

Cash Holdings and Debt Financing of Environmentally Polluting Firms

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Abstract

As public awareness of environmental issues has increased in recent years, the costs of corporate pollution now extend beyond government fines to include reputational damage and higher external financing costs. Environmental pollution conveys negative signals to market participants, leading to the expectation that polluting firms face higher debt financing costs and maintain larger precautionary cash holdings. However, empirical evidence on this relationship remains mixed. This study provides comprehensive empirical evidence on the cash-holding and debt-financing behaviors of environmentally polluting firms using Taiwanese data. The results show that polluting firms tend to hold more cash, obtain fewer bank loans, and issue fewer corporate bonds, although these differences are not statistically significant. Further analyses using bank loan contract-level data reveal that environmentally polluting firms generally receive smaller bank loans and face higher interest rates. Overall, the findings suggest that banks incorporate firms' environmental performance into their lending decisions, reflecting a certain degree of ESG awareness in financial intermediation.

Keywords: Sustainable Development; Environmental Pollution; Cash Holdings; Bank Loan; Corporate Bond.

1. Introduction

Environmental pollution is regarded as a negative externality by economists, because it leads to tremendous social costs. Common environmental pollution includes air, water, soil, noise, and light pollution. The pollutants can not only harm humans, animals, and plants directly, but also lead to climate change indirectly. It becomes a global issue for both developed and developing economies that attracts the worldwide attention. In 2015, the United Nations proposed 17 Sustainable Development Goals (SDGs) in the document “Transforming our world: 2030 Agenda for Sustainable Development,” which cover a wide range of social, economic, and environmental issues. After that, people are more conscious of the environmental issue. The negative externality such as pollution is typically addressed by government regulations. By providing financial incentives or imposing penalty on the firms that violate the regulations, firms are prompted to move away from production that pollutes the environment. In addition, as the public becomes more aware of the environmental issue, firms that cause environmental pollution will affect their reputation and lead to higher financing costs.

Taiwan is a highly developed economy in Asia, and the government has attached great importance to environmental issue since the 1970s. In 1971, the Department of Health at the Executive Yuan set up the Environmental Health Division, which was in charge of the management and monitoring of waste disposal and the supervision of air, water, and noise pollution. The division was upgraded to the Environmental Protection Bureau in 1979, upgraded to the Environmental Protection Administration in 1987, and restructured as the Ministry of Environment in 2023. Over the past half century, the government has legislated many regulations related to environmental protection, including the Waste Disposal Act in 1974, the Water Pollution Control Act in 1974, the Air Pollution Control Act in 1975, the Soil and Groundwater Pollution Remediation

Act in 1990, and the Environmental Impact Assessment Act in 1994, and amendments have been continuously made to these regulations to be in accordance with the current situation. Additionally, Taiwan Stock Exchange listed firms are regulated to prepare and file the Sustainability Reports since 2014 based on the Global Reporting Initiative (GRI) Standards. In 2018, the National Council for Sustainable Development has developed Taiwan Sustainable Development Goals based on the SDGs proposed by the United Nations. Based on the above-mentioned development in Taiwan, the concepts of corporate social responsibility (CSR), environmental, social, and corporate governance (ESG), and sustainable development have been popular and widely accepted by Taiwanese since the past decade, and the sustainable investment has also become the current trend. For instance, as of the end of 2023, fund management companies in Taiwan have launched 9 exchange traded funds (ETFs) which focus on ESG, and these ETFs are widely traded by Taiwanese investors. Under the current trend of sustainable investment, environmentally polluting firms will face higher external financing costs.

In this study, we try to investigate the corporate cash holdings and debt financing policies of the environmentally polluting firms in Taiwan. This research seeks to conduct a thorough empirical study in such important issue about how investors and financial institutions view the environmentally polluting firms, and the consequences these firms will face because of causing pollution.

Two previous studies are closely related to ours but with different focuses. Both Tan et al. (2021) and Qian et al. (2023) focus on firms in China. The study of Tan et al. (2021) investigates the effect of air pollution on corporate cash holdings. They argue that the air pollution in a city will drive pessimistic mood and weaken cognitive ability of management, which leads to poor firm performance and more corporate cash holdings because of the pollution abatement. They use the city-level data of air quality index to investigate the issue. On the other hand, Qian et al. (2023) study the effect of

ESG performance on the loan contracting. Using the contract-level data of bank loan, they find that firms with better ESG performance tend to have greater amount of bank loans, lower probability of collateral requirements, and lower cost of bank loans. However, their results are mainly driven by the social and the governance factors, indicates that the environment factor plays an insignificant role in bank loan contracting. This research project differs from theirs by focusing on how a firm's concern on the environmental regulations affects its corporate cash holdings and debt financing policies, and we study this issue by using both contract-level data for debt financing and firm-year-level data for environmental pollution.

