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Do Green Bonds Change How Banks Lend? Evidence from Post-Issuance Credit Allocation

Leibniz Association

ZEW

Do Green Bonds Change How Banks Lend? Evidence from Post-Issuance Credit Allocation*

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Abstract

Green bonds are an increasingly important source of sustainable bank funding, yet little is known about how their issuance affects banks' subsequent lending. Using green bond issuance by European banks matched with syndicated loans and borrowers' environmental performance, we trace the pass-through from sustainable funding to corporate lending and borrower emissions. Following green bond issuance, banks become more likely to provide sustainability-related loans to firms that are already relatively green, both within existing relationships and when forming new ones. However, issuing banks take smaller shares in these loans. At the portfolio level, the increase in sustainability-related lending is accompanied by a decline in conventional lending, such that issuing banks do not expand their own overall syndicated lending to greener firms. Environmental improvements are concentrated among greener firms receiving sustainability-related loans from green-bond-issuing banks. Overall, our findings show that green bond issuance changes how issuing banks structure their lending.

Keywords: green bonds; bank lending; sustainability-linked loans; green loans
JEL Classification: G19, G21

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1 Introduction

Banks play a central role in financing the transition to a low-carbon economy, but what makes them change their sustainable lending behavior? A range of initiatives seeks to align banks' activities with climate and sustainability objectives, from sustainability disclosure and voluntary climate commitments to climate-risk management, sustainable financial instruments, and dedicated green business models. Importantly, these initiatives differ in how directly they bear on banks' financing decisions. Disclosure and voluntary commitments may increase transparency, create reputational incentives, or signal intentions, whereas other initiatives more directly affect banks' funding, risk management, or business models. A recent literature examines whether such sustainability initiatives ultimately translate into changes in bank lending (Marqués-Ibáñez et al., 2026; Green and Vallée, 2025; Giannetti et al., 2026; Kacperczyk and Peydró, 2026). Green bonds occupy an interesting intermediate position: issuing one is a concrete financing decision and entails explicit sustainability commitments, but it does not mechanically determine how a bank subsequently lends.

Green bonds have become an important source of sustainable finance, with cumulative issuance reaching nearly $4.5 trillion by Mid-2026 and banks accounting for roughly one-quarter to one-third of total issuance (Climate Bonds Initiative, 2026). When issuing a green bond, a bank raises funding under an explicit green label and commits to allocating the proceeds to eligible green projects or activities. Yet, this commitment leaves banks considerable discretion over whether and how to deploy the funding for lending: proceeds can support different types of projects and borrowers and can be used for new financing as well as refinancing. The economic importance of this funding-to-lending link is underscored by a recent market development. In 2024, the International Capital Market Association and the Loan Market Association introduced guidelines for Sustainability-

Linked Loans Financing Bonds (SLLBs), which explicitly link bond financing to portfolios of sustainability-linked loans.[1] More recently, financial institutions have begun adopting this framework; for example, the Nordic Investment Bank introduced an SLLB framework in 2025 under which bond proceeds can be allocated to eligible sustainability-linked loans.[2]

Despite the rapid growth of the green bond market, we know relatively little about what happens on the asset side of banks' balance sheets following issuance. We therefore examine the pass-through from green bond issuance to corporate lending and, ultimately, to borrower emissions, asking whether issuance changes how banks lend, to whom they lend, and whether these changes translate into improvements in borrowers' environmental performance.

How banks' lending responds to green bond issuance is not obvious ex ante. Issuance may reflect or reinforce a bank's internal commitment to sustainability and induce organizational changes that affect subsequent lending decisions. Green bonds may also help issuers diversify their investor base by attracting investors with sustainability preferences (Flammer, 2021; Sangiorgi and Schopohl, 2023), serve as a signal of their sustainability orientation (Flammer, 2021) or, under some conditions, reduce funding costs (e.g., Zerbib, 2019; MacAskill et al., 2021; Caramichael and Rapp, 2024). These motives need not have the same implications for lending. Moreover, even if issuance affects lending, the direction and form of the response are ambiguous. Banks could increase their use of sustainability-linked or green loans, which we collectively refer to as sustainability-related loans (SRLs), reallocate credit toward firms that are already environmentally stronger, provide (re)financing to more carbon-intensive firms seeking to transition, establish relationships with new borrowers, or alter loan contracts within existing relationships without

[1] https://www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/sustainability-linked-loans-financing-bonds-guidelines-sllbg/ (accessed 29 Oct 2026).

[2] https://www.nib.int/news/nib-launches-new-sustainability-linked-loans-financing-bond-framework-to-accelerate-corporate-sustainability-transitions (accessed 29 Oct 2026).

materially changing the overall allocation of credit.[3] Nor does a change in lending necessarily translate into an improvement in borrowers' environmental performance. Which, if any, of these margins responds to green bond issuance is therefore an empirical question. Importantly, our analysis does not require a particular motive for issuance; instead, we examine how banks' lending changes following issuance and whether these changes are associated with subsequent changes in borrower emissions.

To study these questions, we combine data on green bond issuance by European banks with syndicated loan data, bank balance sheets, and information on borrowers' environmental performance. Our loan-level analysis examines how banks change their lending following their first green bond issuance, allowing the response to differ with borrowers' environmental performance. We distinguish between SRLs and conventional loans, existing and new lending relationships, refinancing and new financing, and banks' committed shares in syndicated loans. We complement this analysis by exploiting variation in banks' subsequent green bond issuance to examine whether changes in lending extend beyond their initial entry into the green bond market. Finally, we aggregate lending to the bank-year level to study how changes in loan contracting map into banks' overall syndicated loan portfolios and the allocation of credit across greener and browner borrowers.

We first show that green bond issuance is followed by a pronounced change in how banks structure their lending to greener firms. Following their first green bond issuance, banks become substantially more likely to provide SRLs to greener compared to less green borrowers, both within existing relationships and when establishing new ones. By contrast, we find no systematic increase in the propensity to establish new relationships with greener firms and no corresponding change in refinancing. Issuing banks also

[3]Green loans are use-of-proceeds instruments that finance eligible green projects. Sustainability-linked loans (SLLs), by contrast, link higher sustainability performance to lower financing costs. The Loan Market Association provides market standards for both types of loans through its Green Loan Principles and Sustainability-Linked Loan Principles. These classifications are not mutually exclusive in our data: a loan may be identified as both green and sustainability-linked. Internet Appendix B. provides examples of syndicated SRLs in our sample.

take smaller shares in syndicated SRLs to greener borrowers. Thus, the increase in sustainability-related lending primarily reflects a change in the type of loan contract and does not by itself imply an expansion in the issuing bank's credit supply to greener firms. At the same time, the smaller shares taken by issuing banks imply greater participation by other syndicate members. The increase in SRL contracting associated with green bond issuance thus extends beyond the issuing bank through the syndication process. Importantly, these patterns are not confined to banks' initial entry into the green bond market: greater exposure to green bond funding through subsequent issuance is associated with further increases in SRL contracting, while banks again take smaller shares in these facilities.

We subject these findings to a series of identification and robustness tests. First, we expand the comparison group to include banks that never issue green bonds. We find no evidence that future green bond issuers were already on different trends in SRL activity before issuance, while the increase in SRL contracting remains after issuance. Second, we account for the staggered timing of banks' first green bond issuance using alternative difference-in-differences estimators. Across estimators, pre-treatment effects are generally close to zero, while SRL activity increases following issuance, with the increase concentrated among greener borrowers and becoming more pronounced several years after issuance. This dynamic pattern also makes it less likely that our findings are driven solely by banks issuing green bonds in anticipation of an immediate increase in borrower demand for SRLs. Finally, we progressively tighten our controls for borrower demand, including specifications that absorb endogenous bank-borrower matching and time-varying borrower-level factors. Although the estimated effects become smaller under the most demanding specifications, the differential increase in SRL contracting with greener borrowers remains economically meaningful.

At the portfolio level, these changes in loan contracting do not translate into an

expansion of syndicated lending by green-bond-issuing banks. Following green bond issuance, both the number and volume of SRLs increase, with the increase concentrated among greener borrowers. Conventional lending subsequently declines, particularly to greener firms, while conventional lending to less green firms remains largely unchanged. Despite this shift in the composition of lending, we find no corresponding increase in issuing banks' total syndicated lending, either overall or to greener borrowers. Taken together, these results suggest that green bond issuance is associated primarily with a change in how issuing banks structure and segment their lending rather than with an expansion of their own credit supply.

Finally, we examine whether the changes in lending following green bond issuance are associated with improvements in borrowers' environmental performance. We find no consistent evidence that greater borrowing from green-bond-issuing banks alone is associated with reductions in emissions intensity. Instead, greater exposure to green-bond-issuing banks is associated with relatively larger subsequent reductions in emissions intensity specifically among greener firms receiving SRLs. Thus, the association between green bond issuance and borrower environmental performance appears to operate through the specific lending arrangements toward which issuing banks shift, rather than through greater exposure to green-bond-issuing banks per se.

