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Comparative analysis of environmental performance measures and their impact on firms' financing choices

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ABSTRACT

This study investigates the roles of different measures of environmental performance in firms' financing choices. Environmental performance is measured through energy-efficiency investments, energy intensity, and energy consumption disclosures, which correspond to input-based, output-based, and disclosing perspectives, respectively. We further distinguish between debt financing and equity financing since environmental information asymmetry varies across investors, affecting the pecking order of financial sources. We use Eastern European and Central Asian firm-level data from the World Bank Enterprise Surveys conducted in 2019/2020. The study sample consists of above 3000 private firms from 42 countries. The logit model shows that alternative measures of environmental performance have varying impacts on financing. For a particular measure, it affects bank and equity financing in different ways. We also find that there is a direct joint impact of environmental investments and disclosures on equity financing. Overall, our study indicates that investors prefer to invest in eco-friendly firms rather than supporting conventional firms in reducing their environmental impacts. Hence, it is required to promote government support programs and loan guarantee programs to initiate firm-level environmental practices. Further, the complementary relationship indicates that firms may choose different environmental practices to reduce environmental information uncertainty, which improves the credibility of environmental information from the investors' perspective.

1. Background

1.1. Introduction

Corporate environmental responsibility (CER) is an integral element of corporate social responsibility (CSR) and Environmental, Social, and Corporate Governance (ESG) (Cai et al., 2016; Fan et al., 2021).[1] Accordingly, financial institutions' environmental considerations are often either a subset of sustainable finance or stand alone as carbon finance or green finance (Zhou and Li, 2019; Kumar et al., 2022). While researchers have investigated the relationship between environmental performance and financing (Benlemlih and Cai, 2020; Dorfleitner and Grebler, 2020; Gjergji et al., 2021; Wellalage and Kumar, 2021; Zhang, 2021), little attention has been paid to testing whether this relationship is sensitive to the measures of environmental performance. This is an important issue, especially for private firms that have no standardized measure of environmental performance, resulting in information asymmetries between firm managers and investors (Hoogendoorn et al., 2019).

The measures of environmental performance used in the literature vary by research purposes, scopes, and data availability. As Buntaine (2011) points out, environmental performance is related to environmental targets and mitigation activities, corresponding to output-based and input-based environmental performance measures, respectively. For large, listed firms, third-party agents provide environmental scores such as those in the KLD database and in ASSET4 (Benlemlih and Cai, 2020; Cai et al., 2016; Dorfleitner and Grebler, 2020; Erragragui, 2018; Nandy and Lodh, 2012). Recently, researchers have started to analyze the relationship between environmental performance and financing for private firms, using third-party certifications (Tian and Lin, 2019), environmental performance indexes (Wellage and Kumar, 2021), energy-efficiency investments (Zhang, 2021), and energy consumptions

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[1] See Cai et al. (2016) for the discussion of the importance of CER in CSR. The empirical findings in Erragragui (2018) show that, among components of CSR, only corporate environmental performance is associated with the cost of debt.

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(Zhang et al., 2022).

Our study analyzes and compares the impacts of environmental performance measures on financing from the input-based (energy-efficiency investment), output-based (energy intensity), and disclosing (energy consumption auditing) perspectives. These energy-relevant indicators are interdependent yet reveal a firm's environmental performance from various perspectives, in line with the conceptual typology of environmental performance measures in Buntaine (2011) and Tian and Lin (2019).

Using firm-level data covering 42 countries from the latest wave (2019/2020) of World Bank Enterprise Surveys (WBES), we find that the input-based measure is a positive indicator of both debt and equity financing; however, the disclosing perspective has a contradictory effect on debt financing and equity financing. We distinguish between debt financing and equity financing as a reflection of information differences between investors under the stakeholder theory (Scott and Lane, 2000) and of different costs of adverse selection of debt and equity under the pecking order theory of capital structure (Myers and Majluf, 1984).[2]

Information asymmetry is the primary explanation for the pecking order theory (Fulghieri et al., 2020). The adverse selection risk premium adhered to external financing is due to information asymmetry between firms' managers and outside investors. Environmentally responsible firms are more likely to faithfully report their financial information, influencing the capital market (Chen et al., 2019). Voluntary disclosures motivated by better environmental performance reduce information asymmetry and improve information quality (Cui et al., 2018; Li, 2017), which increases the proportion of soft information in the total information, improving both real and financial efficiency. Hence, the information conveyed through environmental performance alters the content of total information, influencing firms' capital structure policies (Ding et al., 2022). Moreover, information differences between investors may change the channel through which information affects capital structure. For example, Lambert et al. (2012) state that, for different investors, information precision rather than information asymmetry affects a firm's cost structure. The precision of environmental information is even more complex, including various measures of environmental information and a lack of standardized criteria for firms globally and especially for private firms.

Our paper improves the recent literature on the environmental performance and financing nexus in several ways. First, we examine the relationship between environmental profiles and firm financing in an attempt to deepen our knowledge of whether the use of different environmental performance indicators matters. In recent studies, Wellalage and Kumar (2021) and Zhang (2021) analyze the impact of firm environmental performance on debt financing. Wellalage and Kumar (2021) measure environmental performance through non-energy efficiency investments, while Zhang (2021) only uses energy-efficiency investments. As per the authors' knowledge, this is the first study demonstrating a comparative analysis of the impact of environmental performance on financing choices, using energy-based input-output and disclosures.

Second, we distinguish between debt financing and equity financing under the stakeholder theory (Scott and Lane, 2000) and the pecking order theory (Myers and Majluf, 1984), indicating the impact of environmental performance on capital structure. Therefore, our study complements previous studies on the environmental and financial performance nexus since environmental performance may affect both financial performance and firm value through its impact on capital expenditures.

Third, our study provides insights into the environmental performance–financing nexus in private firms. Previous studies mainly focus on U.S.-listed firms (Benlemlih and Cai, 2020; Bolton and Kacperczyk, 2021; Cai et al., 2016; Chen et al., 2020; Erragragui, 2018) or on listed firms in other specific countries (Gjergji et al., 2021; Zhang et al., 2021). Empirical studies on non-U.S. firms confirm that the impacts of environmental performance on financing and contractual terms depend on environmental performance measures as well as institutional features (Ding et al., 2022; Gjergji et al., 2021). There is currently a gap in the literature on cross-country studies of private firms' environmental performance and its impact on bank loan financing *and* on equity financing. We provide a fresh perspective on environmental performance and financing in private firms and highlight the significance of heterogeneity in policy preparations in terms of private firms' access to financing.