Our empirical findings show that environmentally polluting firms tend to hold more cash, obtain fewer bank loans, and issue fewer public corporate bonds; however, these differences are not statistically significant. Further analyses using bank loan and corporate bond contract-level data reveal that environmentally polluting firms generally obtain smaller amounts of bank financing and face higher interest rates, though they appear to face lower collateral requirements. In contrast, these firms tend to issue corporate bonds at lower interest rates.

This research contributes to the related literature in the following ways. First, it conducts empirical analyses regarding the environmentally polluting firms and their decisions on cash holdings and debt financing in Taiwan. To the best of our knowledge, this topic has not been thoroughly investigated in the relevant research field before, highlighting the originality and innovative nature of this research. Overall, this research explores an important issue in the finance research field, as the trend of sustainable investment prevails, firms should be more concerned about the environmental issue while making their production decision, because the costs of environmental pollution will be more than being fined by the government. The findings of this research will be valuable for practitioners.

The remainder of the paper is organized as follows. Section 2 develops the hypothesis to be tested. Section 3 describes data sources and definitions of the variables. Section 4 presents empirical results. Section 5 concludes.

2. Hypothesis Development

We suggest that a polluting firm has higher precautionary motive for cash holdings. Previous literature on corporate cash holdings suggests that when firms have more business transactions, more investment opportunities, higher cost of cutting dividends or losing financial accesses, or higher cash flows volatility, they tend to have higher incentive to build up cash (Opler et al., 1999; Almeida et al., 2004). In addition, Harford et al. (2014) investigate whether cash holdings enable firms to mitigate underinvestment problems due to refinancing risk. Their findings also suggest that larger cash holdings are valuable for firms with shorter-maturity debt. Because of the trend of sustainable investment, investors and financial institutions pay more attention to the ESG performance of their investment, polluting firms will face higher external financing costs and have higher precautionary motive for cash holdings. Based on the above arguments, we develop the following hypothesis.

H1: The cash holdings are higher for the environmentally polluting firms.

On the other hand, the debt choice of a polluting firm depends on its ability to access to capital and the financing costs. In addition, the debt contracting terms (no matter bank loans or public bonds) are related to the expected corporate risks and information asymmetry between the lenders and the borrowers (Porumb et al., 2021). Suggesting by the literature, firms with better ESG performance tend to have better firm performance (Zerbini, 2017), lower firm risks (Lins et al., 2017; Broadstock et al., 2021; Ding et al., 2021; Garel and Petit-Romec, 2021), and lower information asymmetry (Boone and White, 2015; Frydman and Wang, 2020; Gillan et al., 2021; Bofinger et al., 2022). Therefore, firms with better ESG performance tend to access more debt

financing at lower costs (and with less requirements for collaterals in the case of bank loans). However, polluting firms tend to send more negative signal to the market on the opposite, so they have less access to debt financing at higher costs (and will have higher probability of being required for collaterals in the case of bank loans). We thus develop the following hypotheses.

H2: The accesses to debt financing are lower for the environmentally polluting firms.

H3: The debt financing costs are higher for the environmentally polluting firms.

3. Data and Methodology

3.1. Data

The data we use for this research project are collected from the Taiwan Economic Journal (TEJ), including the information on financial statements, bank loans, corporate bonds, and the event data on firms' violation of environmental protection regulations. Financial firms (base on the industry classification of Sustainability Accounting Standards Board, SASB) are excluded from the sample because they are more financially regulated and are less likely to produce environmental pollution because of their industrial traits. Our sample construction process yields a firm-year panel of 13,849 observations from 2014 to 2022. The sample distribution is presented in Table 1. Panel A shows that the number of firms violating environmental protection regulations each year during the sample period ranges from 8 (in 2019) to 20 (in 2018 and 2020). Panel B indicates that firms in the Renewable Resources & Alternative Energy sector are more likely to violate environmental protection regulations (5.00%), whereas those in the Services sector are least likely to do so (0.00%).

[Insert Table 1 about here]

3.2. Variable definition

We first introduce the method used in this study to identify environmentally polluting firms. Based on the comprehensive event data on firms' violation of

environmental protection regulations (including the Waste Disposal Act, the Water Pollution Control Act, the Air Pollution Control Act, the Soil and Groundwater Pollution Remediation Act, and the Environmental Impact Assessment Act), we identify a firm as an environmentally polluting firm if it violates any of the environmental protection regulations in a given year. Therefore, *Polluting* is an indicator variable that equals one if a firm is an environmentally polluting firm, and zero otherwise. We construct an alternative measure using the total penalty that an environmentally polluting firm is fined due to its violation of any environmental protection regulations in a given year. *Penalty* is the natural logarithm of one plus total penalty, so a higher value of this variable indicates that a firm has produced serious pollution (or frequently violates the regulations) and is fined a larger amount of penalty in total.