Related literature. Our findings contribute to several strands of the literature. First, we contribute to a growing literature examining whether banks' sustainability initiatives translate into changes in lending. Existing studies investigate how lending responds to sustainability commitments, climate-related disclosure, environmental preferences, and other changes in banks' sustainability orientation (Degryse et al., 2023; Berg et al., 2024; Marqués-Ibáñez et al., 2026; Green and Vallée, 2025; Giannetti et al., 2026; Hasan et al., 2026; Kacperczyk and Peydró, 2026). More broadly, our paper relates to work showing that borrower environmental characteristics and climate risks are

reflected in loan pricing and credit quantities (Goss and Roberts, 2011; Chava, 2014; Javadi and Al Masum, 2021; Ehlers et al., 2022; Mueller and Sfrappini, 2025; Reghezza et al., 2022; Altavilla et al., 2023; Delis et al., 2024; Ivanov et al., 2024; Martini et al., 2026). We complement these literatures by studying a sustainability-oriented funding decision that originates on the funding side of banks' balance sheets. By tracing banks' green bond issuance into subsequent loan contracting and credit allocation, we show how a sustainability-oriented funding decision is associated with changes on the asset side of the balance sheet.

Second, we contribute to the literature on the consequences of green bond issuance. Existing studies examine the pricing of green bonds relative to comparable conventional bonds, including the existence and determinants of a greenium (e.g., Baker et al., 2022; Hachenberg and Schiereck, 2018; Karpf and Mandel, 2018; Zerbib, 2019; Larcker and Watts, 2020; Tang and Zhang, 2020; MacAskill et al., 2021; Flammer, 2021; Wu, 2022; Caramichael and Rapp, 2024) and their real environmental effects (e.g., Flammer, 2021; Fatica and Panzica, 2021; Guesmi et al., 2025; Pyrgiotakis et al., 2026). Most closely related to our paper, Fatica et al. (2021) show that banks issuing green bonds reduce lending to more carbon-intensive sectors, while Bedendo et al. (2023) find that banks that issue green bonds more intensively reduce lending to polluting sectors and improve their environmental footprint. And Han et al. (2026) examine how green bond issuance is associated with the environmental composition and performance of banks' lending portfolios. We extend this literature by providing a more granular account of how banks adjust their lending after green bond issuance. Our loan-level data allow us to distinguish adjustments in loan contracting, borrower selection, and banks' credit exposure through their participation in loan syndicates, and to relate these different dimensions of lending behavior to subsequent changes in borrowers' emissions. Our analysis is also complementary to Lam and Wurgler (2024), who examine the additionality of projects financed by

corporate and municipal green bonds and find that green bond proceeds rarely finance projects with novel green features. Rather than tracing individual green bond proceeds to particular loans, we ask whether green bond issuance changes banks' subsequent lending behavior. In doing so, we show that banks shift toward sustainability-linked lending, embedding sustainability objectives into loan contracts and tying borrowing costs to borrowers' sustainability performance. Our findings thus highlight how green bond issuance can affect corporate lending beyond the direct allocation of proceeds, by changing how banks structure their loans.

Third, we contribute to the emerging literature on sustainability-linked loans (SLLs). Existing studies examine which firms receive SLLs, how these loans are priced and structured, and whether they are associated with subsequent improvements in borrowers' sustainability performance (Caskey and Chang, 2022; Auzepy et al., 2023; Carrizosa and Ghosh, 2023; Du et al., 2024; Kim et al., 2025; Aleszczyk et al., 2026). We complement this literature by studying a funding-side determinant of banks' use of sustainability-linked and green loans (SRLs). Rather than taking the provision of these loans as given, we ask whether banks change their use of SRLs after issuing green bonds and how this response varies with borrowers' environmental performance. In doing so, we connect the markets for sustainable bank funding and sustainable corporate lending and show how a sustainability-oriented funding decision is reflected in the types of loan contracts banks subsequently use with their borrowers.

2 Data and Sample

To study whether the green funding that banks receive in the green bond market is channeled into their corporate lending and generates any "real effects" in terms of reducing carbon emissions of the borrowing firms, we combine data from four sources. First, we collect bond data from LSEG, formerly known as Eikon, for banks headquartered in

Europe that have issued at least one green bond between 2012 and 2022. We focus on European banks as they have played a leading role in the development of the green bond market. We identify 94 distinct banks headquartered in Europe that issue green bonds in 29 different countries.

Next, we combine these bond data with banks' financial balance sheet information from S&P Global and syndicated loan data from LSEG's DealScan. We focus on the syndicated loan market because syndicated lending transactions are relatively visible and publicly disclosed, making them a particularly salient channel through which banks can signal their green commitment after issuing green bonds. We consider loan originations by both lead arrangers and participant lenders. The unit of observation is at the tranche-lender level.

To measure the environmental performance of borrowers, we collect ESG ratings and data on carbon emissions from Refinitiv and S&P Trucost. We are able to identify 3,093 borrowers with ESG ratings and 2,972 borrowers with carbon data in the syndicated loan market. To keep a borrower in our sample, we require at least one available measure of firm greenness, either ESG or carbon data. At the intersection of all these databases, we end up with a sample of 45 distinct green-bond-issuing banks, 3,727 different borrowing firms, and 20,697 syndicated loans. Figure 1 and Figure 2 show the number of green bond issues by year and country, respectively. Figure 3 and Figure 4 show the number and volume of sustainability-related loans by year and region, respectively.

To identify loans with sustainability-related features, we rely on the *market segment* field in DealScan. DealScan extracts detailed contract information from public loan documentation releases and checks with lenders when documentation is unclear or incomplete. We classify a loan as sustainability-related if its market segment is labeled "sustainable," and zero otherwise. Following Kim et al. (2025), this classification captures both sustainability-linked loans and green loans. Throughout the paper, we collectively re-

fer to these two types of loans as sustainability-related loans (SRLs). In our sample, sustainability-linked loans account for 64% and green loans for 36% of SRLs. Internet Appendix B. provides some examples of syndicated SRLs included in our sample.

In the Internet Appendix, Table IA.1 contains summary statistics for all variables used in the analysis of banks' first green bond issues (Panel A), banks' seasoned green bond issues (Panel B), and borrowers' environmental performance (Panel C). Table A1 in the Data Appendix provides detailed variable definitions and data sources.

3 Green Bond Issuance and Loan Contracting

3.1 Empirical Specification

We start our empirical analysis by examining how banks' sustainable lending behavior changes after their first green bond issuance, allowing the response to differ across borrowers' environmental performance. More formally, we estimate the following model:

$$\begin{aligned} Y_{l,f,b,t} = {} & \beta_1 Green\,Bond_{b,t} \times Green\,Firm_{f,t} \\ & + \beta_2 Green\,Bond_{b,t} + \beta_3 Green\,Firm_{f,t} \\ & + \gamma X_{l,f,b,t} + \alpha_b + \lambda_t + FE + \epsilon_{l,f,b,t}, \end{aligned} \tag{1}$$

where the subscripts l, f, b, t stand for loan tranche, firm, bank, and year-quarter, respectively. Our dependent variables are: $\mathbb{1}(Refinancing)_{l,f,b,t}$ a dummy that is one if the loan refinances an existing loan, and zero if it is a new loan; $\mathbb{1}(SRL)_{l,f,b,t}$ a dummy that indicates whether an existing client receives a sustainability-related loan; $\mathbb{1}(Entry)_{l,f,b,t}$ a dummy that is one if the loan is granted to a new client, and zero if it is granted to an existing borrower; $\mathbb{1}(SRL|Entry)_{l,f,b,t}$ a dummy that indicates whether a new client receives a sustainability-related loan; $Loan\,Share_{l,f,b,t}$ which captures the loan share of bank b in loan l to firm f; and $(Loan\,Share|Entry)_{l,f,b,t}$ which captures the loan share

of bank b in loan l to *new* borrowing firm f at time t.

