BU Questrom School of Business

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Dear Professors,

I am writing to apply for the PhD Student Workshop on Climate Finance scheduled for October 9, 2025. I am a fifth-year PhD candidate in Finance at Boston University and expect to complete my doctorate in September 2025. My dissertation chair, Professor Dirk Hackbarth, has agreed to serve as a reference.

Research Agenda

My dissertation examines how ESG affects firms' capital structure and related firm policies.

"**Sustainability-Linked Loans and Financial Benefits**" (job-market paper, attached)

I model firms' choice between sustainability-linked loans (SLLs) and conventional loans, showing that lower coupons offset compliance costs. Using bank loans from 2016 to 2022, I find SLL issuers display lower default risk and positive post-issuance stock returns; EU Taxonomy instruments address endogeneity.

I will extend the SLL model to allow firms to choose issuance and strategically meet targets.

"**Capital Structure and Environmental Risk**" (with Dirk Hackbarth)

We analyze how firms optimally balance higher ESG maintenance costs against increased investor demand for green assets, yielding heterogeneous effects of ESG scores on cost of capital and financing choices.

Motivation for Attending

The NBER workshop is an ideal venue to refine my job-market paper before entering the academic job market. Thank you for considering my application. I look forward to the possibility of presenting my work and contributing to the workshop's discussion on climate finance.

Warm regards,

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Education

- **Boston University**, Questrom School of Business 2020 –
  Ph.D. in Finance
- **Renmin University of China** 2017 – 2020
  MPhil. in Finance
- **Xiamen University** 2013 – 2017
  Bachelor in Finance

Research Interests

- ESG(Environmental, Social, and Governance), Corporate Finance

Work in Progress

- **Sustainability-linked Loans and Financial Benefits** (Job market paper)
  I develop a model in which firms can choose to issue either sustainability-linked loans (SLLs) or non-SLLs to finance investment. Firms issuing SLLs face a trade-off between the benefit of a lower interest rate and the additional costs required to meet SLL-related sustainability targets. Within this framework, the model predicts that SLL issuers exhibit lower default risk and experience positive stock returns following loan issuance. Using a sample of bank loans issued between 2016 and 2022, I find empirical evidence consistent with these financial benefits of SLL issuance. To address potential endogeneity concerns, I employ the EU Taxonomy as an instrument for SLL issuance and obtain consistent results.

Working Papers

- **Capital Structure and Environmental Risk**
  (with Dirk Hackbarth)

  We build a model in which firms incur additional costs to maintain their ESG status, and this status can potentially attract more investors. That is, firms face the trade-off between the increased distress risk and the added demand for their stocks from ESG-focused investors. In this setting, the impact of ESG ratings on the cost of equity can be positive or negative. Notably, ESG status can increase the cost of equity for firms with high ESG maintenance costs and high leverage. Furthermore, the net effect of ESG ratings on the cost of equity also depends on the market demand for ESG-focused stocks. Finally, our model suggests firms that benefit from their ESG rating use their lower cost of equity to issue more equity. In a large sample of US firms during the 2002—2022 period, we find evidence consistent with the heterogeneous impacts of ESG rating on both the cost of equity and equity issuance.

- **Maturity Overhang: Evidence from M&A**
  (with Zhiyao Chen, Dirk Hackbarth, and Jarrad Harford)

  In the context of mergers and acquisitions, this paper analyzes a maturity overhang problem that is due to shorter debt maturities creating higher rollover risk. Using bond transaction data, we develop a market-based measure of rollover risk and find that i) rollover risk dampens merger activities at the firm and aggregate levels; ii) acquirers facing higher rollover risk are more sensitive to changes in cash reserves and prefer equity as a payment method over cash; and iii) positive market reactions to cash payment are observed only when firms have low rollover risk. To shed light on our empirical findings, we study a dynamic investment model that underscores the importance of precautionary savings and rollover risk for maturity overhang.

- **Conferences**: American Finance Association annual meetings, Midwest Finance Association annual meetings, Financial Intermediation Research Society annual meetings, Asian FA, China International Conference in Finance

Teaching Experience

Instructor at Questrom School of Business

- FE 449: Corporate Financial Management 2025 Summer

Teaching Assistant at Questrom School of Business

- FE 449: Corporate Financial Management 2022 – 2025

Skills

- **Languages :** English (fluent), Mandarin (native)
- **Computer Skills :** SAS, Stata, Matlab, R, Python, LaTeX

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Sustainability-linked Loans and Financial Benefits*

Yuxin Luo

June 11, 2025

Abstract

I develop a model in which firms can choose to issue either sustainability-linked loans (SLLs) or non-SLLs to finance investment. Firms issuing SLLs face a trade-off between the benefit of a lower interest rate and the additional costs required to meet SLL-related sustainability targets. Within this framework, the model predicts that SLL issuers exhibit lower default risk and experience positive stock returns following loan issuance. Using a sample of bank loans issued between 2016 and 2022, I find empirical evidence consistent with these financial benefits of SLL issuance. To address potential endogeneity concerns, I employ the EU Taxonomy as an instrument for SLL issuance and obtain consistent results.

JEL Classification Numbers: G13, G31, G32, Q56

Keywords: Capital Structure, Climate Risk, ESG, Externalities.

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1 Introduction

Sustainability-linked loans (SLLs) are a relatively recent financial innovation designed to incentivize firms to enhance their sustainability performance. Unlike traditional loans, SLLs link the interest rate to the borrower's achievement of predefined sustainability targets. These targets are typically objective key performance indicators (KPIs), with carbon emissions being one of the most common. The SLL market has grown rapidly: as of 2024, the total value of outstanding SLLs reached $463 billion, representing approximately 10% of all loan issuances.

While prior research has primarily focused on environmental, social, and governance (ESG) or sustainability performance following loan issuance, relatively little is known about the financial implications for firms issuing SLLs. The central mechanism of SLLs lies in offering lower interest rates to incentivize improved sustainability outcomes. Thus, firms issuing SLLs are expected to benefit from lower financing costs relative to firms issuing traditional debt. Naturally, this raises the question: what financial benefits, if any, do firms obtain from issuing SLLs?

In this paper, I try to addresses this question by investigating the financial benefits that firms may gain from issuing SLLs. To guide the empirical analysis, I first develop a theoretical model that captures the trade-off faced by firms issuing SLLs. In the model, a firm may choose between issuing an SLL or a traditional (non-SLL) loan to finance investment. Issuing an SLL allows the firm to access capital at a lower interest rate, but also requires the firm to incur additional operating costs to meet the associated sustainability targets. Therefore, the firm faces a trade-off between reduced financing costs and increased compliance costs.