Next, we introduce the measures of corporate cash holdings and debt financing. *Cash* is defined as cash and cash equivalents scaled by total book assets. We construct two firm-level measures of debt financing. Using the detailed contract-level data of bank loans and corporate bonds from the TEJ, we are able to compute the amount of bank loan contracted and corporate bond issued by a firm in a given year. *BankLoan* is defined as bank loan scaled by total debt, and *PublicBond* is defined as public corporate bond scaled by total debt. In addition, we use contract-level measures such as *DebtSize*, *Cost*, and *Collateral* to further study the effect on the costs of debt financing. *DebtSize* is the amount of a debt scaled by total debt of the firm in a given year. *Cost* is the annual interest rate charged by the lending bank (for bank loans) or the public (for public corporate bonds). *Collateral* is an indicator variable that equals one if the debt is secured by collateral, and zero otherwise.

The control variables follow prior studies (Opler et al., 1999; Harford et al., 2008; Bates et al., 2009). *Size* is the natural logarithm of total assets. *TobinsQ* is the firm's

market value of physical assets (the market value of common equity plus the book value of debt minus the firm's current assets) divided by the book value of property, plant, and equipment. *CashFlow* is measured as operating cash flow scaled by total assets, where operating cash flow is computed using earnings after interest, dividends, and taxes but before depreciation. *CashFlowVolatility* is the standard deviation of a firm's *CashFlow* over the previous five years. *NetWorkingCapital* is the difference between current non-cash assets and current liabilities, scaled by total assets. *Leverage* is the ratio of total debt to total assets. *CapitalExp* is the ratio of capital expenditure to total assets. *AcqExp* is the ratio of acquisition expenditure to total assets. *R&DExp* is the ratio of R&D expenditures to total assets and is set to zero when R&D expenditures are missing. *Dividend* is an indicator variable that equals one if a firm pays cash dividends, and zero otherwise. All continuous variables are winsorized at the 1st and 99th percentiles.

3.3. Summary statistics

Table 2 presents the summary statistics for the sample. The preliminary results show that 0.86% of firm-year observations are environmentally polluting firms. In the bank loan contract-level sample, 2.04% of observations are environmentally polluting firms, while in the corporate bond contract-level sample, 1.51% of observations fall into this category.

[Insert Table 2 about here]

4. Empirical Results

4.1. Cash holdings of environmentally polluting firms

To test *H1*, we run regression model using the firm-year-level data as follows.

$$Cash_{it} = \beta_1 Polluting_{it-1} + \beta_k ControlVar_{kit-1} + FirmFE + YearFE + \varepsilon_{it}. \quad (1)$$

In the regression model (1), *i* indexes firms, *t* indexes year, and *k* indexes a specific control variable. We use *Penalty* as an alternative measure for *Polluting*. The control

variables follow prior literature on corporate cash holdings and are included to account for firm-specific factors that may influence cash management decisions. To control for unobservable heterogeneity, we include firm fixed effects (*FirmFE*) to capture time-invariant characteristics across firms, and year fixed effects (*YearFE*) to absorb time-specific shocks that affect all firms within a given year.

Table 3 presents the empirical results for Equation (1). In model (1), environmentally polluting firms are identified using the indicator variable *Polluting*. The regression results show that the coefficients on *Polluting* are positive but statistically insignificant, suggesting that environmentally polluting firms tend to hold more cash, although the difference is not significant at conventional levels. In model (2), we employ *Penalty* as an alternative measure of environmental pollution. The results are consistent with those of model (1), indicating that the coefficients on *Penalty* are positive but insignificant. This finding implies that firms subject to environmental penalties also tend to maintain higher cash balances, though the effect lacks statistical significance.

Overall, the evidence reported in Table 3 does not support *H1*, as the estimated coefficients on environmental pollution measures are not statistically significant. While the positive signs align with the expectation that polluting firms might hold more cash to buffer against potential financial and regulatory risks, the lack of significance suggests that, in the Taiwanese context, such precautionary motives may not have a strong observable impact on cash holdings.

[Insert Table 3 about here]

4.2. Debt financing of environmentally polluting firms

To test *H2*, we run regression model using the firm-year-level data as follows.

$$Debt_{it} = \beta_1 Polluting_{it-1} + \beta_k ControlVar_{kit-1} + FirmFE + YearFE + \varepsilon_{it}. \quad (2)$$

In the regression model (2), *i* indexes firms, *t* indexes year, and *k* indexes a specific

control variable. The dependent variable *Debt* includes *BankLoan* and *PublicBond*, which are the major sources of corporate debt financing. As in the previous analysis, firm fixed effects (*FirmFE*) and year fixed effects (*YearFE*) are included to control for unobserved firm-specific heterogeneity and time-specific shocks that could influence firms' financing decisions.