$Green\,Bond_{b,t}$ is our treatment indicator which equals one for the five years after a bank's first green bond issue and zero before issuance, assigned at the calendar-day level. The choice of five years is based on the average maturity of green bonds. Observations more than five years after first green bond issuance are excluded from the estimation sample, i.e., the treatment indicator does not revert to zero. We examine the differential lending behavior toward green vs. brown firms as shown by the interaction with $Green\,Firm_{f,t}$ and estimated via the β_1 coefficient. We consider three green firm definitions: (i) $High\,ESG_{f,t}$ equals one if firm f has an ESG-score ≥ B+, (ii) $High\,E_{f,t}$ equals one if firm f has an E-score ≥ B+, and (iii) $Low\,CO2_{f,t}$ equals one if firm f has Scope 1 + 2 emission intensity < its industry-year average.[4]

In our baseline specification, we account for industry-level variation in credit demand with industry-by-time fixed effects (FE), and control for unobserved time-invariant differences across banks (α_b) and aggregate time trends (λ_t). By including industry-by-time fixed effects, we limit identifying variation to comparisons of loans to firms within the same industry in each year-quarter. This absorbs all time-varying unobserved heterogeneity across industries, such as variations in industrial cycles, which might correlate with firm performance and thus credit demand. Bank fixed effects eliminate time-invariant heterogeneity across banks, at least partially addressing potential pre-existing differences in attributes between banks issuing green bonds early in the sample period and those having not yet issued green bonds. Aggregate time trends account for general macroeconomic developments that may influence bank lending decisions and could be correlated with green bond issuance.

To mitigate lingering concerns about omitted variable bias, we add $X_{l,f,b,t}$, a vector

[4]Scope 1 emissions are direct carbon emissions that occur from sources that are controlled or owned by a firm, while Scope 2 emissions are indirect carbon emissions associated with the purchase of electricity, steam, heat, or cooling. Emission intensity is measured as firms' respective emissions scaled by revenues.

of loan-specific controls and bank-specific characteristics. $Lead\,Bank_{l,b}$ is a dummy that equals one if bank b is a lead bank in the syndicate, and zero otherwise. $Nr\,of\,Lenders_{l,f,t}$ indicates the number of banks that participate in the syndicate. $Log\,Total\,Assets_{b,t-1}$ captures total bank assets in log billion euros, one year lagged. $Leverage_{b,t-1}$ is bank total debt to total equity, one year lagged, and $ROA_{b,t-1}$ is bank net income (loss) to total assets, one year lagged. Robust standard errors are clustered by bank.

β_1 and β_2 are the coefficients of main interest. The coefficient β_1 measures the differential change in an outcome for environmentally stronger versus weaker borrowers, conditional on the included controls and fixed effects. β_2 measures the change in outcome for environmentally weaker borrowers. Our identification strategy assumes that, conditional on the comprehensive set of fixed effects and control variables, banks which issue green bonds do not face different demand for (green) loans from firms that is systematically correlated with the green-bond-issuing status. In more stringent specifications, we therefore sharpen our approach and control for credit demand by including loan fixed effects, exploiting within-loan variation across syndicate members. In addition, we examine the robustness of our results to potential credit demand concerns by considering only participant lenders. Within the syndicated loan market, credit demand is more exogenous for syndicate participants compared to lead banks.

The causal interpretation of our findings hinges on the parallel trends assumption which is inherently untestable. Figure 5 provides descriptive evidence that SRL activity does not visibly increase prior to green bond issuance. In Section 4, we provide more formal analyses of potential pre-issuance trends.

In addition, since the green bond issuances in our sample occur at different times during our observation period, using traditional TWFE OLS regressions in this staggered treatment setting could produce unreliable estimates (Baker et al., 2022). We will account for these issues and assess robustness to different staggered estimators in Section 4.

3.2 Loan Contracting and Borrower Selection

Table 1 shows the results of estimating Eq. (1). We report the results for our three definitions of green firms separately. Among existing relationships, in Panel A, high-ESG borrowers experience a 6.6 percentage points (pp) larger increase in the probability of receiving a sustainability-related loan (SRL) than lower-rated borrowers of the same issuing bank (column 2). Among newly formed relationships, the differential increase is 8.8 pp (column 4). The estimates therefore point to a change in the types of loans banks provide, both to established clients and when initiating a new relationship.

This response should not be confused with an expansion in the number of green borrowers served. Column 3 provides no significant evidence that issuing banks become more likely to establish new relationships with high-ESG firms relative to lower-rated firms. In other words, conditional on forming a new relationship, a greener borrower is more likely to receive an SRL, but green bond issuance is not associated with a significant shift in which firms become new clients. Column 1 likewise provides no evidence of a systematic change in refinancing patterns. These null results constrain the interpretation of the economically large SRL coefficients: we observe a change in contracting type, but no corresponding increase in the propensity of issuing banks to establish new relationships with greener firms.

Our findings are robust to different definitions of firm greenness. Results in Panel B, where firms' greenness is defined based on their E ratings, are very similar to those in Panel A, while they are qualitatively the same but quantitatively smaller in Panel C, where firms' greenness is measured by their relative CO2 intensity. In Table IA.3, columns 1–4, we repeat our analyses for the subsample of participant lenders. The idea is that participant lenders are not in direct contact with the borrowers but only join the syndicate after the lead bank has negotiated the loan terms with the borrowers. Therefore, the lending decisions of participant banks should reflect loan supply more independent

of loan demand. Results are qualitatively similar.

Taken together, these results show that banks change how they lend following their first green bond issuance. In particular, they become more likely to originate sustainability-related loans to greener firms, with the point estimates larger among new borrowers. These findings point to a shift in loan contracting toward firms that are already relatively green, but do not by themselves provide evidence of an expansion in issuing banks' syndicated credit supply.[5]

3.3 Committed Shares in Syndicated Loans

An increase in sustainability-related loan (SRL) participation does not imply a comparable increase in the amount a bank commits to individual facilities. We therefore examine committed loan shares in Table 2. Bank-specific shares are frequently missing in DealScan, substantially reducing the estimation sample. Using ESG or environmental ratings, issuing banks do not significantly change their shares in loans to existing borrowers but take smaller shares in SRL to new green borrowers. Using relative carbon intensity, the decline in shares is concentrated among existing borrowers.

Restricting the sample to participant lenders yields negative but statistically insignificant estimates for the loan-share regressions (Table IA.3 columns 5–8). Thus, while the direction of the estimates is consistent with our baseline findings, the evidence for a reduction in committed loan shares is weaker among participant lenders. In Table IA.2, we then perform a within-loan analysis, incorporating loan fixed effects to account for (un)observed firm-specific factors. Our results are robust.

[5]We further examine whether the increase in SRL lending to high-ESG borrowers following green bond issuance is concentrated in particular industries. We consider several measures of industry carbon intensity and whether an industry represents a bank's primary lending specialization. Across specifications, the triple interactions between green bond issuance, borrower ESG status, and these industry characteristics are generally statistically insignificant. These findings provide no evidence that the shift toward high-ESG borrowers is concentrated in more carbon-intensive industries or in industries where banks specialize.

Overall, these findings imply that issuing banks appear more frequently in sustainability-related lending to greener firms, but commit less of the syndicated amount. Hence, more SRLs do not by themselves imply an expansion of syndicated credit supplied by green-bond-issuing banks. At the same time, the smaller shares taken by issuing banks imply greater participation by other syndicate members, potentially spreading the risk of lower interest income if borrowers meet their sustainability targets.

3.4 The Role of Green Bond Certification

Next, we examine the role of green bond certification in shaping banks' sustainable lending response. If green bond issuance accompanies a change in banks' environmental commitments or organizational capabilities, the sustainable lending response may differ with the credibility and formality of the issuance framework. Bond certification can be informative to investors and may increase the visibility of the bank's environmental commitments. Previous studies find that third-party certification serves as an important signal that shows funds will be allocated to eligible sustainable projects, and investors are therefore willing to pay a greenium for third-party certified green bonds (Fatica et al., 2021; Flammer, 2021). Non-certified bonds, however, can still be CBI-aligned, meaning the prospectus specifies that proceeds will be invested in projects that align with a 2°C warming trajectory under the CBI's taxonomy, and this alignment might be validated by a second-party opinion provider. Some green bonds may be self-labeled, but these are rare in our sample, preventing us from drawing meaningful inferences for this group.

In Table 3, we compare lending patterns for third-party certified and CBI-aligned green bonds. Both groups exhibit a shift toward SRLs to greener borrowers. Among third-party certified issuers, the differential increase is approximately 7 pp for existing high-ESG borrowers and 19 pp for new high-ESG borrowers. At the same time, these issuers become approximately 8 pp less likely to refinance loans to high-ESG borrow-

ers relative to lower-rated borrowers. Among CBI-aligned issuers, the increase in SRL contracting is approximately 7 pp within existing relationships and 6 pp among new high-ESG borrowers, while we find no significant differential change in refinancing. Overall, the point estimates suggest that the shift in sustainable lending practices is particularly pronounced among issuers of third-party certified green bonds.[6]

3.5 Seasoned Green Bond Issuance Effects

We next ask whether the sustainable lending response extends beyond the first green bond issuance. Do banks ratchet up the shift toward sustainability-related lending after subsequent issuances, or is the response restricted to banks' initial entry into the green bond market? To address this question, we examine whether banks with greater outstanding green bond financing are more likely to change loan contracting and borrower selection. Specifically, we estimate the following model:

$$\begin{aligned} Y_{l,f,b,t} = {} & \beta_1 Green\,Bond\,Ratio_{b,t} \times Green\,Firm_{f,t} \\ & + \beta_2 Green\,Bond\,Ratio_{b,t} + \beta_3 Green\,Firm_{f,t} \\ & + \beta_4 First\,Green\,Issuance_{b,t} + \gamma X_{l,f,b,t} + \alpha_b + \lambda_t + FE + \epsilon_{l,f,b,t} \end{aligned} \tag{2}$$

where $Green\,Bond\,Ratio_{b,t}$ is the percentage of the bank's outstanding bond volume issued as green bonds, measured at the year-quarter level. To control for the effects of the first green bond market entry and focus our analysis on the effects of seasoned green bond issuances, we include an indicator that is one in the six months after a bank's first green bond issue, and zero otherwise ($First\,Green\,Issuance_{b,t}$). Figure 6 shows the average green bond ratio and the total green bond volume outstanding after correcting for bond maturity over time. All other regression variables are the same as specified

[6] In Table IA.8, we show the robustness of these findings to the inclusion of never-treated banks in the comparison group.

before in Eq.(1).