The model delivers two key implications. First, it predicts that SLL issuers can reduce their default risk through issuing SLL, if coupon benefit of SLL is sufficiently large. When the coupon benefit is small, the interest rate remains high, and the additional cost of meeting sustainability targets dominates, reducing the firm's net income and increasing default risk. However, when the coupon benefit is large, the resulting low financing cost improves the firm's financial health and reduces default risk. Second, the model predicts that SLL issuance can lead to higher stock returns, again conditional on the coupon benefit being sufficiently large. By lowering financing costs and reducing default risk, SLL issuance can enhance firm value and boost stock performance. Con-

versely, when the coupon benefit is low and SLL-related costs dominate, SLL issuance may reduce firm value and lead to weaker stock returns.

Guided by these predictions, I empirically examine the financial effects of SLL issuance using a sample of bank loans issued between 2016 and 2022. My regression analysis shows that firms issuing SLLs are significantly more likely to experience a credit rating upgrade within one year of loan issuance, relative to issuers of traditional debt. I also find that this effect occurs quickly: SLL issuers begin to show improved credit ratings as early as three months after issuance. Further, I document positive stock market reactions following SLL issuance. Firms issuing SLLs experience significantly higher stock returns over the following year than comparable non-SLL issuers. These results are consistent with the model's predictions and suggest that SLLs offer tangible financial benefits to issuers.

To strengthen the empirical findings, I conduct several robustness checks. First, I address the possibility of reverse causality—namely, that firms expecting credit rating upgrades may be more likely to issue SLLs. To rule this out, I test whether SLL issuers already experienced credit rating upgrades prior to loan issuance. I find no significant evidence of such pre-trends, suggesting that the observed upgrades occur post-issuance. Second, I address potential endogeneity concerns arising from unobserved firm characteristics that may influence both credit ratings and the likelihood of issuing SLLs. To mitigate this, I use the introduction of the EU Taxonomy as an exogenous shock to instrument for SLL issuance. The EU Taxonomy, implemented in late 2020, provides a regulatory framework for classifying sustainable activities and mandates increased disclosure. Firms located in the EU or with substantial sales exposure to the EU are more likely to be affected by this regulation and, consequently, more likely to issue SLLs. Using the EU Taxonomy as an instrumental variable, I find consistent results, thereby alleviating concerns about endogeneity.

My paper contributes to the literature on the relationship between financial and environmental performance. Most research concludes that firms can only improve their environmental performance when in good financial status. Earlier studies, such as Hong, Kubik, and Scheinkman (2012), indicate that firms tend to prioritize environmental initiatives when they are financially secure or have ample financial slack. Furthermore, Xu and Kim (2022) document that the removal of financial constraints can lead to a reduction in toxic releases by U.S. public firms. When facing poor financial conditions, firms' efforts to improve environmental performance tend to slow down.

Hartzmark and Shue (2023) find that brown firms' environmental impact substantially decreases when they face increasing financing costs. Kumar and Purnanandam (2022) find that concerns over profitability may prevent firms from transitioning to cleaner technologies. In contrast, my paper takes a different perspective by examining how environmental actions affect financial status. I show that by issuing sustainability-linked loans, firms may improve their financial standing through lower credit risk and higher stock returns.

Our paper is also related to the literature on environmental performance and asset returns. Hong and Kacperczyk (2009) show that investors demand a premium for holding stocks from industries associated with sin activities. Bolton and Kacperczyk (2023) document a carbon premium linked to emission levels and growth rates across most sectors and countries. Sautner, Van Lent, Vilkov, and Zhang (2023) find that climate risk exposure is priced in the options market. Pástor, Stambaugh, and Taylor (2022) and Ardia, Bluteau, Boudt, and Inghelbrecht (2023) show that green assets have higher realized returns in recent years, driven by unexpected increases in environmental concerns. In the bond market, studies such as Seltzer, Starks, and Zhu (2022) show that bonds issued by brown firms tend to receive lower credit ratings and offer higher yield spreads. Baker, Bergstresser, Serafeim, and Wurgler (2018) and Zerbib (2019) report that both municipal and corporate green bonds are priced at a premium compared to traditional bonds. However, much of the existing research attributes these return patterns to investor demand for green assets. In contrast, I show that even in the absence of green demand, equity holders can benefit from improvements in firms' environmental performance. By issuing sustaidelnability-linked loans, firms reduce financing costs and credit risk, leading to higher stock returns.

Finally, this paper relates to the growing literature on green financial instruments and firm outcomes. A number of studies examine firm performance after issuing ESG-related instruments. Flammer (2021) shows that firms issuing green bonds improve environmental performance, including higher environmental ratings and reduced emissions. Kim, Kumar, Lee, and Oh (2021) find that high-transparency SLL issuers maintain ESG improvements post-issuance, whereas low-transparency issuers often exhibit a decline in ESG performance. Du, Harford, and Shin (2023) find limited evidence that SLLs improve loan terms or ESG performance. In contrast, I focus on financial outcomes and find that firms issuing SLLs benefit from lower default risk and stronger

stock performance, driven by the lower financing costs associated with SLLs.

The remainder of the paper is organized as follows. Sections 2 and 3 present the model and its predictions, followed by empirical results in Section 4. Section 5 provides robustness tests. Finally, Section 5 concludes the paper.

2 Model

This section develops a parsimonious structural framework that integrates the financial benefits of sustainability-linked loans (SLLs)—primarily coupon reductions—with the costs firms incur to meet associated sustainability targets. I consider a representative firm that is initially all-equity financed and can choose to raise external capital via debt issuance. The firm may either issue conventional debt (non-SLL) at a higher coupon rate without any sustainability commitments, or issue SLLs at a lower coupon rate, subject to compliance with sustainability performance targets.

2.1 All-equity firm

I begin with a representative firm that is fully equity financed. The firm's instantaneous operating profit flow π_0 is given by:

$$\pi_0(X_t) = (1-\tau)K_0^{\alpha}X_t \tag{1}$$

where K_0 denotes productive capital, α represents the production scale parameter, τ is the corporate tax rate, and X_t is a stochastic productivity variable that evolves according to a geometric Brownian motion:

$$dX_t = \mu\, X_t\, dt \;+\; \sigma\, X_t\, dZ_t \tag{2}$$

where Z_t is a standard Brownian motion under a risk-neutral measure.

