	(220.56)		(32.77)	
WASTE		-0.082***		
		(-7.71)		
RECYCLED_WASTE				0.007***
				(3.78)
SIZE	0.051***	0.347***	0.056	0.209***
	(8.58)	(17.08)	(0.34)	(4.40)
ROA	0.004***	0.068***	0.030	0.062***
	(3.50)	(16.45)	(1.00)	(8.10)
LEVERAGE	0.035	-4.244***	0.438	-4.520***
	(0.74)	(-26.66)	(0.32)	(-12.62)
CURRENT_RATIO	-0.017***	0.269***	0.137	0.203***
	(-2.74)	(12.87)	(0.68)	(2.90)
TANGIBILITY	0.065*	0.526***	1.245	0.458
	(1.77)	(4.26)	(1.21)	(1.57)
SALES/ASSETS_RATIO	0.021	-0.858***	-0.449	-1.174***
	(1.32)	(-15.81)	(-0.99)	(-9.80)
TOBINS Q	-0.013	1.106***	0.297	1.166***
	(-1.48)	(38.70)	(1.34)	(13.61)
Intercept	-1.279***	-8.576***	0.076	1.437***
	(-5.61)	(-4.36)	(0.01)	(3.28)
Observations	8,714	8,714	6,002	6,002
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Adj. R^2	0.516	0.516	0.535	0.535
F-stat	167.5	167.5	31.58	31.58
Hansen J (P-value)	0.410	0.410	0.124	0.124

This table presents first-stage and second stage regression results in columns 1-4. *WASTE_IA* and *RECYCLED_WASTE_ IA* (*L.WASTE* and *L.RECYCLED_WASTE*) are instruments with industry-year average (one-year lag) of total waste produced and recycled, respectively.
*, **, and *** represent significance at 0.1, 0.05, and 0.01 levels, respectively.
T statistics are given in parentheses.
All variables are as defined in Appendix 1.

Table 9: Waste management and debt default: channel analysis using ROA

Variables	(1) ***ROA***	(2) ***DTD***	(3) ***ROA***	(4) ***DTD***
WASTE	-0.174***	-0.096***		
	(-6.07)	(-8.94)		
RECYCLED_WASTE			0.014***	0.005***
			(5.12)	(4.26)
ROA		0.177***		0.141***
		(17.96)		(18.85)
WASTE X ROA		-0.002***		
		(-2.84)		
RECYCLED_WASTE X ROA				0.001***
				(2.84)
SIZE	0.073	0.248***	-0.068	0.089***
	(1.28)	(12.82)	(-1.08)	(4.15)
LEVERAGE	-7.157***	-4.146***	-7.126***	-4.278***
	(-15.95)	(-27.17)	(-13.29)	(-23.09)
CURRENT_RATIO	0.464***	0.265***	0.615***	0.194***
	(7.80)	(13.22)	(7.93)	(7.28)
TANGIBILITY	-0.925***	0.548***	-0.117	0.216
	(-2.62)	(4.61)	(-0.29)	(1.57)
SALES/ASSETS_RATIO	1.531***	-0.675***	1.362***	-0.964***
	(10.04)	(-13.11)	(7.57)	(-15.63)
Intercept	8.111***	-4.319***	23.865***	-2.150
	(4.02)	(-6.30)	(3.82)	(-1.00)
Observations	11,010	11,010	7,701	7,701
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Adj. R^2	0.192	0.490	0.206	0.498
F-stat	38.51	148.1	29.76	107.8

This table presents regression results for the channel analysis in columns 1-4.*, **, and *** represent significance at 0.1, 0.05, and 0.01 levels, respectively.
T statistics are given in parentheses.
All variables are as defined in Appendix 1.