Table 4 shows the regression results. We find that greater green bond exposure is associated with a higher probability of sustainability-related lending (SRL) to greener firms. In the high-ESG specification, in Panel A, the estimates are 2.3 pp among existing borrowers and 2.8 pp among new borrowers for a one-percentage-point increase in green bond exposure. Results using environmental ratings and carbon intensity generally point in the same direction, but are less consistent and statistically weaker. In Internet Appendix Table IA.4, we show that these findings are robust to an alternative measure of green bond exposure that excludes the first issuance entirely from outstanding green bond financing. Overall, these patterns suggest that the association between green bond activity and sustainability-related lending extends beyond the initial issuance event.

Table 5 examines syndicated loan shares. Across the three definitions of greenness, banks with greater green bond exposure take smaller shares in SRL to new green borrowers. Loan-fixed-effect specifications in Internet Appendix Table IA.5 yield qualitatively similar effects, albeit less consistent. Thus, repeated issuance is associated with the same separation between the propensity to participate in sustainability-related lending and the amount committed to individual loans.

4 Identification and Robustness

4.1 Never-Treated Banks and Pre-Issuance Trends

A potential concern with the previous analyses using a homogeneous sample of treated and not-yet treated banks is that these banks may differ systematically in unobservables in ways that generate a wedge in SRL activity unrelated to green bond issuance. For example, banks that eventually issue a green bond may be more exposed to rising ESG-related regulatory or investor pressures, or may be earlier adopters of climate-related

strategies. If these differences lead to faster growth in SRL lending, even absent green bond issuance, the estimated effects could overstate the relationship with green bond issuance that we find.

To address this concern, we analyze the robustness of our results to incorporating never-treated banks and tightening identification using bank-quarter-year fixed effects. We construct this new sample by including all non-green bond issuers that lend in DealScan and are located in Europe. The identifying assumption is that these banks follow trends in SRL lending similar to those of green bond issuers prior to issuance. To test this assumption, we first compute both the number and volume of SRL as a percentage of bank's loan portfolio at the bank-year level. We split the sample into the six years prior to and including the first green bond issuance year, and the five years after the first green bond issuance year, while keeping the same set of never-treated banks. The regression specification looks as follows:

$$Y_{b,y} = \beta_1 Green\,Bond\,Issuer_b + FE + \epsilon_{b,y}, \tag{3}$$

where $Y_{b,y}$ is the number ($SRL\,Portfolio\,Nr_{b,y}$) or volume ($SRL\,Portfolio\,Volume_{b,y}$) of SRL as a percentage of bank b loan portfolio in year y, expressed in decimals. To estimate the treatment effect, we construct $Green\,Bond\,Issuer_b$ which equals one for a bank that will or has issued its first green bond. We run this specification to estimate pre- and post-trends separately for the six years prior to and including the first green bond issuance year, and the five years after the first green bond issuance year. FE includes year and/or lender country fixed effects. Year fixed effects control for global trends in sustainable finance affecting all banks in all countries in a given year such as market-wide shifts in investor demand for green assets or overall growth in the SRL market. Using lender country fixed effects, we control for time-invariant differences across countries that might correlate with green bond issuance and SRL activity such as cultural attitudes

toward sustainability and differences in financial and economic development. Standard errors are clustered at the bank-level to mitigate concerns regarding serial correlation biasing our inference.

The results are tabulated in Table 6. Panel A reports the after-issuance estimates: issuers show a larger number-based SRL portfolio share, while the corresponding volume-based response is more modest. The divergence between counts and volumes is consistent with the smaller committed shares documented in Section 3. Panel B shows that, before issuance, future green bond issuers do not differ significantly from never-issuing banks in either measure of SRL activity. Taken together, these findings indicate that differences in SRL portfolio shares between issuing and never-issuing banks emerge primarily after green bond issuance, particularly in terms of the number of SRLs.

We then re-estimate the loan-level specifications (from Table 1 and Table 2) using never-treated banks and bank-quarter-year fixed effects. Table IA.6 in the Internet Appendix reports differential SRL increases of 7.2 percentage points (pp) for existing high-ESG borrowers and 8.9 pp for new high-ESG borrowers. The corresponding committed-share results in Table IA.7 remain qualitatively similar. These exercises alleviate the concern that the baseline results arise solely from comparisons between banks that issue green bonds at different dates.[7]

4.2 Staggered Difference-in-Differences Estimators

Another potential concern is that our estimates reflect the weighting properties of two-way fixed effects (TWFE) estimators under staggered treatment adoption (Baker et al., 2022). Because banks issue their first green bond at different points in time, conventional TWFE estimates may use already-treated banks as controls for banks treated later. We therefore

[7] Table IA.8 shows that the results on certification remain robust to the inclusion of never-treated banks in the sample and controlling more tightly for alternative supply-side factors via bank-quarter-year fixed effects.

complement the analysis with five alternative estimators designed for staggered treatment adoption. These estimators differ in their implementation but share the principle of constructing treatment effects using *clean* controls: banks that are either never treated or not yet treated. We follow the set of estimators considered by Wing et al. (2024).

Figure 7 plots the dynamic effects on the share of sustainability-related loans in banks' syndicated loan portfolios over the five years before and after their first green bond issuance. The results are similar across estimators. Pre-treatment coefficients are generally close to zero, while SRL shares increase substantially following issuance, with the effect becoming more pronounced at longer horizons. The magnitudes vary across estimators, particularly in later years when fewer treated cohorts contribute to identification, but the qualitative pattern is consistent. Thus, our main bank-level result does not appear to be driven by the weighting properties of conventional TWFE estimation.

We next decompose the aggregate SRL share by borrower type. Both outcomes retain all loans in the denominator (regardless of ESG rating). Panels B and C therefore show which borrower types account for the change in a bank's overall SRL portfolio, rather than the propensity to originate an SRL conditional on lending to a particular ESG group. Panel B shows a clear increase in the portfolio share of SRL to high-ESG borrowers, particularly three to four years after issuance. For low-ESG firms, in Panel C, the post-treatment coefficients are much smaller. So the increase is concentrated among high-ESG borrowers, consistent with the loan-level evidence.

4.3 Controlling for Borrower Demand

Finally, we address concerns related to borrower demand. One might worry that green bond issuers may serve a borrower base with greater demand for green products and that our estimates are picking up demand-side rather than supply-side differences. To assess whether such demand-side factors drive our SRL results, we replicate our base-

line SRL-regressions using the expanded sample with never-treated banks and gradually include more granular demand controls to assess coefficient stability. Table 7 therefore adds sequentially bank-by-quarter fixed effects which absorb bank-wide time-varying factors, including contemporaneous changes in a bank's climate strategy or investor ESG pressures. Industry-by-quarter effects absorb sector-specific shifts in demand for sustainable financing. Bank-firm relationship fixed effects, where feasible, account for existing lender-borrower matching, while bank-industry fixed effects account for specialization in the new-relationship sample. Finally, borrower-by-period fixed effects, implemented in broader time bins to preserve variation, address changes in firm's SRL demand over time.

The differential SRL coefficients decline under the most demanding controls but remain economically meaningful: approximately 4 pp for existing relationships and 2 pp for new relationships. These findings make simple bank-level and borrower-demand explanations less plausible.

5 Aggregate Portfolio Adjustments

The preceding results show that banks become more likely to originate sustainability-related loans (SRL) to greener borrowers following green bond issuance. However, these estimates capture changes in loan contracting conditional on lending and do not necessarily imply that issuing banks expand their syndicated credit provision. For example, banks could increase the share of sustainability-related loans in their portfolios while reducing conventional lending or their overall credit exposure. We therefore turn to bank-level evidence to examine whether the shift toward SRL is accompanied by changes in the volume and composition of banks' syndicated lending. We aggregate loan originations to the bank-year level and estimate dynamic treatment effects around banks' first green bond issuance, including banks that never enter the green bond market in the comparison group. We examine both the number of loan participations and committed lending

volumes of banks' total syndicated lending, distinguishing between sustainability-related and conventional lending.