The equity value of the all-equity firm $E_0(X_t)$ should satisfy the Bellman equation over a short time interval dt:

$$E_0(X_t) = (1-\tau)K_0^{\alpha}X_t dt + \frac{1}{1+r}\mathbb{E}\Big[E_0(X_t + dX_t)\Big] \tag{3}$$

where r denotes the constant risk-free rate. The closed-form solution is:

$$E_0(X_t) = \underbrace{\frac{(1-\tau)K_0^{\alpha}X_t}{r-\mu}}_{\text{Future cash flow}} + \underbrace{A_0 X_t^{v_0}}_{\text{Growth option}}$$

The equity value comprises two components: the first term is the present value of expected future profits; the second term represents a growth option, reflecting the firm's potential for future expansion. The constant A_0 is determined via boundary conditions given in the following sections. The exponent v_0 is the positive root of the characteristic quadratic equation:

$$\frac{1}{2}\sigma^2 v^2 + (\mu - \frac{1}{2}\sigma^2)v - r = 0 \tag{4}$$

2.2 Issuing non-SLL

The all-equity financed firm has an opportunity to expand its capital by issuing debt. First, I consider the situation where the firm chooses conventional debt (non-SLL) to finance its investment. Its instantaneous flow of operating profit π_1 is given by

$$\pi_1(X_t) = (1-\tau)K_1^{\alpha}(X_t - c) \tag{5}$$

Compared to the all-financed firm, its capital expands from K_0 to K_1. The firm has debt holding now and c represents the coupon amount the firm needs to pay after raising debt. Here I assume that the firm keeps a constant amount of perpetual debt.

Similarly to Equation 3, the valuation of its equity value $E_1(X_t)$ can be derived through the Bellman equation, its equity value takes the form:

$$E_1(X_t) = \underbrace{\frac{(1-\tau)K_1^{\alpha}X_t}{r-\mu}}_{\text{Future cash flow}} - \underbrace{\frac{(1-\tau)c}{r}}_{\text{Debt payment}} + \underbrace{A_1 X_t^{v_1}}_{\text{Default option}} \tag{6}$$

where v_1 is the negative root of the quadratic equation in Equation 4. The equity value of the levered firm consists of three parts. The first part is still the discounted future profits. Then

second part comes from the coupon payment in the future. The third part comes from the option to default. The firm holds debt after investment and it can default when unable to repay coupon now.

Its debt value D_1 can also be obtained from the Bellman equation.

$$D_1(X_t) = cdt + \frac{1}{1+r}\mathbb{E}\Big[D_1(X + dX_t)\Big] \tag{7}$$

and the debt value takes the form

$$D_1(X_t) = \underbrace{\frac{c}{r}}_{\text{Coupon payment}} + \underbrace{(\phi\frac{(1-\tau)K_1^{\alpha}X_d}{r-\mu} - \frac{c}{r})(\frac{X_t}{X_d})^{v_1}}_{\text{Potential Liquidation}} \tag{8}$$

where ϕ is the liquidation recovery rate. It captures the value the debtholder can obtain after bankruptcy. X_d is the productivity threshold at which the firm chooses to default and will be solved from boundary conditions. The debt value consists of two parts. The first part is the discounted future coupon payment. The second part comes form the value of potential liquidation when the firm goes bankrupt.

To solve the system, the post-investment firm should satisfy default conditions

$$E_1(X_d) = 0 \tag{9}$$

$$E_1'(X_d) = 0 \tag{10}$$

The pre-investment firm should satisfy investment conditions

$$E_0(X_I) + (K_1 - K_0) = E_1(X_I) + D_1(X_I) \tag{11}$$

$$E_0'(X_I) = E_1'(X_I) + D_1'(X_I) \tag{12}$$

X_I is where the firm chooses to invest. X_d, X_I, A_0 and A_1 can be determined by these boundary conditions.

2.3 Issuing SLL

Next, I consider the case where the firm issues SLL debt. Compared to the non-SLL case, the firm receives a coupon benefit but also incurs costs to meet sustainability targets.

Its instantaneous flow of operating profit π_1 is given by

$$\pi_1(X_t) = (1-\tau)\Big[(1-\kappa)K_1^{\alpha}X_t - (c-\omega)\Big] \tag{13}$$

There are two new terms compared to the non-SLL case. First, κ represents the additional cost of complying with SLL targets, which reduces the firm's net income. Second, ω is the coupon benefit from SLL, which lowers the interest rate and increases income.

The equity value of the firm becomes:

$$E_1(X_t) = \frac{(1-\tau)K_1^{\alpha}X_t}{r-\mu} - \frac{(1-\tau)c}{r} + A_1 X_t^{v_1} + \underbrace{(1-\tau)(\frac{\omega}{r} - \frac{\kappa K_1^{\alpha}X_t}{r-\mu})}_{\text{SLL part}} \tag{14}$$

Compared to the equity value of the firm issuing non-SLL (6), this includes an additional term reflecting the net financial effect of the SLL: the coupon benefit ω and the sustainability cost κ. The firm issuing SLL faces the the trade-off between the coupon benefit from the SLL and additional cost to meet SLL targets.

Similarly, the debt value of SLL takes the form

$$D_1(X_t) = \frac{c}{r} + (\phi\frac{(1-\tau)K_1^{\alpha}X_d}{r-\mu} - \frac{c}{r})(\frac{X_t}{X_d})^{v_1} + \underbrace{\frac{\omega}{r}\Big[(\frac{X_t}{X_d})^{v_1} - 1\Big]}_{\text{SLL part}} \tag{15}$$

Compared to the debt value of the firm issuing non-SLL (8), this debt value includes an SLL-specific adjustment. On one hand, the lower coupon rate reduces income to the debtholder. On the other hand, lower interest payments reduce the firm's credit risk, which may increase the value of the debt.

For the SLL issuance problem, it can also be solved by the same boundary conditions Equation 9, 10, 11 and 12.

2.4 Default probability

After issuing debt, both the non-SLL and SLL firms may default when unable to meet coupon payments. Their default probability can be derived from the first passage time of a geometric Brownian motion. Given a time horizon T, the probability that X_t hits a lower boundary X_d from initial value X_0 is:

$$P(\tau \leq T), \text{ where } \tau = \inf\{t > 0 | X_t \leq X_d\} \tag{16}$$

where τ denotes the first time X_t hits the default threshold X_d. Using the reflection principle, the probability $P(\tau \leq T)$ is given by:

$$P(\tau \leq T) = \Phi(\frac{\log(X_d/X_0) - (\mu - \frac{1}{2}\sigma^2)T}{\sigma\sqrt{T}}) + (\frac{X_d}{X_0})^{\frac{2\mu-\sigma^2}{\sigma^2}} \Phi(\frac{\log(X_d/X_0) + (\mu - \frac{1}{2}\sigma^2)T|}{\sigma\sqrt{T}}) \tag{17}$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function. Intuitively, this expression captures the likelihood that the firm's cash flow declines to the default boundary within the specified time horizon.

3 Predictions

Next, I parameterize the model to examine the impact of SLL issuance on credit risk and equity value. This analysis proceeds in two parts. First, I compare the default risk between firms issuing SLL and non-SLL. Then, I evaluate how issuing SLL affects firms' equity value relative to issuing non-SLL.