Table 4 presents the empirical results for Equation (2). In models (1) and (2), we focus on bank financing by using *BankLoan* as the dependent variable. The coefficients on *Polluting* and *Penalty* are both negative but statistically insignificant, suggesting that environmentally polluting firms tend to obtain fewer bank loans compared with non-polluting firms, although the difference is not significant at conventional levels. In models (3) and (4), we examine firms' access to the public bond market using *PublicBond* as the dependent variable. The results similarly show that the coefficients on *Polluting* and *Penalty* are negative and insignificant, implying that environmentally polluting firms also tend to issue fewer public corporate bonds; however, the difference is not statistically significant.

Overall, the results reported in Table 4 do not provide support for *H2*, as the coefficients on environmental pollution measures lack statistical significance across both bank loans and bond financing. Although the negative signs of the coefficients align with the expectation that firms with poor environmental performance may face constraints in external debt markets, the lack of statistical significance suggests that, in Taiwan, banks and bond investors do not systematically penalize environmentally polluting firms in their debt financing decisions.

[Insert Table 4 about here]

4.3. Debt contracts of environmentally polluting firms

To test *H3*, we run regression model using the contract-level data as follows.

$$Contract_{ijt} = \beta_1 Polluting_{it-1} + \beta_k ControlVar_{kit-1} + YearFE + \varepsilon_{it}. \quad (3)$$

In the regression model (3), i indexes firms, j indexes a specific debt contract, t indexes year, and k indexes a specific control variable. The dependent variable *Contract* includes *DebtSize*, *Cost*, and *Collateral*.

Table 5 presents the empirical results of the analyses for Equation (3). Panel A reports the results based on bank loan contract-level data, while Panel B reports those based on corporate bond contract-level data. In models (1) and (2), we examine the amount of debt financing obtained by environmentally polluting firms, using *DebtSize* as the dependent variable. Models (3) and (4) analyze the cost of debt financing, measured by *Cost*, while models (5) and (6) investigate the collateral requirements of debt contracts using the indicator variable *Collateral*.

The regression results in Panel A indicate that environmentally polluting firms tend to obtain a smaller amount of debt financing from bank loans and are charged higher interest rates. However, their collateral requirements appear to be lower when borrowing from banks. The regression results in Panel B, however, show that environmentally polluting firms tend to issue corporate bonds with lower interest rates.

Overall, the results presented in Table 5 provide partial support for *H3*. Specifically, when environmentally polluting firms borrow from banks, their financing costs tend to be higher, consistent with the notion that banks incorporate environmental risk into loan pricing. However, the evidence from bond contracts suggests a weaker or even opposite pattern, implying that bond investors may perceive environmental risk differently from banks or may rely more heavily on other factors, such as firm reputation, credit rating, or market liquidity, when pricing debt securities.

[Insert Table 5 about here]

4.4. Additional analysis

We conduct an additional analysis to investigate whether banks with better ESG performance offer different lending conditions to environmentally polluting firms

compared with other firms. *BankESG* is defined as the ESG rating score of the lending bank, as evaluated by TEJ. We incorporate *BankESG* and its interaction term with *Polluting* to extend regression model (3) and estimate the model using bank loan contract-level data. Since TEJ began providing TESG rating data in 2016, the sample size for this analysis is relatively small.

Table 6 presents the empirical results. In models (1) and (2), the coefficients on *BankESG* are both positive and significant, indicating that banks with better ESG performance tend to provide a higher loan amount in each loan transaction they undertake. However, the coefficients on *Polluting* and the interaction term are statistically insignificant, suggesting that banks with better ESG performance do not exhibit different lending behavior toward polluting firms compared with non-polluting firms. In models (3) and (4), the coefficients on *BankESG* are both negative and significant, suggesting that banks with better ESG performance provide loans at lower interest rates. In addition, both the coefficients on *Polluting* and the interaction term are significant, and the sum of these coefficients is positive. This result indicates that environmentally polluting firms are likely to face higher borrowing costs when obtaining loans from banks with better ESG performance. In models (5) and (6), the coefficients of the main variables are not statistically significant, suggesting that banks with better ESG performance do not impose different collateral requirements on environmentally polluting firms compared with non-polluting firms.