The results reported in Figure 8 reveal three patterns. First, green bond issuance is followed by a substantial and persistent increase in both the number and committed volume of sustainability-related loans, concentrated among high-ESG borrowers (Panel A). Second, conventional lending remains largely unchanged immediately after issuance and declines in subsequent years, particularly among high-ESG borrowers (Panel B). By contrast, conventional lending to low-ESG borrowers shows no comparable decline. These patterns may reflect a shift from conventional to sustainability-related lending. Third, despite the increase in SRL activity, we do not find a corresponding expansion in issuing banks' total syndicated lending (Panel C). If green bond issuance led issuing banks to extend more credit to greener firms, we would expect to observe an increase in total lending volumes or loan participation to these borrowers. Instead, the estimated effects are small and generally statistically indistinguishable from zero. We obtain similar results using alternative staggered difference-in-differences estimators in Internet Appendix Figure IA.1.

Taken together, these results demonstrate that green bond issuance is associated with greater segmentation in banks' corporate lending. The sustainability-related lending expansion is concentrated among greener borrowers, while conventional lending to less green firms remains largely unchanged. Moreover, the shift in loan contracting does not translate into an expansion of syndicated lending by issuing banks to greener borrowers.

6 Environmental Performance of Borrowers

6.1 Empirical Specification

Finally, we examine whether the shift toward SRLs is associated with subsequent improvements in borrowers' environmental performance. Formally, we estimate the following model:

$$\begin{aligned}\Delta Emission\,Intensity_{f,y} = \beta Green\,Credit_{f,y} \otimes Green\,Firm_{f,y} \otimes Green\,Loan_{f,y} \\ + \gamma Z_{f,y-1} + \alpha_f + \lambda_y + \epsilon_{f,y},\end{aligned} \tag{4}$$

where the subscripts f and y stand for firm and year, respectively, and $\otimes$ includes all the single and cross-interaction effects. Our dependent variable is $\Delta Emission\,Intensity_{f,y}$ which is the log-difference in emission intensity of firm f between loan origination year y and $y+3$.[8]

The main coefficient of interest is the triple-interaction coefficient β, which captures whether the association between exposure to green-bond-issuing banks and subsequent changes in emissions intensity differs for greener firms receiving SRLs relative to the corresponding differences across borrower and loan types. $Green\,Credit_{f,y}$ is the % of credit that the firm received from banks issuing green bonds (i.e., we require that at least one syndicate member has issued a green bond). $Green\,Firm_{f,y}$ is an indicator that equals one if the firm is green. We consider three green firm definitions: (i) $High\,ESG_{f,y}$ equals one if firm f has an ESG-score $\geq$ B+, (ii) $High\,E_{f,y}$ equals one if firm f has an E-score $\geq$ B+, and (iii) $Low\,CO2_{f,y}$ equals one if firm f has Scope 1 + 2 emission intensity < its industry-year average. $Green\,Loan_{f,y}$ is an indicator that equals one if firm f has received at least one sustainability-related loan (SRL) in year y. $Z_{f,y-1}$ is a vector of firm characteristics and contains $Log\,Total\,Assets_{f,y-1}$, which is the total assets in log

[8] Emission intensity is a firm's Scope 1 + 2 carbon emissions scaled by its revenues.

million dollars, one-year lagged, and $ROA_{f,y-1}$, which is net income (loss) to total assets, one-year lagged. We saturate the model with firm fixed effects (α_f) and year fixed effects (λ_y). Robust standard errors are clustered by firm.

6.2 Borrower-level Results

Table 8 shows the estimation results of Eq. (4). We report the results for our three definitions of green firms: columns 1–2 define green firms using ESG ratings, columns 3–4 using E-ratings, and columns 5–6 using CO2 intensity.

The odd-numbered columns do not distinguish SRL from conventional lending. In these specifications, there is no consistent evidence that greener firms with greater exposure to green-bond-issuing banks experience larger reductions in emissions intensity. This indicates that a lending relationship with a green-bond-issuing bank is not, by itself, associated with systematically better emissions outcomes.[9]

The even-numbered columns introduce the distinction between sustainability-related and conventional loans. Greater exposure to green-bond-issuing banks is associated with relatively larger subsequent reductions in emissions intensity specifically among greener firms receiving SRLs.

7 Conclusion

What makes banks change their sustainable lending behavior? In this paper, we examine whether green bond issuance is associated with changes in banks' corporate lending decisions. Using data on European banks' green bond issuance and syndicated lending, matched with information on borrowers' environmental performance, we document a shift toward sustainability-related lending following banks' entry into the green bond market.

[9] There is a small significantly positive effect when measuring firm greenness using CO2 intensity but the effect is economically negligible.

After the first green bond issuance, existing and new green borrowers become 6.6 and 8.8 percentage points more likely, respectively, to receive a sustainability-related loan relative to less green borrowers borrowing from the same bank. Yet, we find no corresponding increase in the formation of new lending relationships with greener firms. Moreover, issuing banks take smaller shares in the syndicated sustainability-related loan facilities to new green borrowers. This shift extends beyond banks' initial entry into the green bond market: greater exposure to green bond funding through subsequent issuance is associated with further increases in sustainability-related lending to greener firms, while issuing banks again take smaller shares in these facilities. At the bank-year level, the number and volume of SRLs increase, but total syndicated lending by issuing banks does not. Taken together, these findings suggest that green bond issuance is associated with a change in how banks structure their lending rather than an expansion of their own credit supply.

Do these changes in lending translate into improvements in borrowers' environmental performance? We find that greater exposure to green-bond-issuing banks is associated with relatively larger subsequent reductions in emissions intensity specifically among greener firms receiving SRLs. We find no comparable improvements among borrowers of issuing banks more generally. Thus, while the shift toward sustainability-related lending is associated with better environmental outcomes for selected firms, the evidence for broader improvements across banks' corporate loan portfolios is limited. The environmental effects therefore appear to be linked to the specific lending arrangements toward which issuing banks shift, rather than to greater exposure to green-bond-issuing banks per se.

Our findings contribute to the debate on whether financial institutions' environmental commitments translate into changes in their financing activities. They show that a sustainability-oriented funding decision on the liability side of banks' balance sheets is

associated with meaningful changes in lending on the asset side. However, the distinction between loan contracting and credit supply is important. An increase in sustainability-related lending does not necessarily imply that issuing banks provide more credit or redirect their own financing toward transition firms facing the greatest challenges in reducing emissions. Instead, the shift toward sustainability-related lending is concentrated among firms that are already relatively green. More broadly, our results highlight the importance of distinguishing changes in the type of lending from changes in the allocation and amount of credit when assessing the real effects of sustainable finance.

Data Appendix

Table A1. Variable Definitions and Data Sources

Variable Name	Definition and Source
$CO2\,Intensity_{f,t}$	The amount of Scope 1 + 2 carbon emissions of a borrower in a year, scaled by its revenues. *Source: S&P Trucost.*
$\mathbb{1}(Entry)_{l,f,b,t}$	Equals one if the loan is granted to a new borrower, and zero if granted to a repeat borrower. *Source: Self-constructed.*
$ESG\,Score_{f,t}$	Environmental, Social, and Governance score, expressed as an alphabetical rating ranging from A to D. *Source: Refinitiv.*
$First\,Green\,Issuance_{b,t}$	Indicator that equals one in the first six months after a bank's first green bond issuance, and zero otherwise. *Source: LSEG.*
$Green\,Bond_{b,t}$	Treatment indicator, equals one in the five years after the day a bank issued its first green bond, and zero in the preceding years. *Source: LSEG.*
$Green\,Bond\,Issuer_{b}$	Equals one for banks that issue green bonds. *Source: LSEG.*
$Green\,Bond\,Ratio_{b,t}$	The amount of outstanding green bond volume of a bank divided by its total amount of outstanding bonds (in %), averaged at year-quarter. *Source: Self-constructed.*
$Green\,Credit_{f,y}$	The loan amount a firm received from green-bond-issuing banks (we require that at least one syndicate member issued a green bond before the loan origination date) divided by total amount of loans received in a calendar year (in %). *Source: Self-constructed.*
$Green\,Firm_{f,t}$	Depending on the specification, we employ three green firm definitions: (i) $High\,ESG_{f,t}$ equals one if a firm has an ESG-score ≥ B+, (ii) $High\,E_{f,t}$ equals one if a firm has an E-score ≥ B+, and (iii) $Low\,CO2_{f,t}$ equals one if a firm has Scope 1 + 2 emission intensity < its industry-year average. *Source: Refinitiv and S&P Trucost.*
$Green\,Loan_{f,y}$	Equals one if a firm received at least one sustainability-related loan in a calendar year. *Source: Self-constructed.*
$Industry_{f}$	Dummies for a borrower's three-digit Standard Industry Classification codes. *Source: LSEG DealScan.*
$Lead\,Bank_{l,b,t}$	Equals one if a bank is a syndicate lead bank, and zero otherwise. We define as lead bank(s) (i) the administrative agent of the syndicate, if not available (ii) all lenders that act as agent, (mandated or coordinating) arranger, bookrunner, (mandated) lead arranger, lead bank or manager (Ivashina, 2009). *Source: LSEG DealScan.*
$Leverage_{b,t-1}$	Ratio of debt to equity (in %) of a bank in the previous calendar year. *Source: S&P Global.*
$Loan\,Share_{l,f,b,t}$	The percentage of loan amount that a bank contributed in the syndicate (in decimals). We focus only on observations with non-missing loan shares in related tests. *Source: LSEG DealScan.*
$Log\,Total\,Assets_{b,t-1}$	The amount of total assets of a bank in billion Euro (in logs) in the previous calendar year. *Source: S&P Global.*
$Log\,Total\,Assets_{f,y-1}$	The amount of total assets of a borrower in million USD (in logs) in the previous calendar year, winsorized at 1-99pct level. *Source: Compustat.*