Following the literature (e.g., Gomes and Schmid (2010)), I adopt standard parameter values, which are listed in Table 1. I categorize firms into two groups: those issuing SLL and those issuing non-SLL. The key assumption is that firms issuing SLL can obtain a lower coupon rate for the same amount of debt, but must also incur additional costs to meet the sustainability targets.

3.1 Default risk

I proceed to explore the impact of SLL issuance on firms' default risk. Figure 1 compared the default risk between firms issuing SLL and firms issuing non-SLL. Here, the coupon benefit ω, represented on the x-axis, refers to the coupon reduction by sustainability-linked loans. Firms issuing sustainability-linked loans enjoy a lower coupon rate, when issuing the same amount of debt, but required to pay additional cost κ to meet SLL targets. The y-axis variable refers to default probability. I use the firm issuing non-SLL as a benchmark. For the firm issuing non-SLL, coupon benefit ω and additional cost κ are both zero. Figure 1 shows that when coupon benefit ω is low, the firm issuing SLL is more likely to default. The additional cost to meet SLL targets dominates the coupon benefits. Thus, the firm issuing SLL has lower net income, which exhibits a higher default probability. However, as SLL provides a higher coupon benefit, this benefit from coupon reduction outweighs the cost to meet the loan targets. This improves the financial status of the firm issuing SLL and makes it less likely to default. Thus, the firm issuing SLL exhibits a lower default probability than the firm issuing non-SLL. Based on this finding, I propose the following hypothesis.

I begin by exploring the impact of SLL issuance on firms' default risk. Figure 1 compares the default probabilities of firms issuing SLL and those issuing non-SLL. The x-axis represents the coupon benefit ω—that is, the reduction in the interest rate of SLL. Firms that issue SLLs enjoy a lower coupon rate but are required to incur an additional cost κ to comply with sustainability targets. The y-axis shows the default probability. Firms issuing non-SLL serve as the benchmark, for which both the coupon benefit ω and the additional cost κ are equal to zero. As shown in Figure 1, when the coupon benefit ω is low, firms issuing SLLs face a higher likelihood of default. In this case, the cost of meeting sustainability targets dominates the financial benefit from reduced interest payments, leading to lower net income and higher credit risk. However, as the coupon benefit increases, the advantage from reduced financing costs outweighs the cost of sustainability compliance. This improves the financial condition of SLL-issuing firms and reduces their likelihood of default. Therefore, at higher levels of coupon benefit, firms issuing SLLs exhibit lower default probabilities than those issuing non-SLLs. Based on this observation, I have the following hypothesis:

Hypothesis 1. *Firms may lower their default risk through issuing sustainability-linked loans (SLL), compared to issuing non-SLL, when these loans provide sufficient coupon benefits*

3.2 Post-issuance equity value

Next, I examine the impact of SLL issuance on firms' equity value. Given that SLL issuance affects default risk, I investigate how this change in credit risk influences post-issuance equity value. Figure 2 displays the standardized equity value for both SLL- and non-SLL-issuing firms. The standardized equity value is defined as the ratio of the market value of equity to the present value of future cash flows:

$$E_1(X_t)/\frac{X_t}{r-\mu} \tag{18}$$

where $\frac{X_t}{r-\mu}$ denotes the discounted value of all future operating profits.

The x-axis shows the coupon benefit ω, while the y-axis plots the standardized equity value after debt issuance. The solid line represents the equity value of a firm issuing non-SLL, and the dashed line represents that of a firm issuing SLL. Figure 2 indicates that when the coupon benefit ω is low, issuing an SLL results in a lower equity value. This is because the cost of meeting sustainability targets reduces net income, which in turn increases default risk and lowers equity value.

However, as the coupon benefit increases, the net financial benefit of issuing SLLs becomes positive. The lower financing cost improves the firm's income relative to non-SLL issuance, reducing default risk and increasing the value of equity. This pattern mirrors the one observed for default probability and leads to the following hypothesis:

Hypothesis 2. *Firms experience a greater increase in equity value through issuing sustainability-linked loans (SLL), compared to issuing non-SLL, when these loans provide sufficient coupon benefits.*

Prior theoretical literature has sought to explain the superior stock performance of green firms in recent years. Most studies attribute this outperformance to investor demand for sustainable assets (e.g., Pástor, Stambaugh, and Taylor (2021); Pedersen, Fitzgibbons, and Pomorski (2021)). In contrast, my model highlights a capital structure channel: by issuing sustainability-linked loans

(SLLs), firms benefit from lower interest rates and reduced default risk, which in turn enhances their stock performance.

4 Empirics

I first describe the data and variable constructions. Following this, I present our empirical results that support my model's predictions regarding relationship between sustainability-linked loan (SLL) issuance and default risk.

4.1 Data and measures

The data includes loan-level information from Dealscan spanning 2016 to 2022. I restrict the sample to loan issuers that are included in the CRSP/Compustat universe. Issuer credit rating data is obtained from S&P Ratings. The final sample consists of 5,965 loans with corresponding issuer-level credit rating and accounting information. Table 2 presents summary statistics for the sample. Definitions of all variables used in the empirical analysis are provided in Table A1.

4.2 SLL and credit rating

First I test the first model prediction: the impact of SLL issuance on default risk. In my regressions, I use changes in issuer credit ratings as a proxy for changes in default risk. The relationship is estimated using the following ordered probit model:

$$\Delta\text{Rating} = a + b\ \text{SLL} + c\ \text{Controls} + e, \tag{19}$$

The dependent variable captures changes in the issuer's credit rating within one year following loan issuance. It takes a value of 0 if the credit rating remains unchanged, +1 if the rating is upgraded or newly assigned, and -1 if it is downgraded or becomes unrated.

The key independent variable is SLL, a dummy variable equal to one if the loan is classified as sustainability-linked. The coefficient of interest is b, which captures the correlation between SLL

issuance and subsequent changes in credit rating. My model predicts $b > 0$, implying that firms issuing SLLs are more likely to experience upgrades in their credit ratings relative to firms issuing non-SLLs. Control variables include a range of loan- and firm-level characteristics, as defined in Table A1.

The results in Table 3 support the model's predictions. Column (1) presents an univariate regression in which the coefficient on SLL is positive and statistically significant at the 1% level, with standard errors clustered at the issuer level. Economically, firms issuing SLLs are 5 percentage points more likely to be upgraded and 6 percentage points less likely to be downgraded within one year of issuance. In column (2), I include additional controls for loan and firm characteristics. The coefficient on SLL remains positive and statistically significant. Column (3) further adds industry and year fixed effects, and the coefficient on SLL remains positive and significant at the 5% level. Overall, Table 3 shows that firms issuing SLLs are more likely to experience credit rating upgrades, which is consistent with the model's prediction that SLL issuance reduces default risk.