Overall, the findings in Table 6 provide partial support for *H3*, revealing that banks with better ESG performance may integrate environmental considerations into their credit risk assessments, primarily through interest rate adjustments rather than changes in loan size or collateral requirements. This pattern implies that ESG-oriented banks in Taiwan may be more sensitive to environmental risk when pricing loans.

[Insert Table 6 about here]

5. Conclusion

This study examines the cash-holding and debt-financing behaviors of environmentally polluting firms in Taiwan. Using firm-level and contract-level data, we analyze how environmental performance influences corporate financial decisions and how financial institutions respond to firms' environmental risk.

The results indicate that environmentally polluting firms tend to hold more cash, obtain fewer bank loans, and issue fewer public corporate bonds; however, these differences are not statistically significant, possibly due to the limited sample size and reduced statistical power. The contract-level analyses provide more detailed insights. Specifically, polluting firms generally receive smaller bank loan amounts and are charged higher interest rates, yet they appear to face lower collateral requirements. In contrast, in the bond market, environmentally polluting firms tend to issue corporate bonds at lower interest rates.

Overall, the findings indicate that banks, rather than bond investors, are more likely to consider firms' environmental performance in their lending decisions. This suggests that environmental considerations and ESG awareness are beginning to shape credit allocation in Taiwan's banking sector, although their influence remains uneven across different segments of the financial market. These results contribute to a deeper understanding of how environmental responsibility is being integrated into financial intermediation.

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Table 1. Sample Distribution

This table presents the distribution of the sample firms.

Panel A: Sample Distribution by Years					
Sample	<i>Polluting</i> = 1		<i>Polluting</i> = 0		Total
Year	N	Percentage	N	Percentage	N
2013	13	0.86%	1,500	99.14%	1,513
2014	10	0.65%	1,533	99.35%	1,543
2015	11	0.70%	1,561	99.30%	1,572
2016	10	0.63%	1,588	99.37%	1,598
2017	18	1.11%	1,607	98.89%	1,625
2018	20	1.21%	1,632	98.79%	1,652
2019	8	0.48%	1,673	99.52%	1,681
2020	20	1.17%	1,695	98.83%	1,715
2021	10	0.58%	1,715	99.42%	1,725
Panel B: Sample Distribution by SASB Thematic Sectors					
Sample	<i>Polluting</i> = 1		<i>Polluting</i> = 0		Total
SASB Thematic Sector	N	Percentage	N	Percentage	N
Consumer Goods	14	0.92%	1,515	99.08%	1,529
Extractives & Minerals Processing	15	2.33%	628	97.67%	643
Food & Beverage	8	1.90%	413	98.10%	421
Health Care	2	0.19%	1,044	99.81%	1,046
Infrastructure	9	0.82%	1,088	99.18%	1,097
Renewable Resources & Alternative Energy	10	5.00%	190	95.00%	200
Resource Transformation	34	1.34%	2,500	98.66%	2,534
Services	0	0.00%	470	100.00%	470
Technology & Communications	19	0.32%	5,976	99.68%	5,995
Transportation	9	1.31%	680	98.69%	689

Table 2. Summary Statistics

This table presents the summary statistics. Refer to Table A1 for definitions of the variables.

Panel A: Firm-Year-Level Sample						
Variable	Mean	Standard Deviation	25th Percentile	Median	75th Percentile	N
<i>Polluting</i>	0.0086	0.0923	0.0000	0.0000	0.0000	13,849
<i>Cash</i>	0.1910	0.1376	0.0880	0.1620	0.2591	13,849
<i>BankLoan</i>	0.0001	0.0002	0.0000	0.0000	0.0002	13,849
<i>PublicBond</i>	0.0106	0.0493	0.0000	0.0000	0.0000	13,849
<i>Size</i>	15.3593	1.4526	14.3573	15.1674	16.1632	13,849
<i>TobinsQ</i>	1.3055	0.9730	0.7500	0.9900	1.4700	13,849
<i>CashFlow</i>	0.0679	0.0827	0.0301	0.0683	0.1123	13,849
<i>CashFlowVolatility</i>	0.0431	0.0464	0.0166	0.0284	0.0506	13,849
<i>NetWorkingCapital</i>	0.1086	0.1716	0.0012	0.0989	0.2113	13,849
<i>Leverage</i>	0.4129	0.1798	0.2757	0.4158	0.5425	13,849
<i>CapitalExp</i>	0.0364	0.0460	0.0063	0.0199	0.0478	13,849
<i>AcqExp</i>	0.0016	0.0094	0.0000	0.0000	0.0000	13,849
<i>R&DExp</i>	0.0300	0.0449	0.0011	0.0136	0.0379	13,849
<i>Dividend</i>	0.7331	0.4423	0.0000	1.0000	1.0000	13,849
Panel B: Bank Loan Contract-Level Sample						
Variable	Mean	Standard Deviation	25th Percentile	Median	75th Percentile	N
<i>Polluting</i>	0.0204	0.1413	0.0000	0.0000	0.0000	51,351
<i>DebtSize (\$million)</i>	0.3206	1.3991	0.0309	0.0800	0.2148	51,351
<i>Cost (%)</i>	1.5889	0.7658	1.0800	1.4500	1.9000	51,351
<i>Collateral</i>	0.3382	0.4731	0.0000	0.0000	1.0000	51,351
Panel C: Corporate Bond Contract-Level Sample						
Variable	Mean	Standard Deviation	25th Percentile	Median	75th Percentile	N
<i>Polluting</i>	0.0151	0.1219	0.0000	0.0000	0.0000	1,394
<i>DebtSize (\$million)</i>	1,954.6290	2,782.5260	400.0000	1,000.0000	2,369.4500	1,394
<i>Cost (%)</i>	0.5370	0.6038	0.0000	0.5200	0.9100	1,394
<i>Collateral</i>	0.3859	0.4870	0.0000	0.0000	1.0000	1,394