Variable Name	Definition and Source
$Log\,Total\,Credit_{b,y}$	The total USD volume syndicated loans issued by b in year y (in logs). *Source: Self-constructed.*
$Nr\,of\,Lenders_{l,f,t}$	The number of syndicate members. *Source: LSEG DealScan.*
$\mathbb{1}(Refinancing)_{l,f,b,t}$	Equals one if the loan is an amendment of a pre-existing tranche, and zero otherwise. *Source: LSEG DealScan.*
$ROA_{b,t-1}$	Return on assets of a bank (in %) in the previous calendar year. *Source: S&P Global.*
$ROA_{f,y-1}$	Return on assets of a borrower (in %) in the previous calendar year, winsorized at 1-99pct level. *Source: Compustat.*
$\mathbb{1}(SRL)_{l,f,b,t}$	Equals one if a loan's market segment is labeled as sustainability-linked or green loan, and zero otherwise. *Source: LSEG DealScan.*
$SRL\,Portfolio\,Nr_{b,y}$	The number of SRL as a percentage of total number of syndicated loans issued by bank b in year y, expressed in decimals. *Source: Self-constructed.*
$SRL\,Portfolio\,Volume_{b,y}$	The USD volume of SRL as a percentage of total USD volume syndicated loans issued by b in year y, expressed in decimals. *Source: Self-constructed.*
$Subsequent\,GB\,Ratio_{b,t}$	The amount of outstanding green bond volume excluding bonds issued on the bank's first green bond issuance date, divided by its total outstanding bond volume (in %), averaged at the year-quarter level. *Source: Self-constructed.*

References

Aleszczyk, A. A., M. Loumioti, and G. Serafeim (2026). The issuance and design of sustainability-linked loans. *The Accounting Review*, 1–32.

Altavilla, C., M. Boucinha, M. Pagano, and A. Polo (2023). Climate risk, bank lending and monetary policy. CEPR Discussion Paper 18541, Centre for Economic Policy Research.

Auzepy, A., C. E. Bannier, and F. Martin (2023). Are sustainability-linked loans designed to effectively incentivize corporate sustainability? a framework for review. *Financial Management 52*(4), 643–675.

Baker, A. C., D. F. Larcker, and C. C. Wang (2022). How much should we trust staggered difference-in-differences estimates? *Journal of Financial Economics 144*, 370–395.

Baker, M., D. Bergstresser, G. Serafeim, and J. Wurgler (2022). The pricing and ownership of us green bonds. *Annual Review of Financial Economics 14*, 415–437.

Bedendo, M., G. Nocera, and L. Siming (2023). Greening the financial sector: Evidence from bank green bonds. *Journal of Business Ethics 188*(2), 259–279.

Berg, T., R. Döttling, X. Hut, and W. Wagner (2024). Do voluntary initiatives make loans greener? evidence from project finance. In *Proceedings of the EUROFIDAI-ESSEC Paris December Finance Meeting 2024*.

Callaway, B. and P. Sant'Anna (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics 225*(2), 200–230.

Caramichael, J. and A. C. Rapp (2024). The green corporate bond issuance premium. *Journal of Banking and Finance 162*, 107126.

Carrizosa, R. and A. Ghosh (2023). Sustainability-linked loan contracting. Working paper, SSRN.

Caskey, J. and M. W.-H. Chang (2022). Do ESG-linked loans enhance the credibility of ESG disclosures? Working paper, SSRN.

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

Climate Bonds Initiative (2026). Sustainable debt global state of the market h1 2026. Technical report, Climate Bonds Initiative.

de Chaisemartin, C. and X. D'Haultfoeuille (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review 110*(9), 2964–2996.

Degryse, H., R. Goncharenko, C. Theunisz, and T. Vadasz (2023). When green meets green. *Journal of Corporate Finance 78*, 102355.

Delis, M. D., K. de Greiff, and S. Ongena (2024). Being stranded with fossil fuel reserves? Climate policy risk and the pricing of bank loans. *Financial Markets, Institutions & Instruments 33*(3), 239–265.

Du, K., J. Harford, and D. Shin (2024). Who benefits from sustainability-linked loans? Working paper, SSRN.

Ehlers, T., F. Packer, and K. de Greiff (2022). The pricing of carbon risk in syndicated loans: Which risks are priced and why? *Journal of Banking and Finance 136*, 106180.

Fatica, S. and R. Panzica (2021). Green bonds as a tool against climate change? *Business Strategy and the Environment 30*(5), 2688–2701.

Fatica, S., R. Panzica, and M. Rancan (2021). The pricing of green bonds: Are financial institutions special? *Journal of Financial Stability 54*, 100873.

Flammer, C. (2021). Corporate green bonds. *Journal of Financial Economics 142*(2), 499–516.

Gardner, J. (2022). Two-stage differences-in-differences. *Papers 2207.05943, arXiv.org*.

Giannetti, M., M. Jasova, M. Loumioti, and C. Mendicino (2026). "Glossy green" banks: The disconnect between environmental disclosures and lending activities. *Management Science*.

Goss, A. and G. S. Roberts (2011). The impact of corporate social responsibility on the cost of bank loans. *Journal of Banking and Finance 35*(7), 1794–1810.

Green, D. and B. Vallée (2025). Measurement and effects of bank exit policies. *Journal of Financial Economics 172*, 104129.

Guesmi, K., P. Makrychoriti, and E. Pyrgiotakis (2025). Climate change exposure and green bonds issuance. *Journal of International Money and Finance* (103281).

Hachenberg, B. and D. Schiereck (2018). Are green bonds priced differently from conventional bonds? *Journal of Asset Management 19*(6), 371–383.

Han, J., T. Liu, and Q. Zhou (2026). Do bank green bonds deliver? Evidence from global lending and borrower emissions. *The British Accounting Review*, 101943.

Hasan, I., H. Lee, B. Qiu, and A. Saunders (2026). Climate-related disclosure commitment of the lenders, credit rationing, and borrower environmental performance. *Review of Accounting Studies 31*(1), 74–117.

Ivanov, I. T., M. S. Kruttli, and S. W. Watugala (2024). Banking on carbon: Corporate lending and cap-and-trade policy. *Review of Financial Studies 37*, 1640–1684.

Ivashina, V. (2009). Asymmetric information effects on loan spreads. *Journal of Financial Economics 92*(2), 300–319.

Javadi, S. and A. Al Masum (2021). The impact of climate change on the cost of bank loans. *Journal of Corporate Finance*, 102019.

Kacperczyk, M. T. and J.-L. Peydró (2026). Carbon emissions and the bank-lending channel. *Review of Financial Studies*, 1–41.

Karpf, A. and A. Mandel (2018). The changing value of the 'green'label on the us municipal bond market. *Nature Climate Change 8*(2), 161–165.

Kim, S., N. Kumar, J. Lee, and J. Oh (2025). ESG lending. *Journal of Financial Economics 173*, 104150.

Lam, P. and J. Wurgler (2024). Green bonds: new label, same projects. NBER Working Paper 32960, National Bureau of Economic Research.

Larcker, D. F. and E. M. Watts (2020). Where's the greenium? *Journal of Accounting and Economics 69*(2-3), 101312.

MacAskill, S., E. Roca, B. Liu, R. A. Stewart, and O. Sahin (2021). Is there a green premium in the green bond market? systematic literature review revealing premium determinants. *Journal of Cleaner Production 280*, 124491.