In Table 4, I test whether the impact of SLL issuance on credit ratings also holds over shorter horizons. In column (1), the dependent variable is defined as the credit rating change within nine months of issuance. I include the full set of control variables, along with industry and year fixed effects. The coefficient on SLL remains significantly positive. Columns (2) and (3) examine credit rating changes within six and three months, respectively. The results remain robust across all specifications, indicating that the credit quality improvements associated with SLL issuance occur even in the short term.

4.3 SLL and stock returns

Next, I test the second model prediction: the impact of SLL issuance on stock returns. The previous tables show that SLL issuance is associated with improved credit ratings, suggesting lower default risk. I now examine how this improvement translates into equity market performance. The regression specification is given by the following linear model:

$$\text{Future returns} = a + b\ \text{SLL} + c\ \text{Controls} + e, \tag{20}$$

TThe dependent variable, *Future returns*, is the issuer's cumulative stock return over one year following loan issuance. The model predicts $b > 0$.

Table 5 presents the results. In column (1), I regress one-year future stock returns on the SLL dummy. The coefficient on SLL is positive and statistically significant, indicating that SLL issuers experience higher stock returns relative to non-SLL issuers. The estimated economic effect is substantial: issuing an SLL is associated with a 7.7 percentage point increase in stock returns over the subsequent year.

Columns (2) through (5) use various definitions of excess returns as the dependent variable. In column (2), I subtract the risk-free rate to compute excess returns. Columns (3) through (5) subtract returns from benchmark portfolios: the market return, the Fama-French six portfolios, and the Fama-French 25 portfolios, respectively. Across all specifications, the coefficient on SLL remains significantly positive.

These results demonstrate that the positive impact of SLL issuance on stock returns is robust across different measures of abnormal performance. The findings are consistent with the model's second prediction: by issuing SLLs, firms reduce default risk and increase equity value relative to issuing non-SLLs.

5 Robustness

In the previous section, I show many empirical results to support my model predictions. Compared to issuing non SLL, issuing SLL can improve the issuer's credit ratings and bring positive stock returns. In the following section, I will show some robustness tests to further support my results.

5.1 Reverse Causality

It is possible that reverse causality exists and firms with better credit ratings issue are more likely to issue SLL than firms with low credit ratings. To eliminate this concern, I run the following regression:

$$\text{Pre rating change} = a + b\ \text{SLL} + c\ \text{Controls} + e, \tag{21}$$

where the dependent variable *Pre rating change* is the changes in the credit rating of the issuer before the loan issuance. It can take three values: 0 if the issuer has the same rate as when the loan is issued, +1 if the issuer has been upgraded or assigned a new rating, -1 if the issuer has been downgraded or unrated.

Table 6 shows the regression results under different time horizons. In column (1), the dependent variable is the credit rating change one year before the loan issuance. The coefficient of the key variable of the interest, SLL, is insignificant. Thus, it rules out the possibility that firms getting credit upgrade are more likely to issue green SLL. From the column (2) to (4), I examine the relationship between SLL issuance and the credit rating change nine, six, and three months before the loan issuance. The coefficient of SLL is insignificant in all specifications. Thus, my regressions results more support that issuance of SLL lead to positive credit rating change and rule out the possibility of reverse causality.

5.2 IV regressions: EU taxonomy

Another concern of my regression results is endogeneity. It is possible that firms that issue sustainability-linked loans and get credit rating upgraded have unobserved common characteristics. In this part, I use the event of the EU taxonomy as the instrument variable to eliminate this concern.

The EU Taxonomy is a regulation designed to reach the EU's 2050 climate-neutrality target and came into effect in late 2020. It is a legally-binding classification system that defines when an economic activity can be called "environmentally sustainable". The EU Taxonomy gives investors and companies a common language and curbs green-washing. It also require firms to disclose information concerning the degree of alignment of their activities with the Taxonomy. The major goal of this regulation is to direct the capital flow towards the green capital.

Thus, the EU taxonomy can be considered as a shock to firms in EU. Those firms should invest more in green transition and sustainable activities. Compared to other firms, the EU firms are more likely to issue sustainability-linked loans. Therefore, I have the following the first-stage

specification, where I use the EU taxonomy as an instrument variable for SLL issuance.

$$\text{SLL} = a + b\ \text{EU headquarter} + c\ \text{EU headquarter} \times \text{After EU taxonomy} + d\ \text{Controls} + e \quad (22)$$

The dependent variable SLL is a dummy indicating the loan is SLL. *EU headquarter* is a dummy indicating the firm is headquartered in the EU. Compared to other firms, the firms headquartered in the EU are more affected by the EU taxonomy. The interaction term *EU headquarter* $\times$ $After\ EU\ taxonomy$ is the variable of the interest. It is a dummy variable indicating the loan is issued after 2020, when the EU taxonomy is in effect. It captures the impact of the EU taxonomy on the EU firms after the regulation comes into force. I also control other loan and issuer characteristics, and include the industry and year fixed effects. After EU taxonomy is absorbed in the year fixed effect.

Also, firms with more income from the EU should also be more affected by the EU taxonomy. Thus, I have another specification.

$$\text{SLL} = a + b\,\text{EU income fraction} + c\,\text{EU income fraction} \times \text{After EU taxonomy} + d\,\text{Controls} + e \quad (23)$$

where *EU income* $fraction$ is the fraction of income from the EU. This income data is from Compustat segment. Firms with *EU income* $fraction$ are more affected by the EU taxonomy and should be more likely to issue sustainability-linked loans.

Table 7 shows the IV regression results. Column (1) shows the first-stage regression result of Equation 22. The coefficient of *EU headquarter* is significantly positive, so firms headquartered in the EU are more likely to issue SLL. The coefficient of the interaction term, *EU headquarter* $\times$ $After\ EU\ taxonomy$ is also significantly positive. Thus, the EU taxonomy motivates firms headquartered in the EU to issue more SLL. The F-stat for the first-stage is 20.26, exceeding the weak instrument test threshold of 10, as recommended by Stock and Yogo (2002). Column (2) shows second-stage regression results. The coefficient of $Sustainability - linked\ loan$ is still significantly positive at 5% level.

In column (3), I show the first-stage regression result of Equation 23. The coefficient of the interaction term, $EU\ income fraction \times After\ EU\ taxonomy$ is significantly positive. So, firms with more income from the EU are more likely to issue SLL after the EU taxonomy. Column (4) shows the second-stage regression results. The coefficient of SLL remains significant positive. Thus, the positive impact of SLL issuance on issuers' credit ratings remain robust under these IV regressions, which alleviates the endogeneity concern.

6 Conclusion

This paper develops a model to study the financial effects of sustainability-linked loan (SLL) issuance and empirically tests its predictions using a comprehensive sample of bank loans from 2016 to 2022. In the model, firms face a trade-off between the lower financing costs associated with SLLs and the additional expenditures required to meet sustainability targets. The model predicts that SLL issuance can reduce default risk and enhance equity value, provided that the coupon benefit of the SLL is sufficiently large.