Table 3. Environmentally Polluting Firms and Cash Holdings

This table presents the regression analysis of firms' cash holdings, using *Cash* as the dependent variable. Definitions of the variables are stated in Table A1. *t*-statistics based on standard errors robust to heteroskedasticity are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable	<i>Cash</i>	
Model	(1)	(2)
<i>Polluting</i>	0.0064 (1.29)	
<i>Penalty</i>		0.0004 (1.24)
<i>Size</i>	-0.0142*** (-3.48)	-0.0142*** (-3.48)
<i>TobinsQ</i>	0.0150*** (7.42)	0.0150*** (7.42)
<i>CashFlow</i>	0.0762*** (3.91)	0.0761*** (3.91)
<i>CashFlowVolatility</i>	0.1130*** (3.01)	0.1130*** (3.01)
<i>NetWorkingCapital</i>	-0.0677*** (-5.22)	-0.0677*** (-5.22)
<i>Leverage</i>	-0.1255*** (-8.17)	-0.1255*** (-8.17)
<i>CapitalExp</i>	-0.2324*** (-10.67)	-0.2324*** (-10.67)
<i>AcqExp</i>	-0.1667** (-1.96)	-0.1668** (-1.96)
<i>R&DExp</i>	0.2493*** (2.64)	0.2492*** (2.64)
<i>Dividend</i>	0.0057** (2.22)	0.0057** (2.22)
FirmFE	Yes	Yes
YearFE	Yes	Yes
N	13,849	13,849
Adjusted R ²	0.7189	0.7189

Table 4. Environmentally Polluting Firms and Debt Financing

This table presents the regression analysis of firms' debt financing, using *BankLoan* as the dependent variable in models (1) and (2), and *PublicBond* as the dependent variable in models (3) and (4). Definitions of the variables are stated in Table A1. *t*-statistics based on standard errors robust to heteroskedasticity are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable	<i>BankLoan</i>		<i>PublicBond</i>	
Model	(1)	(2)	(3)	(4)
<i>Polluting</i>	-0.0013 (-1.02)		-0.3084 (-0.77)	
<i>Penalty</i>		-0.0001 (-0.83)		-0.0204 (-0.73)
<i>Size</i>	-0.0003 (-0.59)	-0.0003 (-0.58)	0.1279 (0.58)	0.1278 (0.58)
<i>TobinsQ</i>	-0.0003 (-1.11)	-0.0003 (-1.11)	0.4400*** (4.28)	0.4399*** (4.28)
<i>CashFlow</i>	0.0033 (1.21)	0.0033 (1.22)	2.5720*** (3.01)	2.5725*** (3.01)
<i>CashFlowVolatility</i>	-0.0048 (-1.01)	-0.0048 (-1.01)	-3.1634* (-1.72)	-3.1616* (-1.72)
<i>NetWorkingCapital</i>	-0.0175*** (-10.01)	-0.0175*** (-10.01)	-1.6203*** (-2.81)	-1.6201*** (-2.81)
<i>Leverage</i>	-0.0038* (-1.85)	-0.0038* (-1.85)	-2.0120*** (-2.78)	-2.0116*** (-2.78)
FirmFE	Yes	Yes	Yes	Yes
YearFE	Yes	Yes	Yes	Yes
N	13,849	13,849	13,849	13,849
Adjusted R ²	0.5562	0.5562	0.0633	0.0633