The rest of the paper is organized as follows. Section 1.2 briefly reviews the relevant literature and then derives hypotheses. Section 2 describes the data sample and research design, followed by the presentation of the empirical findings in Section 3 and robustness checks in Section 4. We then summarize the main findings and their implications in Section 5.

1.2. Conceptualization

The literature on the relationship between environmental performance and financing is very broad in terms of measures and data used.[3] Benlemlih and Cai (2020) use the leverage ratio of total debt to total assets and find that environmentally responsible firms have significantly lower debt ratios due to lower costs of financial distress. Benlemlih and Cai (2020) separate environmental strengths and concerns and estimate two separate models. They find that only environmental strengths significantly lower leverage. Thus, environmental strengths and concerns are not considered with the same importance in firms' capital structure policies.

Financing variables also vary widely between existing studies. Regarding the cost of debt, Erragragui's (2018) empirical findings indicate that environmental strengths reduce firms' cost of debt, and that the opposite is true for environmental concerns. Previous empirical studies indicate that the components of environmental performance have different impacts on financing. Ding et al. (2022) discover that environmental disclosure moderates the impact of environmental administrative penalties on the cost of debt for Chinese listed firms. Gjergji et al. (2021) use the listed Italian SMEs and construct an ESG disclosure index based on a content analysis of discretionary environmental, social, and governance information. They find that environmental disclosures lead to an increase in the cost of capital for SMEs excluding family-owned SMEs, which differs from the findings in Ding et al. (2022). Recently, Zhang et al. (2021) document a positive relationship between the environmental management system certification, an indicator of better environmental performance, and access to finance for Chinese public firms. For Turkish listed firms, Kalash's (2021) findings demonstrate that carbon disclosure positively affects their financial leverage. Zhang (2021) provides empirical findings indicating that banks are more willing to lend money to eco-friendly firms, and that, for firms with an approved loan application, good environmental performance reduces the probability of collateral requirements being imposed and the amount of collateral value. However, Wellalage and Kumar (2021) document that environmental performance has a

[2] The other main theories in capital structure are the trade-off theory (Bradley et al., 1984), the market timing theory Baker and Wurgler (2002), and the inertia theory (Welch, 2004).

[3] We primarily review recent empirical studies that use firm-level data to assess the relationship between environmental performance and financing. For sustainable finance, see Kumar et al. (2022) for a recent review. Table A1 in the Appendix summarizes the measures of environmental performance used in empirical studies. Although some studies investigate the impact of environmental performance on stock prices (Flammer, 2013; Bolton and Kacperczyk, 2021), we do not find empirical studies that use firm-level data to directly test the relationship between environmental performance and equity financing. As an additional analysis, Benlemlih and Cai (2020) include the equity equation in the model but do not report the estimation results.

significant impact on loan size but not on the collateral to loan ratio.

The above studies focus on debt financing and bank loan contractual terms. Few empirical studies have directly assessed the impact of environmental performance on equity financing, although researchers evaluate the impact of environmental performance on listed firms' stock prices (Bolton and Kacperczyk, 2021; De Haan et al., 2012; Flammer, 2013). According to the market timing theory of capital structure, firms tend to issue equity when the market value is high relative to book value and to past market values (Baker and Wurgler, 2002). For U.S.-listed firms, environmentally responsible firms experience a significant stock price increase around the announcement of environmentally relevant news (Flammer, 2013), and lower carbon dioxide emissions are associated with higher returns, indicating a carbon premium (Bolton and Kacperczyk, 2021). However, using the Newsweek Green Rankings for the U.S.-listed firms, De Haan et al. (2012) confirm a negative relationship between environmental performance and stock returns among the 500 largest U.S.-listed companies, which is attributed to corporate risk exposure as revealed in environmental performance reporting.

Based on the above arguments drawn from capital structure theory and previous empirical studies, we posit the following hypotheses:

Hypothesis 1. (**H1**): Different sources of financing (either debt or equity) respond differently to various measures of environmental performance.

Hypothesis 2. (**H2**): Different measures of environmental performance have different impacts on debt financing and equity financing.

Finally, there may be a joint impact of different environmental performance measures on financing choices. For example, firms with investments in pollution prevention technologies and with low environmental impacts signal better environmental performance, alleviating lenders' environmental concerns. Regarding environmental disclosures, poor environmental performers may adopt environmental reporting to boost their environmentally responsible activities (Doan and Sassen, 2020). However, environmental disclosures, together with input- or output-based environmental performance measures, may substantially enhance the quality of environmental information, reducing information asymmetries between managers and investors (Aerts et al., 2008; Clarkson et al., 2008; Li, 2017). As such, we derive our third hypothesis as follows:

Hypothesis 3. (**H3**): There is a joint impact of various measures of environmental performance on financing choices.

2. Data and methodology

To investigate the impacts of environmental performance on financing choices, we use the data from the World Bank Enterprise Surveys (WBES) (Enterprise Surveys, 2020).[4] The surveys employ a uniform stratified sampling methodology to generate samples. For each sample country, the stratified random samples were selected in the dimensions of industry, region, and firm size to represent the non-agriculture private economy.

The surveys provide comparative information on the business environment of firms in most developing countries and in some developed countries. There have been several waves over the years, with each wave collecting data on some (not all) countries. Unlike the older waves, the latest 2019–2020 wave includes a Green Economy Module on firms' green management practices and green investments. One of the strengths of the new wave is the survey questions about energy use, energy-efficiency investments, and energy consumption auditing, which address environmental performance from various perspectives. In addition, the surveys provide information on firms' financing decisions and their potential determinants, such as growth, firm age, and ownership.

The latest WBES wave covered firms in 42 economies in Europe, Central Asia, and Middle East and North Africa. The original sample includes about 28,000 firms. Among them, about 10,000 firms reported their energy consumption. After excluding firms with missing observations, we further restrict our analysis to sample firms that applied for bank loans or issued new equity; see more below.

2.1. Dependent variables

This study employed bank lending and equity financing as a proxy for financing choices. For bank lending, the relevant survey questions are, "… did this establishment apply for any lines of credit or loans?" and "… what was the outcome of the application?" We set a dummy variable, *Bank*, that equals 1 for firms with a loan application approved in full and 0 otherwise. Some firms did not apply for any line of credit or loans for the reasons of unfavorable interest rates, high collateral requirements, or insufficient size of loan and maturity. We treat those firms as having been rejected by banks since they may predict a negative result according to early communications with financial institutions. Thus, we obtained a sample of 3375 firms that either applied for bank loans or did not apply for bank loans for the reasons listed above.