Consistent with these theoretical predictions, I find that firms issuing SLLs are more likely to experience credit rating upgrades and exhibit significantly higher stock returns compared to non-SLL issuers. These benefits materialize shortly after issuance and remain robust across various specifications and time horizons. To address endogeneity concerns, I use the introduction of the EU Taxonomy as an exogenous instrument for SLL issuance and obtain consistent results.

Taken together, these findings suggest that SLLs are more than a symbolic commitment to sustainability—they offer real financial advantages to firms. By linking financing costs to environmental performance, SLLs align firms' sustainability incentives with shareholder value creation. This research contributes to the literature on green finance by highlighting a capital structure channel through which ESG-related borrowing can improve firm outcomes.

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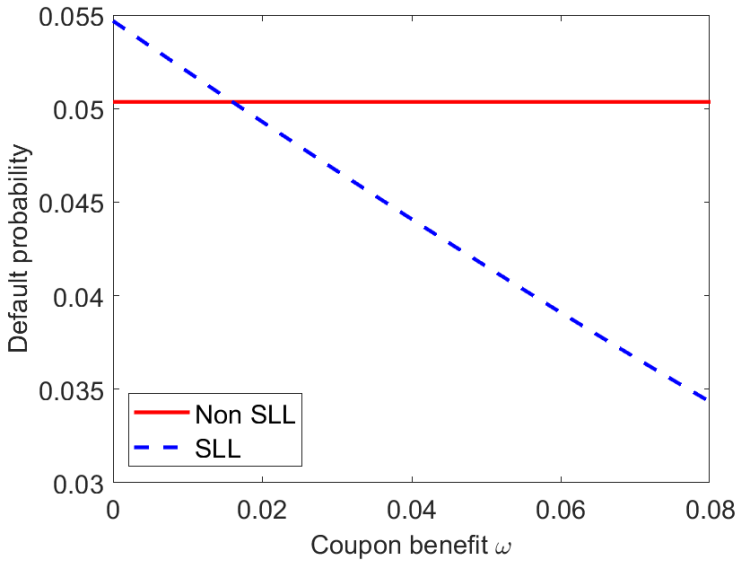


Figure 1. Default Probability and SLL issuance

This figure demonstrates how SLL issuance impacts default probability. The solid line is non-SLL, representing the firm issuing non-sustainability-linked loan. The dashed line is SLL, representing the firm issuing sustainability-linked loan. The y-axis variable is firms' default probability. The x-axis variable is coupon benefit of SLL ω, which is zero for non-SLL.

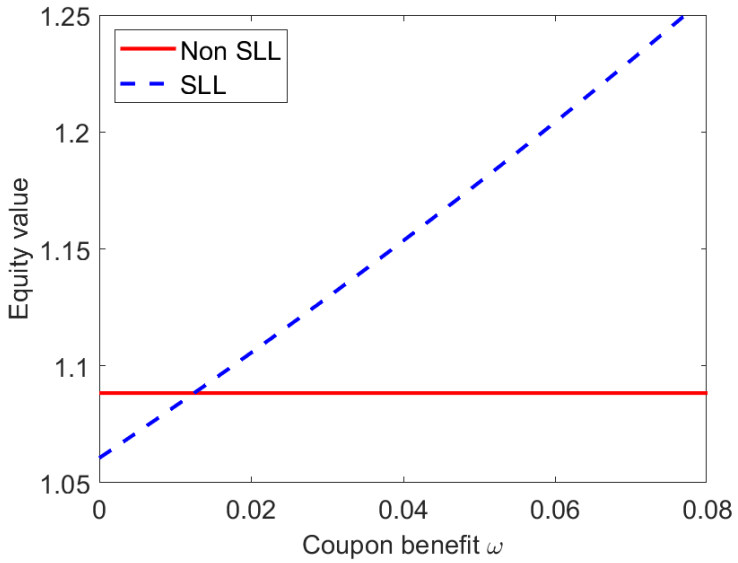


Figure 2. Equity value and SLL issuance

This figure demonstrates how SLL issuance impacts equity value. The solid line is non-SLL, representing the firm issuing non-sustainability-linked loan. The dashed line is SLL, representing the firm issuing sustainability-linked loan. The y-axis variable is firms' standardized equity value. The x-axis variable is coupon benefit of SLL ω, which is zero for non-SLL.

Table 1. Baseline parameter values
This table lists baseline parameter values for model calibration. They are chosen based on the literature. Additionally, we choose the amount of coupon so that the leverage of the representative firm is close to the average leverage in data.

Parameter	Notation	Value
Risk-neutral drift	μ	0
Cash flow volatility	σ	0.2
Risk-free rate	r	0.05
Tax rate	τ	0.2
Coupon	c	0.4
Recovery rate	ϕ	0.7
Cost to meet loan requirement	κ	0.04
Initial capital	K_0	1
Capital after investment	K_1	5
Scale	α	0.7

Table 2. Summary statistics

This table reports summary statistics of my sample. My sample includes loans from Dealscan, ranging from 2016 to 2022. Accounting data and return data are from Compustat and CRSP respectively. Credit rating data is from S&P rating.

	N	Mean	SD	P10	P25	Median	P75	P90
Loan size	5,965	6.799	1.157	5.303	6.108	6.909	7.601	8.243
Maturity	5,965	4.087	1.675	1.000	3.003	4.702	5.003	5.990
Market-to-book	5,744	0.987	0.941	0.185	0.387	0.688	1.279	2.123
Log(size)	5,753	9.121	1.597	7.182	7.946	8.893	10.160	11.387
Return volatility	5,774	0.025	0.014	0.012	0.016	0.022	0.030	0.043
Investment grade	5,965	0.406	0.491	0.000	0.000	0.000	1.000	1.000
Multiple Tranche	5,965	0.422	0.494	0.000	0.000	0.000	1.000	1.000
Number of covenants	5,965	0.166	0.490	0.000	0.000	0.000	0.000	1.000
ROA	5,753	0.007	0.025	-0.012	0.001	0.008	0.017	0.030
Leverage	5,744	0.376	0.223	0.118	0.202	0.341	0.506	0.717

Table 3. Credit ratings and sustainability-linked loans

This table reports the results from ordered probit regressions to examine the relationship between credit ratings and sustainability-linked loans. The sample includes loans from Dealscan issued between 2016 and 2022, matched with data from CRSP/Compustat and S&P credit ratings. The dependent variable is *Credit rating change*, which takes the value of +1 if the issuer's credit rating is upgraded or newly assigned within one year following the loan issuance; -1 if the credit rating is downgraded or becomes unrated; and 0 otherwise. *Sustainability-linked loan (SLL)* is a dummy variable equal to one if the loan is classified as sustainability-linked. Control variables are defined in the appendix. Standard errors are clustered at the issuer level. t-statistics are reported in parentheses. Statistical significance is denoted by * p<0.10, ** p<0.05, and *** p<0.01.