Marqués-Ibáñez, D., P. Sastry, and E. Verner (2026). Business as usual: Bank net zero targets, lending, and engagement. Working paper, SSRN.

Martini, F., Z. Sautner, S. Steffen, and C. Theunisz (2026). Climate transition risks of banks: Evidence from syndicated loan books. Working paper, SSRN.

Mueller, I. and E. Sfrappini (2025). Climate change-related regulatory risks and bank lending. *Journal of International Economics 158*, 104156.

Pyrgiotakis, E., P. Sette, and J. D. Varez (2026). The carbon footprint of green bonds: Evidence from project-level data. Working paper, SSRN.

Reghezza, A., Y. Altunbas, D. Marqués-Ibáñez, C. R. d'Acri, and M. Spaggiari (2022). Do banks fuel climate change? *Journal of Financial Stability 62*, 101049.

Sangiorgi, I. and L. Schopohl (2023). Explaining green bond issuance using survey evidence: Beyond the greenium. *The British Accounting Review 55*(1), 101071.

Sun, L. and S. Abraham (2021). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics 225*(2), 175–199.

Tang, D. Y. and Y. Zhang (2020). Do shareholders benefit from green bonds? *Journal of Corporate Finance 61*, 101427.

Wing, C., M. Yozwiak, A. Hollingsworth, S. Freedman, and K. Simon (2024). Designing difference-in-difference studies with staggered treatment adoption: Key concepts and practical guidelines. *Annual Review of Public Health 45*, 485–505.

Wu, Y. (2022). Are green bonds priced lower than their conventional peers? *Emerging Markets Review 52*, 100909.

Zerbib, O. D. (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds. *Journal of Banking and Finance 98*, 39–60.

Figure 1. Green Bond Issuance over Time

This figure shows the annual number and total issuance volume of green bonds issued by the 45 banks in our final sample from 2012 to 2022. Bars show the number of green bonds issued each year (left y-axis), and the dashed line shows their aggregate issuance volume in billion of U.S. dollars (right y-axis). Issuance volume is measured by the total face value of bonds at issuance.

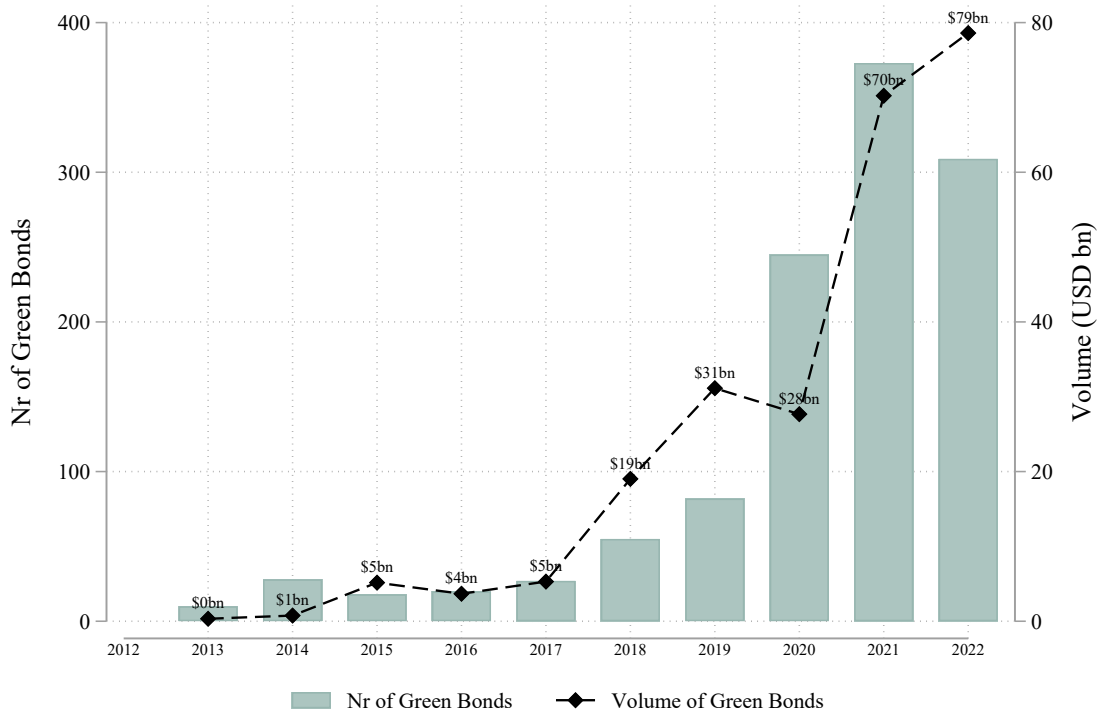


Figure 2. Green Bond Issuance by Country

This figure shows the distribution of green bond issuance across countries for the 45 banks in our final sample. Bars show the total number of green bonds issued by banks headquartered in Europe. Although our sample consists of European banking groups, some bonds are issued by their foreign subsidiaries, explaining the presence of non-European countries in the figure. Countries are ranked in descending order of the number of green bonds issued.

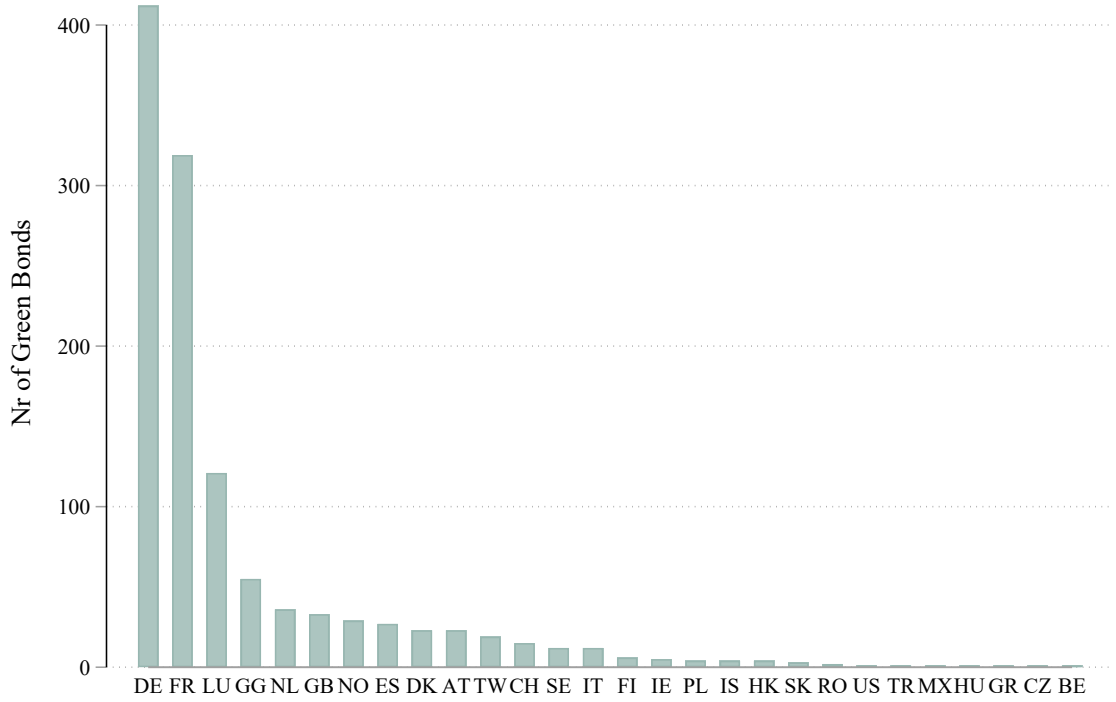


Figure 3. Sustainability-Related Loans over Time

This figure shows the annual number and total volume of sustainability-related loans (SRLs) issued by year in our final sample. Missing years (2012-2015) have zero issues. Bars show the number of SRLs issued each year (left y-axis), and the dashed line shows their aggregate volume in billions of U.S. dollars (right y-axis). Loan volume is measured by the tranche amount at issuance.