For equity financing, the relevant survey question is about the sources of financing for fixed investments in the last fiscal year. For this analysis, we restrict the sample to firms that invested in fixed assets, a total of 3143 firms. A dummy variable, *Equity*, equals 1 for firms that financed their fixed investments with owners' contributions or new equity shares, and 0 otherwise.

2.2. Measuring environmental performance

A key design issue in this study is to obtain reliable measures of environmental performance that are comparable across firms in different sectors. This study measures environmental performance through investment in improving energy efficiency, energy intensity, and voluntary disclosures of energy consumption. These energy-relevant indicators are interdependent yet reveal a firm's environmental performance from input-based, output-based, and disclosing perspectives, in line with the conceptual typology of environmental performance measures in Buntaine (2011) and Tian and Lin (2019).

Energy consumption causes environmental pollution and further influences sustainable efficiency (Chen et al., 2019; Zhu et al., 2020). Firms with energy-efficiency investments seek to reduce their environmental impacts, which signals better environmental responsibility. Furthermore, energy efficiency reduces the total fuel burn-up and thus the quantity of pollutants and greenhouse gases emitted. There are no generally established principles or methodologies for measuring a firm's environmental performance (Ameer and Othman, 2012). Moreover, there is no quantitative data accessible for the environmental performance of unlisted firms (Wellalage and Kumar, 2021). Hence, following prior literature, we use firms' self-estimation as the most appropriate method for a proxy for environmental performance (Wellalage and Kumar, 2021).

Using the survey questions, we first set two dummy variables for energy-efficiency investments and energy-consumption auditing, respectively. The dummy, *Efficiency-Investment*, equals 1 for firms that adopted measures to enhance energy efficiency over the last three years. The dummy, *Disclosure*, equals 1 for firms that completed an external

[4] Previous studies using WBES data to investigate firms' environmental behavior and/or financing include Gorodnichenko and Schnitzer (2013), Tian and Lin (2019), Wellalage and Kumar (2021), Zhang (2021), Zhang et al. (2020), and Zhang and Xie (2021).

audit of their energy consumption over the last three years.[5]

For energy intensity, there are different measures used in the literature. At the macro level, energy intensity equals the ratio of total energy use to GDP.[6] At the firm level, some studies measure energy intensity through a ratio of energy expenditures to sales (Zhang et al., 2020). Energy expenditures do not take energy composition into account and are less comparable for firms in different countries. In the surveys used here, firms reported their annual consumption of electricity, fuels, natural gas, and coal. We converted the units of these energy inputs into megajoules based on the average unit conversion factors presented in IEA (2005). The variable, *Energy-Intensity*, equals the ratio of energy input in megajoules to sales. A low value of *Energy-Intensity* indicates better environmental performance.

We tabulate the mean values of the three environmental variables for samples with regard to firms' financing choices. A dummy variable's mean represents the share of firms with the dummy = 1 out of the sample. As such, the table indicates that firms with energy-efficiency investments or energy consumption disclosures are more likely to gain access to bank loans or to new equity. Energy-intensive firms prefer debt financing rather than new equity capital.

	Bank = 0	*Bank* = 1	*Equity* = 0	*Equity* = 1
Efficiency-Investment	0.356	0.480	0.507	0.653
Energy-Intensity	0.269	0.335	0.342	0.302
Disclosure	0.202	0.208	0.226	0.407

2.3. Model specifications

To estimate the impact of environmental performance measures on *Bank* or *Equity* (*Y*), we apply a logit model in the form of:

$$\Pr(Y_i = 1|\boldsymbol{X}) = f(Z_i) \tag{1}$$

$$Z_i = a_0 + a_1 EfficiencyInvestment_i + \sum_{k=1}^{m} b_k X_{k,i} + Country\ dummies + Sector\ dummies + U_i \tag{2a}$$

$$Z_i = a_0 + a_1 EnergyIntensity_i + \sum_{k=1}^{m} b_k X_{k,i} + Country\ dummies + Sector\ dummies + U_i \tag{2b}$$

$$Z_i = a_0 + a_1 Disclosure_i + \sum_{k=1}^{m} b_k X_{k,i} + Country\ dummies + Sector\ dummies + U_i \tag{2c}$$

where *i* denotes firms in the sample; *Y* stands for the dependent variable, i.e., *Bank* (Model A) and *Equity* (Model B), one at a time; $\boldsymbol{X}$ represents a vector of dependent variables; $\Pr(Y_i = 1|\boldsymbol{X})$ is the cumulative distribution function of a logit distribution; *U* is an error term. In Equations (2a) – (2c), country dummies and sector dummies control for firm heterogeneity at the country and industrial sector levels.[7]

For either Model A or Model B, there are three regressions in correspondence to *Efficiency-Investment* in Equations (1) and (2a), *Energy-Intensity* in Equations (1) and (2b), and *Disclosure* in Equations (1) and (2c). Additionally, there is a model regression with all environmental variables.

For control variables, we follow previous studies (Benlemlih and Cai, 2020; Wellalage and Kumar, 2021; Zhang, 2021) and include the following variables in the model specifications. As an indicator of growth opportunities, the growth rate of sales over the last three years (*Growth*) likely affects demand for external financing. Exporters and firms with foreign ownership may have better corporate governance and be more profitable than their counterparts, which influences their position in the financing pecking order. Thus, the dummy variables, *Exporter* and *Foreign-Ownership* are set for exporters and firms partially owned by foreign investors, respectively. Compared to shareholding firms, sole proprietorships (*Sole-Proprietorship*) have limited access to equity financing and hence rely more on debt financing. Firms that are a part of larger establishments (*Part*) may rely less on external funding. Firms' age (*Firm-Age*) and size (*Small-Firm* or *Medium-Firms*) are potential indicators of business risk, influencing their financing sources. Firms in competitive markets (*Competition*) need more financial resources for working capital. Firms' locations (*Small-City* or *Large-City*) may reflect the level of credit supply, influencing firms' financing decisions. See Table A2 in the Appendix for the definitions of dependent and independent variables.

Table 1 demonstrates summary statistics for variables used in Models A and B. Of the firms that applied for bank loans, 49% had their applications approved. Of firms that purchased new fixed assets, 9.1% issued new equity for financing fixed investments. Environmental performance's impact on financing choices varies by measures. For *Efficiency-Investment* and *Disclosure*, environmental performers prefer equity to bank debt; the opposite is true when it comes to *Energy-Intensity*.