Table 5. Environmentally Polluting Firms and Debt Contracts

This table presents the regression analysis of firms' debt contracts, using *DebtSize* as the dependent variable in models (1) and (2), *Cost* as the dependent variable in models (3) and (4), and *Collateral* as the dependent variable in models (5) and (6). Definitions of the variables are stated in Table A1. *t*-statistics based on standard errors robust to heteroskedasticity are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Bank Loan Contract-Level Sample						
Dependent Variable	<i>DebtSize</i>		<i>Cost</i>		<i>Collateral</i>	
Regression Model	OLS	OLS	OLS	OLS	Probit	Probit
Model	(1)	(2)	(3)	(4)	(5)	(6)
<i>Polluting</i>	-0.0006*** (-5.61)		0.0642*** (4.26)		-0.3153*** (-6.76)	
<i>Penalty</i>		-0.0000*** (-5.85)		0.0047*** (4.66)		-0.0238*** (-7.26)
<i>Size</i>	-0.0008*** (-56.17)	-0.0008*** (-56.10)	-0.0744*** (-34.71)	-0.0745*** (-34.71)	-0.1872*** (-40.91)	-0.1868*** (-40.81)
<i>TobinsQ</i>	0.0006*** (12.53)	0.0006*** (12.52)	-0.0085 (-1.53)	-0.0084 (-1.51)	-0.0288** (-2.52)	-0.0292** (-2.55)
<i>CashFlow</i>	-0.0057*** (-11.55)	-0.0057*** (-11.56)	-1.7672*** (-27.35)	-1.7665*** (-27.34)	-2.5384*** (-20.85)	-2.5412*** (-20.88)
<i>CashFlowVolatility</i>	0.0018*** (2.58)	0.0018*** (2.59)	1.9322*** (26.12)	1.9329*** (26.13)	3.2227*** (19.35)	3.2202*** (19.34)
<i>NetWorkingCapital</i>	-0.0011*** (-6.92)	-0.0011*** (-6.92)	0.2800*** (14.65)	0.2802*** (14.66)	0.5472*** (13.44)	0.5463*** (13.42)
<i>Leverage</i>	-0.0060*** (-32.09)	-0.0060*** (-32.09)	1.1741*** (50.64)	1.1745*** (50.65)	0.7917*** (16.56)	0.7898*** (16.52)
YearFE	Yes	Yes	Yes	Yes	Yes	Yes
N	50,491	50,491	50,491	50,491	50,491	50,491
Adjusted/Pseudo R ²	0.1429	0.1429	0.2607	0.2607	0.0726	0.0727

(continued on next page)

Table 5. (continued)

Panel B: Corporate Bond Contract-Level Sample						
Dependent Variable	<i>DebtSize</i>		<i>Cost</i>		<i>Collateral</i>	
Regression Model	OLS	OLS	OLS	OLS	Probit	Probit
Model	(1)	(2)	(3)	(4)	(5)	(6)
<i>Polluting</i>	-0.2879 (-0.24)		-0.2657*** (-4.04)		-0.2514 (-0.65)	
<i>Penalty</i>		-0.0266 (-0.33)		-0.0178*** (-4.13)		-0.0194 (-0.72)
<i>Size</i>	-4.5480*** (-29.39)	-4.5469*** (-29.35)	0.2063*** (34.52)	0.2064*** (34.46)	-0.3224*** (-12.72)	-0.3223*** (-12.71)
<i>TobinsQ</i>	1.2424** (2.06)	1.2417** (2.06)	0.0319* (1.84)	0.0320* (1.84)	-0.0795 (-0.93)	-0.0794 (-0.93)
<i>CashFlow</i>	-13.2219 (-1.38)	-13.2301 (-1.38)	-0.7780*** (-3.09)	-0.7784*** (-3.09)	-8.2673*** (-7.33)	-8.2696*** (-7.33)
<i>CashFlowVolatility</i>	26.4147 (1.50)	26.4303 (1.50)	0.5292 (1.13)	0.5316 (1.14)	4.4625** (2.29)	4.4609** (2.29)
<i>NetWorkingCapital</i>	-7.6351*** (-4.09)	-7.6296*** (-4.09)	0.5367*** (5.63)	0.5380*** (5.64)	1.1556*** (4.29)	1.1553*** (4.28)
<i>Leverage</i>	-34.3412*** (-13.06)	-34.3546*** (-13.05)	0.4724*** (5.04)	0.4716*** (5.02)	2.8768*** (7.54)	2.8757*** (7.53)
YearFE	Yes	Yes	Yes	Yes	Yes	Yes
N	1,383	1,383	1,383	1,383	1,383	1,383
Adjusted/Pseudo R ²	0.6232	0.6232	0.4873	0.4873	0.3410	0.3410

Table 6. Bank ESG Performance and Lending Conditions to Environmentally Polluting Firms