Dependent variable	Credit rating change		
	(1)	(2)	(3)
Sustainability-linked loan (SLL)	0.292***	0.343***	0.220**
	(2.90)	(3.23)	(2.03)
Loan size		-0.006	0.019
		(-0.32)	(0.91)
Maturity		-0.003	0.003
		(-0.25)	(0.26)
Market-to-book		0.001	0.017
		(0.02)	(0.45)
Log(size)		0.080***	0.100***
		(3.98)	(4.36)
Return volatility		-3.181	-3.049
		(-1.54)	(-1.15)
Investment grade		-0.538***	-0.654***
		(-9.18)	(-10.99)
Multiple Tranche		-0.042	-0.041
		(-1.04)	(-0.96)
Number of covenants		0.058*	0.038
		(1.73)	(1.06)
ROA		3.117***	3.042***
		(3.04)	(2.98)
Leverage		-0.704***	-0.794***
		(-4.70)	(-4.72)
Observations	5,965	5,624	5,499
Controls	No	Yes	Yes
Year & Industry FE	No	No	Yes

Table 4. Credit ratings and sustainability-linked loans in shorter horizons
This table reports the results from ordered probit regressions tp examine the relationship between credit ratings and sustainability-linked loans in shorter time horizons. The sample includes loans from Dealscan issued between 2016 and 2022, matched with data from CRSP/Compustat and S&P credit ratings. The dependent variable is *Credit rating change*, which takes the value of +1 if the issuer's credit rating is upgraded or newly assigned following the loan issuance; -1 if the credit rating is downgraded or becomes unrated; and 0 otherwise. The time horizon for this measure is nine months in column (1), six months in column (2), and three months in column (3). *Sustainability-linked loan (SLL)* is a dummy variable equal to one if the loan is classified as sustainability-linked. I include control variables, defined in the appendix, industry-and year-fixed effects, and cluster standard errors at the issuer level. t-statistics are reported in parentheses. Statistical significance is denoted by * p<0.10, ** p<0.05, and *** p<0.01.

Dependent variable	Credit rating change		
Horizon	Nine months	Six months	Three months
	(1)	(2)	(3)
Sustainability-linked loan (SLL)	0.277**	0.265**	0.284**
	(2.33)	(2.22)	(2.15)
Loan size	0.022	0.038*	0.045**
	(1.03)	(1.81)	(2.02)
Maturity	0.002	-0.000	0.002
	(0.14)	(-0.03)	(0.12)
Market-to-book	0.007	0.012	-0.017
	(0.23)	(0.36)	(-0.47)
Log(size)	0.095***	0.063***	0.038
	(4.15)	(2.80)	(1.55)
Return volatility	-3.868	-2.160	-1.718
	(-1.39)	(-0.75)	(-0.53)
Investment grade	-0.640***	-0.558***	-0.462***
	(-10.67)	(-9.07)	(-6.57)
Multiple Tranche	-0.055	-0.086*	-0.171***
	(-1.27)	(-1.89)	(-3.15)
Number of covenants	0.031	0.023	0.010
	(0.88)	(0.57)	(0.19)
ROA	3.193***	3.639***	4.024***
	(2.99)	(3.27)	(3.04)
Leverage	-0.871***	-0.853***	-0.911***
	(-5.33)	(-4.90)	(-4.65)
Observations	5,499	5,499	5,499
Controls	Yes	Yes	Yes
Year & Industry FE	Yes	Yes	Yes

Table 5. Stock returns and sustainability-linked loans

This table reports the results to examine the relationship between stock returns and sustainability-linked loans across different time horizons. The sample includes loans from Dealscan issued between 2016 and 2022, matched with data from CRSP/Compustat and S&P credit ratings. In column (1), the dependent variable is the issuer's one-year raw return following the loan issuance. Columns (2) through (5) use the issuer's one-year excess return as the dependent variable, calculated relative to different benchmark portfolios. Specifically, column (2) uses the risk-free rate as the benchmark, column (3) uses the market factor, column (4) uses the corresponding Fama-French six-factor (FF6) portfolio, and column (5) uses the corresponding Fama-French 25 (FF25) portfolio. *Sustainability-linked loan (SLL)* is a dummy variable equal to one if the loan is classified as sustainability-linked. I include control variables, defined in the appendix, industry-and year-fixed effects, and cluster standard errors at the issuer level. t-statistics are reported in parentheses. Statistical significance is denoted by * p<0.10, ** p<0.05, and *** p<0.01.

Dependent variable	Issuer returns				
Base portfolio	Raw	Risk-free rate	Market return	FF6	FF25
	(1)	(2)	(3)	(4)	(5)
Sustainability-linked loan (SLL)	0.077**	0.077**	0.093***	0.079**	0.067**
	(2.35)	(2.37)	(2.83)	(2.44)	(2.04)
Loan size	0.004	0.004	0.005	0.002	0.003
	(0.53)	(0.53)	(0.64)	(0.27)	(0.34)
Maturity	-0.003	-0.003	-0.002	-0.000	-0.000
	(-0.64)	(-0.63)	(-0.37)	(-0.01)	(-0.10)
Market-to-book	0.034**	0.034**	0.037**	0.014	0.014
	(2.15)	(2.17)	(2.37)	(0.86)	(0.90)
Log(size)	-0.005	-0.005	-0.006	-0.010	-0.007
	(-0.62)	(-0.61)	(-0.73)	(-1.25)	(-0.91)
Return volatility	5.167***	5.195***	3.737**	2.566	1.914
	(3.05)	(3.07)	(2.24)	(1.43)	(1.06)
Investment grade	0.049**	0.049**	0.038*	0.037*	0.031
	(2.20)	(2.19)	(1.73)	(1.66)	(1.38)
Multiple Tranche	-0.003	-0.004	-0.002	-0.000	-0.000
	(-0.22)	(-0.22)	(-0.11)	(-0.02)	(-0.00)
Number of covenants	0.006	0.007	0.007	-0.001	-0.002
	(0.48)	(0.52)	(0.57)	(-0.10)	(-0.21)
ROA	-0.699	-0.706	-0.858	-0.688	-0.823
	(-1.01)	(-1.02)	(-1.24)	(-1.02)	(-1.23)
Leverage	0.208**	0.208**	0.227***	0.169**	0.172**
	(2.55)	(2.55)	(2.83)	(2.11)	(2.16)
Observations	5,304	5,304	5,304	5,218	5,218
Controls	Yes	Yes	Yes	Yes	Yes
Year & Industry FE	Yes	Yes	Yes	Yes	Yes

Table 6. Credit rating change before sustainability-linked loans

This table reports the results to examine the relationship between sustainability-linked loans and credit rating change before loan issuance. The sample includes loans from Dealscan issued between 2016 and 2022, matched with data from CRSP/Compustat and S&P credit ratings. The dependent variable is *Credit rating change*, which takes the value of +1 if the issuer's credit rating is upgraded or newly assigned before the loan issuance; -1 if the credit rating is downgraded or becomes unrated; and 0 otherwise. The time horizon for this measure is one year in column (1), nine months in column (2), six months in column (3), and three months in column (4). *Sustainability-linked loan (SLL)* is a dummy variable equal to one if the loan is classified as sustainability-linked. I include control variables, defined in the appendix, industry-and year-fixed effects, and cluster standard errors at the issuer level. t-statistics are reported in parentheses. Statistical significance is denoted by * p<0.10, ** p<0.05, and *** p<0.01.