Table 2 reports a pairwise correlation matrix for variables used in Models A and B. For the sample used for Model A, *Bank* is significantly and positively correlated with *Efficiency-Investment* and *Energy-Intensity*. For the sample used for Model B, *Equity* is significantly and positively correlated with *Efficiency-Investment* and *Disclosure*. Among environmental variables, *Efficiency-Investment* and *Disclosure* are strongly correlated, while *Energy-Intensity* is weakly correlated with either *Efficiency-Investment* or *Disclosure*. Most of the control variables are more significantly correlated to bank financing than to equity, implying that banks and shareholders rely on different sources of information.

In sum, the statistical analysis indicates that the role of environmental performance in financing depends on its measures and varies between equity financing and bank financing. Thus, it is important to distinguish between equity and bank debt and to use various measures of environmental performance in the regression analysis.

Table 1
Summary statistics.

Variable	Sample for Model A		Sample for Model B	
	Mean	SD	Mean	SD
Bank	0.490	0.500		
Equity			0.091	0.287
Efficiency-Investment	0.417	0.493	0.520	0.500
Energy-Intensity	0.302	0.615	0.338	0.627
Disclosure	0.205	0.404	0.243	0.429
Growth	16.38	24.77	16.94	23.59
Exporter	0.074	0.262	0.085	0.279
Foreign-Ownership	0.071	0.258	0.121	0.326
Sole-Proprietorship	0.157	0.364	0.141	0.348
Part	0.097	0.295	0.141	0.348
Firm-Age	2.831	0.641	2.881	0.662
Small-Firm	0.423	0.494	0.344	0.475
Medium-Firm	0.337	0.473	0.347	0.476
Competition	0.544	0.498	0.518	0.500
Small-City	0.337	0.473	0.404	0.491
Large-City	0.252	0.434	0.241	0.428

[5] Previous studies compile environmental or ESG disclosure scores from firms' annual financial reports, sustainability reports, company websites, and so on (Doan and Sassen, 2020; Fan et al., 2021). This study directly measures environmental disclosures through energy consumption reports.

[6] The World Bank reports energy intensity by country; see https://data.worldbank.org/indicator/EG.EGY.PRIM.PP.KD.

[7] Since some countries only have limited observations (firms), we follow Gorodnichenko and Schnitzer (2013) and use regional dummies in regressions to avoid a high level of multicollinearity.

Table 2
Correlation matrix.

Variable	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sample for Model A															
Bank	1														
Efficiency-Investment	2	0.1263***													
Energy-Intensity	3	0.0533**	0.0477**												
Disclosure	4	0.0076	0.2977***	0.0679***											
Growth	5	0.0316	0.0392*	−0.0910***	0.0187										
Exporter	6	0.0902***	0.1222***	0.0163	0.1187***	−0.0097									
Foreign-Ownership	7	0.0594***	0.0479**	0.024	0.0926***	−0.0087	0.0968***								
Sole-Proprietorship	8	−0.0813***	−0.0709***	0.0116	−0.0702***	−0.0217	−0.0541**	−0.0881***							
Part	9	0.1126***	0.0978***	0.0198	0.0722***	−0.0028	0.1138***	0.0885***	−0.0777***						
Firm-Age	10	0.0828***	0.1015***	0.0609***	0.1048***	−0.1887***	0.1194***	0.0124	−0.0205	0.1242***					
Small-Firm	11	−0.1760***	−0.1687***	−0.0420*	−0.1580***	−0.0048	−0.1240***	−0.1445***	0.1510***	−0.1483***	−0.1878***				
Medium-Firm	12	0.0595***	0.0178	0.0044	−0.0069	0.0353*	0.0082	−0.0224	−0.0664***	−0.0124	−0.0163	−0.6108***			
Competition	13	−0.0658***	−0.0355*	−0.0009	−0.0177	−0.0385*	−0.0398*	−0.0903***	0.0616***	−0.0067	−0.0462**	0.0525**	−0.017		
Small-City	14	0.1635***	0.0409*	0.0929***	−0.006	−0.0205	0.0103	0.0333	−0.0618***	0.0000	0.0656***	−0.0498**	0.0680***	−0.0863***	
Large-City	15	−0.0271	−0.0005	0.0041	−0.0009	−0.0052	0.0541**	0.0088	0.001	0.0367*	−0.0141	−0.0247	0.0096	−0.0321	−0.4141***
Sample for Model B															
Equity	1														
Efficiency-Investment	2	0.0837***													
Energy-Intensity	3	−0.0185	0.0083												
Disclosure	4	0.1210***	0.2779***	0.0519**											
Growth	5	0.0309	0.0205	−0.0778***	0.0143										
Exporter	6	0.0786***	0.0985***	0.0205	0.1229***	−0.0311									
Foreign-Ownership	7	0.0083	0.0718***	−0.0029	0.0716***	−0.0206	0.0756***								
Sole-Proprietorship	8	0.1081***	−0.0603***	0.0301	−0.022	−0.0098	−0.0675***	−0.1110***							
Part	9	0.031	0.0769***	−0.0409*	0.0601***	−0.0448*	0.0861***	0.1600***	−0.0931***						
Firm-Age	10	−0.019	0.1162***	0.0781***	0.1080***	−0.2325***	0.1201***	0.0089	−0.0222	0.1236***					
Small-Firm	11	−0.028	−0.1841***	−0.0083	−0.1709***	0.0165	−0.1125***	−0.1868***	0.1213***	−0.1629***	−0.2030***				
Medium-Firm	12	−0.0743***	−0.0342	0.0168	−0.0403*	0.0206	0.0127	−0.0415*	−0.0604***	−0.0213	−0.0178	−0.5279***			
Competition	13	0.0139	−0.0286	0.0166	−0.0423*	−0.0021	−0.0306	−0.0790***	0.0768***	−0.024	−0.0175	0.0573**	−0.0167		
Small-City	14	−0.0794***	0.0017	0.1062***	−0.0352*	−0.0515**	0.0258	0.0438*	−0.0328	−0.0305	0.0571**	−0.0093	0.1010***	−0.0691***	
Large-City	15	0.0242	−0.0339	−0.0122	−0.0152	−0.0168	0.0072	−0.0337	−0.0245	0.0322	0.0115	−0.0037	−0.0137	−0.0258	−0.4638***

Note: *, **, and *** stand for the significance level of 10%, 5%, and 1%, respectively.