This table presents the regression analysis of the lending conditions of banks with different ESG performance levels, using *DebtSize* as the dependent variable in models (1) and (2), *Cost* as the dependent variable in models (3) and (4), and *Collateral* as the dependent variable in models (5) and (6). Definitions of the variables are stated in Table A1. *t*-statistics based on standard errors robust to heteroskedasticity are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable	<i>DebtSize</i>		<i>Cost</i>		<i>Collateral</i>	
Regression Model	OLS	OLS	OLS	OLS	Probit	Probit
Model	(1)	(2)	(3)	(4)	(5)	(6)
<i>BankESG</i>	0.0012** (2.00)	0.0012** (2.02)	-0.7245*** (-8.96)	-0.7253*** (-8.98)	0.1714 (1.17)	0.1744 (1.19)
<i>Polluting</i>	0.0002 (0.12)		-0.5777** (-2.43)		-0.3563 (-0.49)	
<i>Penalty</i>		0.0000 (0.39)		-0.0399** (-2.40)		-0.0140 (-0.27)
<i>BankESG</i> × <i>Polluting</i>	-0.0011 (-0.45)		0.8765** (2.33)		0.0424 (0.04)	
<i>BankESG</i> × <i>Penalty</i>		-0.0001 (-0.71)		0.0626** (2.39)		-0.0151 (-0.18)
<i>Size</i>	-0.0010*** (-27.22)	-0.0010*** (-27.21)	-0.0854*** (-16.41)	-0.0855*** (-16.42)	-0.1957*** (-18.67)	-0.1955*** (-18.65)
<i>TobinsQ</i>	0.0005*** (4.05)	0.0005*** (4.05)	0.0052 (0.38)	0.0052 (0.39)	-0.0821*** (-2.96)	-0.0826*** (-2.98)
<i>CashFlow</i>	-0.0068*** (-5.70)	-0.0068*** (-5.70)	-1.9455*** (-13.79)	-1.9452*** (-13.79)	-2.2093*** (-8.24)	-2.2095*** (-8.24)
<i>CashFlowVolatility</i>	-0.0008 (-0.55)	-0.0008 (-0.55)	1.2254*** (9.06)	1.2288*** (9.09)	4.4534*** (14.65)	4.4517*** (14.65)
<i>NetWorkingCapital</i>	-0.0012*** (-3.16)	-0.0012*** (-3.16)	0.3396*** (8.60)	0.3398*** (8.60)	0.8370*** (9.78)	0.8361*** (9.77)
<i>Leverage</i>	-0.0056*** (-12.54)	-0.0056*** (-12.54)	0.9974*** (18.47)	0.9981*** (18.48)	0.5508*** (5.24)	0.5505*** (5.23)
YearFE	Yes	Yes	Yes	Yes	Yes	Yes
N	9,721	9,721	9,721	9,721	9,721	9,721
Adjusted/Pseudo R ²	0.1487	0.1487	0.2630	0.2630	0.0876	0.0877

Appendix

Table A2. Variable Definitions

This table presents the definitions of the variables.

Variable	Definition
<i>Polluting</i>	Indicator variable that equals one if a firm is an environmentally polluting firm, and zero otherwise.
<i>Penalty</i>	The natural logarithm of one plus total penalty of the firm in a given year.
<i>Cash</i>	The cash and cash equivalents scaled by total book assets.
<i>BankLoan</i>	The amount of annual bank loan scaled by total debt of the firm in a given year.
<i>PublicBond</i>	The amount of annual public corporate bond scaled by total debt of the firm in a given year.
<i>DebtSize</i>	The amount of a debt scaled by total debt of the firm in a given year.
<i>Cost</i>	The annual interest rate charged by the lending bank (bank loan) or the public (public corporate bond).
<i>Collateral</i>	Indicator variable that equals one if the debt is collateralized, and zero otherwise
<i>Size</i>	The natural logarithm of total assets.
<i>TobinsQ</i>	The firm's market value of physical assets (the market value of common equity plus the book value of debt minus the firm's current assets) divided by the book value of property, plant, and equipment.
<i>CashFlow</i>	The operating cash flow scaled by total assets, where operating cash flow is computed using earnings after interest, dividends, and taxes but before depreciation.
<i>CashFlowVolatility</i>	The standard deviation of a firm's <i>CashFlow</i> in five years.
<i>NetWorkingCapital</i>	The difference between current non-cash assets and current liabilities, scaled by total assets.
<i>Leverage</i>	Total debt divided by total assets.
<i>CapitalExp</i>	The capital expenditures divided by total assets.
<i>AcqExp</i>	The acquisition expenditures divided by total assets.
<i>R&DExp</i>	The R&D expenditures divided by total assets.
<i>Dividend</i>	Indicator variable that equals one if a firm pays cash dividends, and zero otherwise