Dependent variable	Credit rating change			
Horizon	One year	Nine months	Six months	Three months
	(1)	(2)	(3)	(4)
Sustainability-linked loan (SLL)	-0.134	-0.147	-0.091	-0.172
	(-1.15)	(-1.30)	(-0.73)	(-1.54)
Loan size	-0.010	-0.014	-0.006	0.001
	(-0.48)	(-0.67)	(-0.27)	(0.04)
Maturity	0.085***	0.092***	0.089***	0.103***
	(7.43)	(7.82)	(7.04)	(7.21)
Market-to-book	-0.033	-0.041	-0.075**	-0.055
	(-1.06)	(-1.27)	(-2.24)	(-1.38)
Log(size)	-0.029	-0.019	-0.027	-0.023
	(-1.31)	(-0.81)	(-1.21)	(-1.07)
Return volatility	-17.911***	-13.297***	-10.928***	-5.079*
	(-6.66)	(-4.87)	(-3.86)	(-1.89)
Investment grade	-0.253***	-0.284***	-0.287***	-0.253***
	(-4.03)	(-4.47)	(-4.57)	(-4.09)
Multiple Tranche	0.073	0.069	0.007	-0.013
	(1.57)	(1.48)	(0.15)	(-0.26)
Number of covenants	-0.003	0.018	0.050	0.107**
	(-0.09)	(0.51)	(1.23)	(2.20)
ROA	2.865***	4.059***	3.950***	3.850***
	(3.01)	(3.99)	(3.60)	(3.48)
Leverage	-0.890***	-0.958***	-1.101***	-0.952***
	(-4.94)	(-5.37)	(-6.30)	(-4.70)
Observations	5,499	5,499	5,499	5,499
Controls	Yes	Yes	Yes	Yes
Year & Industry FE	Yes	Yes	Yes	Yes

Table 7. Credit ratings, sustainability-linked loans, and EU taxonomy -IV regressions
This table reports the results to examine the relationship between credit ratings and sustainability-linked loans, using the EU taxonomy as an instrumental variable. The sample includes loans from Dealscan issued between 2016 and 2022, matched with data from CRSP/Compustat and S&P credit ratings. The dependent variable is *Credit rating change*, which takes the value of +1 if the issuer's credit rating is upgraded or newly assigned within one year following the loan issuance; -1 if the credit rating is downgraded or becomes unrated; and 0 otherwise. *Sustainability-linked loan (SLL)* is a dummy variable equal to one if the loan is classified as sustainability-linked. *After EU Taxonomy* is a dummy indicating that the loan was issued after the introduction of the EU taxonomy. *EU headquarter* is a dummy indicating the headquarter of the issuer is in the EU. *EU income fraction* is the fraction of the issuer's income from the EU. I include control variables, defined in the appendix, industry-and year-fixed effects, and cluster standard errors at the issuer level. t-statistics are reported in parentheses. Statistical significance is denoted by * p<0.10, ** p<0.05, and *** p<0.01.

Instrument variable	EU headquarter		EU income fraction	
IV regression stage	First stage	Second stage	First stage	Second stage
	(1)	(2)	(3)	(4)
Sustainability-linked loan (SLL)		1.019**		1.485*
		(1.99)		(1.71)
EU headquarter	0.038**			
	(2.10)			
EU headquarter × After EU taxomony	0.103*			
	(1.90)			
EU income fraction			0.019	
			(0.55)	
EU income fraction × After EU taxomony			0.215**	
			(1.97)	
Loan size	-0.001	0.009	-0.001	0.019
	(-0.20)	(0.96)	(-0.06)	(1.33)
Maturity	0.007***	-0.005	0.010**	-0.015
	(4.10)	(-0.87)	(2.35)	(-1.22)
Market-to-book	-0.003	0.010	-0.001	-0.007
	(-0.62)	(0.61)	(-0.07)	(-0.26)
Log(size)	0.008**	0.036***	0.013**	0.020
	(2.37)	(3.29)	(2.06)	(0.97)
Return volatility	-0.428*	-1.011	-0.796	-0.614
	(-1.78)	(-0.85)	(-1.56)	(-0.29)
Investment grade	0.011	-0.293***	0.009	-0.258***
	(1.42)	(-11.10)	(0.51)	(-5.44)
Multiple Tranche	0.002	-0.018	-0.001	-0.059**
	(0.29)	(-0.98)	(-0.04)	(-1.99)
Number of covenants	0.005	0.012	0.004	-0.001
	(1.04)	(0.78)	(0.41)	(-0.02)
ROA	-0.081	1.381***	0.348	1.112
	(-0.96)	(3.09)	(1.45)	(1.21)
Leverage	-0.004	-0.346***	0.020	-0.371***
	(-0.19)	(-4.75)	(0.44)	(-3.20)
Observations	5,499	5,499	1,712	1,712
Controls	Yes	Yes	Yes	Yes
Year & Industry FE	Yes	Yes	Yes	Yes

Table A1. Empirical variable definitions

Variable	Definition
	Panel A: Loan characteristics
Loan size	Logarithm of total amount the loan (Source: Dealscan)
Maturity	Maturity of the loan (Source: Dealscan)
Investment grade	Standard & Poor credit rating higher than BB+ (Source: S&P ratings)
Multiple Tranche	The number of tranches in the loan deal is larger than one (Source: Dealscan).
Number of covenants	The number of financial covenants in the loan (Source: Dealscan)
	Panel B: Issuer characteristics
Market-to-book ratio	The ratio of the market value of asset (PRCC×CSHO + DLC + DLTT) to its book value (AT) (Source: Compustat)
Log(size)	Logarithm of total book value (AT) (Source: Compustat)
Return volatility	Standard deviation of firm's daily stock returns over the past year (Source: CRSP)
ROA	Returns on asset (NI\AT) (Source: Compustat)
Leverage	Total book debt (DLC + DLTT) divided by the sum of book debt and equity (PRCC×CSHO + DLC + DLTT) (Source: Compustat)