3. Empirical results

3.1. Main findings

Tables 3 and 4 present the estimation results for Models A (for *Bank*) and B (for *Equity*), respectively. For each model, there are four regressions that correspond to the measures of environmental performance, i.e., *Efficiency-Investment*, *Energy-Intensity*, *Disclosure*, and all three environmental performance measures. In all four regressions, the values of McFadden's pseudo-R^2 range from 0.08 to 0.086 for Model A and from 0.082 to 0.106 for Model B, indicating Model B's better goodness of fit.[8] For these logit model regressions, the estimated coefficients represent changes in the odds ratio of the use of a type of financing and not in response to a one-unit change in a variable of interest (from 0 to 1 for a dummy variable). An alternative is to report marginal effects derived from the estimates, which tell changes in the probability of using a type of financing in response to a one-unit change in a variable of interest. Tables 3 and 4 report the marginal effects since changes in the probability are more intuitive for understanding the impact on the financing of environmental performance and other control variables.

Table 3 results show that *Efficiency-Investment* and *Disclosure* significantly affect bank financing, which supports **H1**. For Model A1, the probability of being granted a bank loan is 8.71% higher for firms with energy-efficiency investments. From an investor perspective, environmental performance reduces firms' information asymmetry and business risk, which then affects their creditworthiness. For example, it has been suggested that banks should integrate lenders' environmental risk into the wider credit management system (Weber et al., 2008).

Nevertheless, we find that, for Model A3, the probability of being granted a bank loan is 3.93% smaller for firms with energy consumption disclosure than for their counterparts. Regarding environmental disclosures, poor environmental performers may provide the report per bank request resulting in the rejection of loan applications, in line with the findings in Doan and Sassen (2020).

The insignificant coefficient of *Energy-Intensity* in Models A3 and A4 implies that banks do not consider firms' energy use when evaluating their loan applications. The insignificant impact of the output-based measure is likely attributed to the unavailability of the relevant information, indicating a direction for possible improvement in the reliability and credibility of environmental disclosures.

Table 4 identifies that *Efficiency-Investment* and *Disclosure* are significantly associated with equity financing, in line with the findings for bank debt. However, both *Efficiency-Investment* and *Disclosure* are positively associated with equity financing while *Disclosure* affects bank loan financing in a negative direction. For Model B1, firms with energy-efficiency investments have a 3.33% higher probability of using equity for capital expenditures than conventional firms. For Model B3, disclosing energy consumption would increase the probability of using equity for capital expenditure by 5.01%. Environmental disclosures reduce information asymmetries for shareholders by improving the precision of earnings forecasts (Aerts et al., 2008). Similar to the findings in Table 3, Table 4 also reports that energy-efficient firms do not differ from energy-inefficient firms when it comes to new equity for fixed investments.

Table 3
Estimation results of model a for *Bank*.

Variable	Model A1	Model A2	Model A3	Model A4
	Estimate	Estimate	Estimate	Estimate
Efficiency-Investment	0.0871***			0.1008***
	[0.0191]			[0.0198]
Energy-Efficiency		0.0148		0.0156
		[0.0152]		[0.0153]
Disclosure			−0.0393*	−0.0709***
			[0.0234]	[0.0241]
Growth	0.0011***	0.0012***	0.0012***	0.0011***
	[0.0004]	[0.0004]	[0.0004]	[0.0004]
Exporter	0.0779**	0.0898**	0.0938***	0.0847**
	[0.0366]	[0.0361]	[0.0361]	[0.0365]
Foreign-Ownership	0.0164	0.0144	0.0176	0.0214
	[0.0370]	[0.0368]	[0.0369]	[0.0370]
Sole-Proprietorship	−0.037	−0.0361	−0.0351	−0.0393
	[0.0269]	[0.0268]	[0.0268]	[0.0269]
Part	0.1065***	0.1133***	0.1147***	0.1081
	[0.0321]	[0.0319]	[0.0319]	[0.0322]
Firm-Age	0.0137	0.017	0.0192	0.0161
	[0.0154]	[0.0153]	[0.0153]	[0.0154]
Small-Firm	−0.17***	−0.185***	−0.1921***	−0.1786***
	[0.0247]	[0.0243]	[0.0245]	[0.0249]
Medium-Firm	−0.0515**	−0.0609**	−0.0663***	−0.0579**
	[0.0252]	[0.0249]	[0.0251]	[0.0253]
Competition	−0.0369**	−0.0366**	−0.0359**	−0.0365**
	[0.0187]	[0.0187]	[0.0187]	[0.0188]
Small-City	0.1225***	0.1227***	0.1236***	0.121***
	[0.0221]	[0.0220]	[0.0220]	[0.0222]
Large-City	−0.0052	−0.0052	−0.005	−0.0063
	[0.0238]	[0.0237]	[0.0237]	[0.0238]
Country dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Pseudo R^2	0.084	0.080	0.080	0.086
Observations	3375	3375	3375	3375

Note: *, **, and *** stand for the significance level of 10%, 5%, and 1%, respectively. Standard errors are in brackets.

Table 4
Estimation results of model B for *Equity*.

Variable	Model B1	Model B2	Model B3	Model B4
	Estimate	Estimate	Estimate	Estimate
Efficiency-Investment	0.0333***			0.0243**
	[0.0094]			[0.0097]
Energy-Efficiency		−0.0049		−0.0071
		[0.0078]		[0.0077]
Disclosure			0.0501***	0.0422***
			[0.0127]	[0.0125]
Growth	0.0002	0.0002	0.0002	0.0002
	[0.0002]	[0.0002]	[0.0002]	[0.0002]
Exporter	0.0919***	0.0989***	0.085***	0.0819***
	[0.0251]	[0.0258]	[0.0244]	[0.0241]
Foreign-Ownership	0.0061	0.0067	0.0058	0.0058
	[0.0146]	[0.0148]	[0.0145]	[0.0144]
Sole-Proprietorship	0.0755***	0.0785***	0.0718***	0.0721***
	[0.0184]	[0.0187]	[0.0182]	[0.0183]
Part	0.0111	0.011	0.0112	0.01
	[0.0135]	[0.0136]	[0.0135]	[0.0133]
Firm-Age	−0.0156**	−0.0137**	−0.0156**	−0.0162**
	[0.0068]	[0.0068]	[0.0067]	[0.0067]
Small-Firm	−0.0304***	−0.0402***	−0.0287***	−0.023**
	[0.0102]	[0.0097]	[0.0103]	[0.0106]
Medium-Firm	−0.0408***	−0.0478***	−0.04***	−0.036***
	[0.0099]	[0.0096]	[0.0098]	[0.0100]
Competition	0.0015	0.0016	0.0022	0.0025
	[0.0089]	[0.0090]	[0.0089]	[0.0088]
Small-City	−0.0186*	−0.0182*	−0.0184*	−0.0177*
	[0.0110]	[0.0111]	[0.0109]	[0.0109]
Large-City	0.0057	0.0049	0.0047	0.0055
	[0.0116]	[0.0116]	[0.0115]	[0.0115]
Country dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Pseudo R2	0.106	0.082	0.097	0.097
Observations	3143	3143	3143	3143

Note: *, **, and *** stand for the significance level of 10%, 5%, and 1%, respectively. Standard errors are in brackets.

[8] For the value of McFadden's pseudo-R^2, 0.2–0.4 indicate the best fitness (Dedman et al., 2014).

Comparing the results in Table 3 with the results in Table 4 highlights the different roles of environmental performance in bank and equity financing, which generally supports **H2**. The *Efficiency-Investment* variable has a much stronger impact on debt financing than on equity financing (8.71% in Model A1 versus 3.33% in Model B1). Banks and shareholders may evaluate the effectiveness of pollution prevention investments in different ways, depending on their existing knowledge and other complementary information available. *Disclosure* negatively affects bank financing but positively affects equity financing (−3.93% in Model A3 versus 5.01% in Model B3). Firms with poor environmental performance, as revealed in their disclosures, may rely on equity financing for environmental investments. Thus, our findings are similar to those of Halov and Heider (2011), who find that firms issue more equity and less debt when information asymmetries stem from risk factors.

Regarding control variables, the estimates have the same significance levels with marginally different magnitudes from the four regressions for either Model A or Model B. However, there are significant differences in estimates between the two models. Firms with a high growth rate and that are part of a larger establishment are more likely to use bank financing than their respective counterparts; however, they do not differ from their respective counterparts regarding equity financing. On the contrary, sole-proprietorship firms rely more on equity financing than firms with other legal statuses. Bank debt and equity capital are both more accessible to exporters than to non-exporters. Small and medium-sized firms are constrained by access to external financing, whereas firms in a competitive market are only constrained by access to bank financing. The coefficient of *Small-City* is positive in Model A and negative in Model B, indicating that firms located in small cities are more likely to replace equity capital with bank debt.

3.2. Interaction effect

For *Efficiency-Investment* and *Disclosure*, the main results show their opposite impacts on bank debt and similar impacts on equity capital. It is interesting to test the joint impact of energy-efficiency investments and environmental disclosures on financing decisions. We re-estimate Models A and B by including three dummies based on the interaction between *Efficiency-Investment* and *Disclosure*, namely *EfficiencyInvestment-only* for firms that invested in energy-efficiency technologies but did not disclose energy consumption, *Disclosure-only* for firms that disclosed energy consumption but did not invest in energy-efficiency technologies, and *EfficiencyInvestment-Disclosure* for firms that invested in energy-efficiency technologies and disclosed their energy consumption. These interaction teams are compared with firms without energy-efficiency investments and environmental disclosures (the base) in the regressions.

Table 5 presents the estimation results for the regressions for *Bank* and *Equity* with interaction terms. For bank debt, there is no joint impact of *Efficiency-Investment* and *Disclosure*; however, for equity financing, the coefficient of *EfficiencyInvestment-Disclosure* is significant. The magnitude of *EfficiencyInvestment-Disclosure* is greater than that of *Efficiency-Investment* or *Disclosure* in the original results (7.92% versus 3.33% and 5.01%), indicating the joint impact of the measures of environmental performance on equity financing. Thus, we fail to reject **H3** for equity financing. Incorporating the interaction term in the model for bank loans changes the estimates of the standalone environmental variables. The negative impact of *Disclosure-only* is much higher than that of *Disclosure* in the original results (−10.53% versus −3.93%). Banks may evaluate the credibility of environmental disclosures based on whether firms invest in energy efficiency technologies.

3.3. Endogeneity

Endogeneity is a typical issue affecting the estimated impact of environmental performance on financing. As stated in Kacperczyk and Peydró (2021), banks may, on the one hand, cut credit to conventional firms and channel credit toward green firms. On the other hand, banks may provide credit to conventional firms for environmental investments. Thus, better environmental performance is likely attributed to accessible sources of financing, indicating an inverse causality from financing to environmental performance. For a binary dependent variable as used in this study (e.g., *Bank* and *Equity*), a bivariate probit model is an appropriate approach for testing the endogeneity of the dummy variables, *Efficiency-Investment* and *Disclosure* (Marra et al., 2017), and a control function is a useful tool for testing endogeneity of a continuous variable such as *Energy-Intensity* (Wooldridge, 2015). The two approaches need an instrument variable (IV) for the measures of environmental performance. The surveys include a question about whether a firm's customers required environmental certifications or adherence to certain environmental standards as a pre-condition to doing business with this firm. Customers' environmental concerns motivate firms to implement environmental practices but are not obviously related to financing choices. As such, a dummy variable based on whether firms' customers are environmentally conscious servers as an IV in the test for endogeneity.[9]

For either *Efficiency-Investment* or *Disclosure*, the bivariate probit model estimates two regression equations, one for the environmental variable on all control variables and IV, and the other for *Bank* or *Equity*.

Table 5
Estimation Results of Model A for *Bank* and Model B for *Equity*, with interaction terms.

Variable	Model A	Model B
	Estimate	Estimate
EfficiencyInvestment-only	0.0899***	0.013
	[0.0219]	[0.0117]
Disclosure-only	−0.1053***	−0.007
	[0.0387]	[0.0213]
EfficiencyInvestment-Disclosure	0.0416	0.0792***
	[0.0286]	[0.0189]
Growth	0.0011***	0.0001
	[0.0004]	[0.0002]
Exporter	0.0815**	0.0805***
	[0.0366]	[0.0240]
Foreign-Ownership	0.0215	0.0063
	[0.0371]	[0.0145]
Sole-Proprietorship	−0.039	0.0678
	[0.0269]	[0.0179]
Part	0.1085***	0.0109
	[0.0322]	[0.0134]
Firm-Age	0.0163	−0.0162**
	[0.0154]	[0.0067]
Small-Firm	−0.1778***	−0.022**
	[0.0249]	[0.0107]
Medium-Firm	−0.0564	−0.0354***
	[0.0253]	[0.0100]
Competition	−0.0364**	0.002
	[0.0188]	[0.0088]
Small-City	0.1225***	−0.0175*
	[0.0221]	[0.0109]
Large-City	−0.0068	0.0045
	[0.0238]	[0.0115]
Country dummies	Yes	Yes
Sector dummies	Yes	Yes
Pseudo R^2	0.086	0.114
Observations	3375	3143

Note: *, **, and *** stand for the significance level of 10%, 5%, and 1%, respectively. Standard errors are in brackets.

[9] The IV is a strong predictor of *Efficiency-Investment* and *Disclosure*, indicating its validity. However, the IV is not significant in the control function for *Energy-Intensity*. We alternatively use the average energy intensity by country, region, and industrial sector as an IV, a strong predictor of firm-level energy intensity. However, the endogeneity test result for *Energy-Intensity* is unchanged.

In total, there are four bivariate probit models. For each of the models, the Lagrange multiplier test results fail to reject the null hypothesis that *Efficiency-Investment* and *Disclosure* are exogenous variables in the logit regressions for financing variables.

For *Energy-Intensity*, the control function approach first estimates an ordinary least squared (OLS) regression with *Energy-Intensity* being the dependent variable and on all control variables and IV. Then, the logit model for financing variables is modified by including the residual from the OLS regression, which tests for endogeneity. For *Bank* and *Equity*, the coefficient of the residual from the OLS regression is insignificant, indicating the exogeneity of *Energy-Intensity* in the logit regressions for financing variables.

4. Robustness checks

4.1. Multinominal logit model

Our study consists of four discrete financing choices: *Bank*, *Equity*, *Bank* and *Equity*, and others. Hence, we re-run our data using a multinomial logit model. The multinomial logit model is used with discrete dependent variables that take on more than two outcomes and do not have a natural ordering, namely Model A for *Bank*, Model B for *Equity*, and Model C for *Bank* and *Equity*. The estimates of the coefficients in the multinomial logit regressions in Table 6 indicate that energy efficiency investment is positively associated with all kinds of financing choices and environmental disclosure only positively contributes to equity financing, in line with the findings derived from our baseline regressions.

4.2. Alternative proxy

In our baseline regressions, we measure *Energy-Intensity* as the ratio of energy input in megajoules to sales. As a robustness check, we measure *Energy-Intensity* as the ratio of energy input in monetary units to sales. The logit regression results with the alternative measure of *Energy-Intensity* (Table 7) indicate that the coefficient of *Energy-Intensity* significantly affects bank financing but at a 9% significant level and does not affect equity, which is aligned with our baseline regressions.

5. Conclusion

A growing literature has investigated the relationship between environmental performance and financing but provides mixed results. This study revisits this relationship by comparing the impacts of different environmental performance measures on financing choices. The aggregate unidimensional measures of environmental performance used in the literature may blur its impact on financing and fails to reveal the ways in which environmental performance plays a role in firms' financing choices. We measure environmental performance through energy-efficiency investments, energy intensity, and energy-consumption disclosures. We further distinguish between bank financing and equity financing since the availability of environmental information depends on stakeholder power and urgent claims under the stakeholder theory. Regarding empirical cases, this study uses a large sample of private firms from 42 countries and hence distinguishes itself from previous studies, most of which use data on large, public firms in the U.S. or other individual countries.

Our results and the derived implications are as follows. First, the measures of environmental performance differently impact bank debt

Table 6
Robustness check: Multinominal logit results of Model A for *Bank,* Model B for *Equity*, and Model C for *Bank and Equity*.

Variable	Model A1	Model B1	Model C1	Model A2	Model B2	Model C2	Model A3	Model B3	Model C3
	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
Efficiency-Investment	0.178*** [0.065]	0.920*** [0.166]	0.693*** [0.243]						
Energy-Efficiency				0.065 [0.051]	0.098 [0.122]	−0.248 [0.233]			
Disclosure							−0.061 [0.081]	1.034*** [0.165]	0.151 [0.259]
Growth	0.004*** [0.001]	0.003 [0.003]	0.010** [0.005]	0.004*** [0.001]	0.005 [0.003]	0.011** [0.005]	0.004*** [0.001]	0.004 [0.003]	0.011** [0.005]
Exporter	0.368*** [0.121]	0.678** [0.264]	1.404*** [0.292]	0.389*** [0.120]	0.795*** [0.261]	1.490*** [0.289]	0.398*** [0.121]	0.672** [0.265]	1.473*** [0.292]
Foreign-Ownership	−0.468*** [0.115]	0.012 [0.251]	0.070 [0.328]	−0.467*** [0.115]	0.003 [0.249]	0.084 [0.327]	−0.463*** [0.115]	−0.045 [0.253]	0.077 [0.327]
Sole-Proprietorship	−0.079 [0.095]	1.119*** [0.183]	−0.528 [0.442]	−0.086 [0.095]	1.148*** [0.181]	−0.533 [0.443]	−0.082 [0.095]	1.106*** [0.184]	−0.544 [0.442]
Part	0.089 [0.101]	0.201 [0.227]	0.462 [0.290]	0.109 [0.101]	0.246 [0.226]	0.478 [0.292]	0.105 [0.101]	0.248 [0.228]	0.500* [0.291]
Firm-Age	−0.0001 [0.052]	0.318*** [0.120]	0.010 [0.180]	0.006 [0.052]	0.282** [0.118]	−0.055 [0.180]	0.012 [0.052]	−0.317*** [0.119]	0.036 [0.179]
Small-Firm	−0.507*** [0.087]	−1.115*** [0.193]	−0.346 [0.313]	−0.542*** [0.086]	−1.371*** [0.187]	−0.490 [0.308]	−0.551*** [0.087]	−1.075*** [0.195]	−0.470 [0.310]
Medium-Firm	−0.188** [0.083]	−1.142*** [0.208]	−0.254 [0.285]	−0.211** [0.083]	−1.307*** [0.204]	−0.350 [0.282]	−0.216*** [0.083]	−1.110*** [0.209]	−0.336 [0.283]
Competition	−0.091 [0.064]	0.059 [0.158]	−0.284 [0.228]	−0.09 [0.064]	0.066 [0.157]	−0.278 [0.229]	−0.092 [0.063]	0.053 [0.159]	−0.291 [0.228]
Small-City	0.336*** [0.077]	−0.217 [0.201]	0.435 [0.300]	0.335*** [0.077]	−0.215 [0.199]	0.451 [0.299]	0.341*** [0.077]	−0.204 [0.200]	0.430 [0.299]
Large-City	0.011 [0.084]	−0.130 [0.196]	0.564* [0.299]	0.007 [0.084]	−0.160 [0.195]	0.553* [0.299]	0.011 [0.084]	−0.150 [0.197]	0.550* [0.299]
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.866*** [0.207]	−1.748*** [0.462]	−4.555*** [0.750]	−0.811*** [0.206]	−1.333*** [0.451]	−4.265*** [0.741]	−0.805*** [0.206]	−1.638*** [0.460]	−4.289*** [0.737]
Akaike Inf.Crit	8366.501	8366.501	8366.501	8404.982	8404.982	8404.982	8367.529	8367.529	8367.529

Note: *, **, and *** stand for the significance level of 10%, 5%, and 1%, respectively. Standard errors are in brackets.

Table 7
Robustness check: Energy-Efficiency = Energy input in monetary unit/Sales.

Variable	Model A2	Model B2
	Estimate	Estimate
Energy-Efficiency	−0.1745*	−0.0145
	[0.1046]	[0.0266]
Growth	0.0011***	0.0003
	[0.0004]	[0.0002]
Exporter	0.0903**	0.1036***
	[0.0365]	[0.0266]
Foreign-Ownership	0.0114	0.0064
	[0.0372]	[0.0148]
Sole-Proprietorship	−0.0289	0.0775***
	[0.0271]	[0.0188]
Part	0.1167***	0.0112
	[0.0323]	[0.0139]
Firm-Age	0.0161	−0.0155**
	[0.0154]	[0.0069]
Small-Firm	−0.1892***	−0.0409***
	[0.0245]	[0.0098]
Medium-Firm	−0.0625**	−0.0478***
	[0.0252]	[0.0097]
Competition	−0.0369**	0.0012
	[0.0189]	[0.0091]
Small-City	0.1295***	−0.0209*
	[0.0223]	[0.0112]
Large-City	0.0031	0.0018
	[0.0240]	[0.0116]
Country dummies	Yes	Yes
Sector dummies	Yes	Yes
Pseudo R2	0.079	0.082
Observations	3375	3066

Note: *, **, and *** stand for the significance level of 10%, 5%, and 1%, respectively. Standard errors are in brackets.

and equity. While the input-based measure and environmental disclosures significantly affect financing choices, there is no connection between the output-based measure of environmental performance and financing choices. Firm managers may consider effective ways to adopt green practices and convey environmental information to investors.

Second, both environmental investments and environmental disclosures impact bank financing and equity financing in different ways. The value and credibility of environmental information depend on investors' power and knowledge. This is also likely related to the specificities of available environmental information (risk/assets in place versus growth options). For example, our results indicate that firms with environmental disclosures prefer equity to bank debt. If environmental disclosures are more about the value of assets in places, debt is easily underpriced, indicating firms' priority for equity financing. Analyzing the contents of environmental disclosures may improve the efficiency of firms' financing choices and financial institutions' investment decisions.

Third, the causality direction is from environmental performance to financing decisions rather than the opposite. Thus, investors prefer to invest in eco-friendly firms rather than supporting conventional firms in reducing their environmental impacts. Conventional firms mainly rely on their internal funds to implement environmental practices, which may hamper the transition to a sustainable economy. Government support programs such as green credit policies may help conventional firms initiate environmental practices. Additionally, loan guarantee programs provide lenders with the necessary security, which allows private firms to obtain loans for environmental investments.

Fourth, regarding overlap between different measures, environmental investments reduce the negative impact of environmental disclosures on bank financing, and there is a direct joint impact of environmental investments and disclosures on equity financing. This complementary relationship indicates that firms may choose different environmental practices to reduce environmental information uncertainty. This further improves the credibility of environmental information from the investors' perspective.

Our study has limitations, some of which are possible paths for future research. In this paper, we consider environmental performance measures through energy efficiency investments, energy intensity, and energy consumption disclosures. Although energy is a key factor influencing firms' environmental impacts, comparing the impacts of other types of environmental performance measures on financing is a subject worthy of study. Future studies can consider more depth of environmental performance measures and their relationship to firm financing choices. In addition, researchers generally integrate environmental performance in CSR and evaluate the impact of aggregate and unidimensional measures on debt financing. Our research stimulates further studies on the different roles of CSR measures on the pecking order of debt and equity in firms' capital structure.

CRediT authorship contribution statement

Dengjun Zhang: Writing – original draft, Conceptualization, Methodology, Data curation, Investigation, Writing – review & editing. **Nirosha Hewa Wellalage:** Writing – original draft, Conceptualization, Methodology, Data curation, Investigation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix

Table A1
Measures of environmental performance and examples of references on financing

Measures of environmental performance	Examples of references	
	Authors	Key findings
Environmental scores from the KLD database	Benlemlih and Cai (2020)	Superior environmental performance is associated with a lower debt ratio and the uses of short-term debt.
	Erragragui (2018)	A positive (negative) impact of environmental concerns (strength) on the cost of debt.
	Nandy and Lodh (2012)	Eco-friendly firms are more likely to get a favorable loan contract.
Environmental scores from Thomson Reuters ASSET4	Dorfleitner and Grebler (2020)	Environmental innovation is the dominating driver of credit ratings.
Environmental management system (EMS) certification	Zhang et al. (2021)	A positive relationship between EMS certification and access to finance.
Environmental disclosures	Gjergji et al. (2021)	

(continued on next page)

Table A1 (*continued*)

Measures of environmental performance	Examples of references	
	Authors	Key findings
		Environmental disclosure leads to an increase in the cost of capital for SMEs except for family-owned SMEs.
Toxic chemical emissions for US manufacturing facilitates	Chen et al. (2020)	High polluting firms are granted with costly loans with short maturities and great collateral.
Pollution prevention measures for firms in WBES	Wellalage and Kumar (2021)	Superior environmental performance increases the use of loans but has no impact of contractual terms.
	Zhang (2021)	Banks reward environmental performers with better contractual terms.

Table A2
Variable definitions

Variable	Definition
Dependent variables	
Bank	= 1 for firms with access to bank loans, and 0 otherwise.
Equity	= 1 for firms that issued new equity shares, and 0 otherwise.
Environmental performance measures	
Efficiency-Investment	= 1 for firms with energy-efficiency investments, and 0 otherwise.
Energy-Intensity	The ratio of energy input in megajoules to sales.
Assurance	= 1 for firms with energy consumption disclosing, and 0 otherwise.
Control variables	
Growth	The rate of changes in sales, in percentage points.
Exporter	= 1 for exporters, and 0 otherwise.
Foreign-Ownership	= 1 for firms with foreign ownership, and 0 otherwise
Sole-Proprietorship	= 1 for firms with sole proprietorship, and 0 otherwise.
Part	= 1 for firms that is a part of larger establishment, and 0 otherwise.
Firm-Age	Firm age in years and logarithm.
Small-Firm	= 1 for firms with 5–19 employees, and 0 otherwise.
Medium-Firm	= 1 for firms with 20–99 employees, and 0 otherwise.
Competition	= 1 for firms with too many competitors to count, and 0 otherwise.
Small-City	= 1 for firms in the location with population less than 50,000, and 0 otherwise.
Large-City	= 1 for firms in the location with population between 50,000 and 250,000, and 0 otherwise.

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