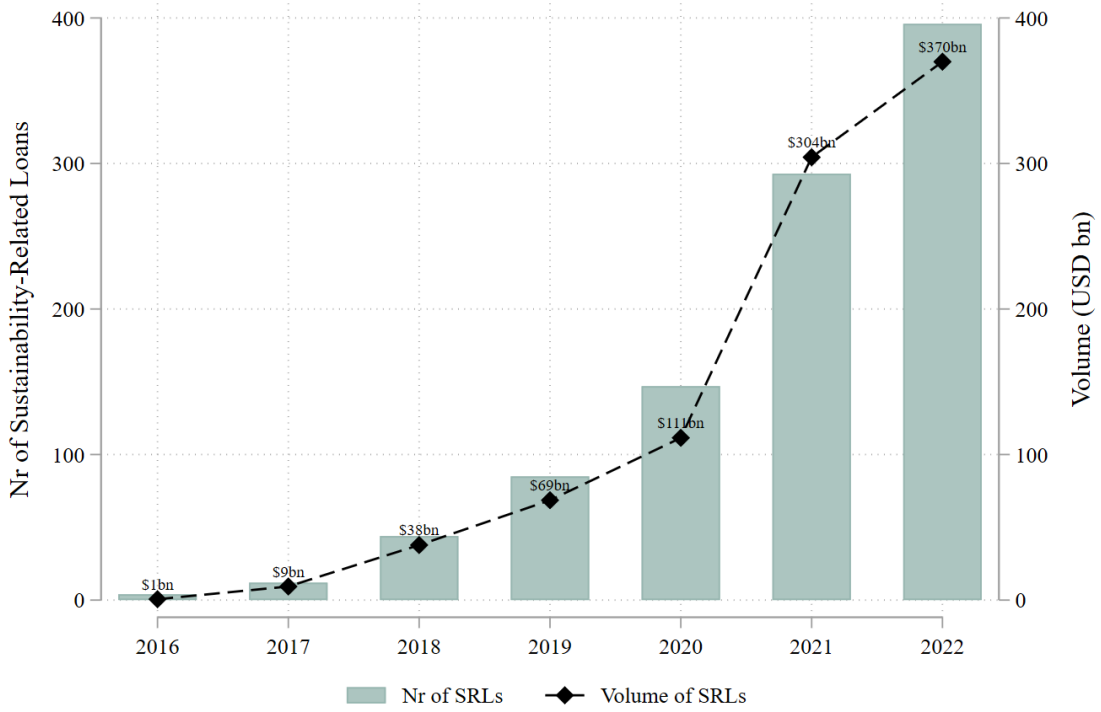


Figure 4. Sustainability-Related Loans by Region

This figure shows the distribution of sustainability-related loans (SRLs) across regions in our final sample. Bars show the total number of SRLs (left y-axis), and the dashed line shows their aggregate volume in billions of U.S. dollars (right y-axis). Loan volume is measured by the total tranche amount at issuance. Regions are ranked in descending order of their number of SRLs issued.

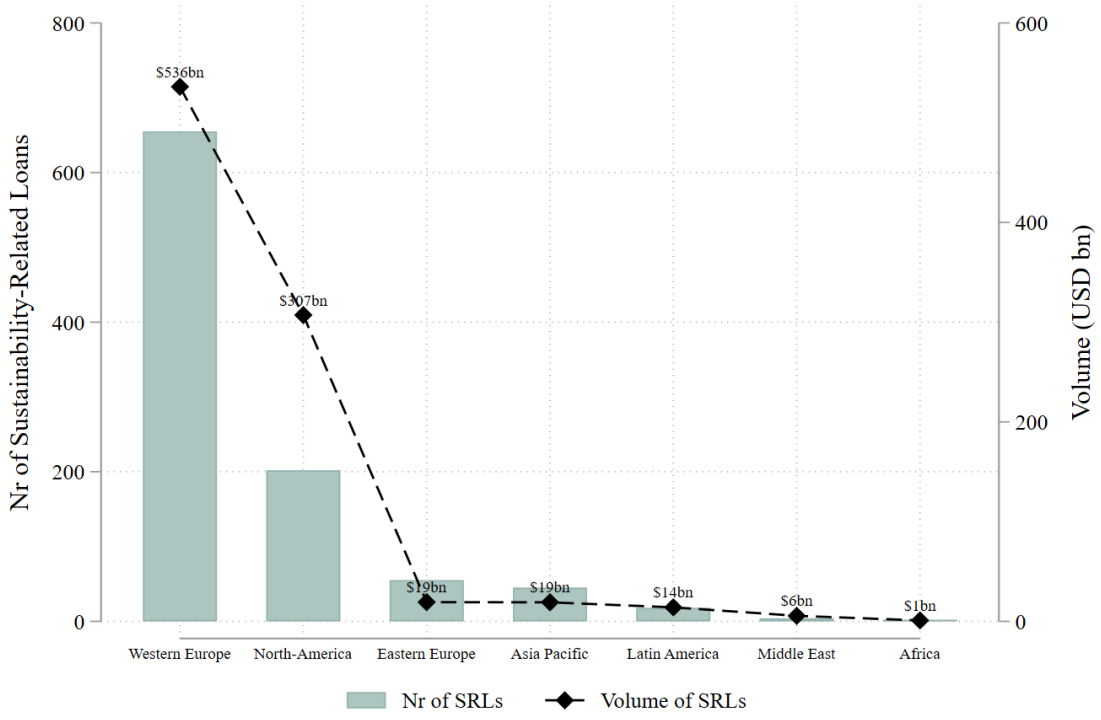


Figure 5. Sustainability-Related Lending around First Green Bond Issuance

This figure shows the evolution of sustainability-related loans (SRLs) in the five years before and after banks' first green bond issuance. The lines show the average percentage change in the share of SRLs in banks' syndicated loan portfolios, measured by the number of loans (in blue) and committed lending volume (in sand). Committed lending volume is calculated using the original lender allocation shares reported in DealScan multiplied by the corresponding tranche amounts. To construct the figure, banks are stacked by their first green bond issuance date, and portfolio shares are calculated at the bank-year level and normalized by their value in the year preceding issuance. Banks with no SRL lending the reference year are excluded because percentage changes cannot be calculated relative to a zero baseline. Shaded areas represent 95% confidence intervals. The vertical dashed line indicates the year of first green bond issuance.

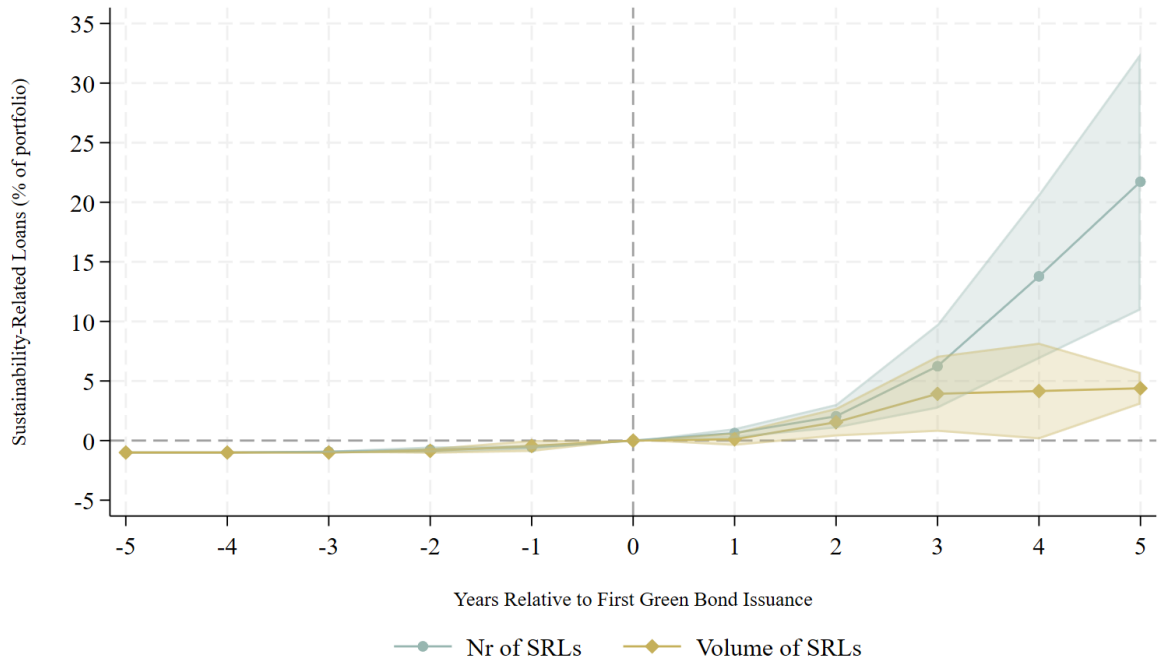


Figure 6. Green Bond Holdings and Outstanding Volume over Time

This figure shows the evolution of green bonds outstanding for the 45 banks in our final sample from 2012 to 2022. The solid line reports the average share of green bonds in banks' total outstanding bond volume (left y-axis), and the dashed line shows the aggregate volume of green bonds outstanding in billions of U.S. dollars (right y-axis). The green bond ratio is calculated for each bank as the face value of outstanding green bonds divided by the face value of all outstanding bonds (conventional + green), expressed as a percentage, and averaged across banks. Outstanding amounts are constructed from bond issuance and maturity dates, with each bond's face value held constant over its lifetime. Bonds denominated in foreign currencies are converted into U.S. dollars at issuance, avoiding changes in outstanding amounts driven by subsequent exchange rate fluctuations. Both measures are constructed at the quarterly level using monthly observations. The aggregate volume of green bonds outstanding is obtained by summing outstanding amounts across banks.

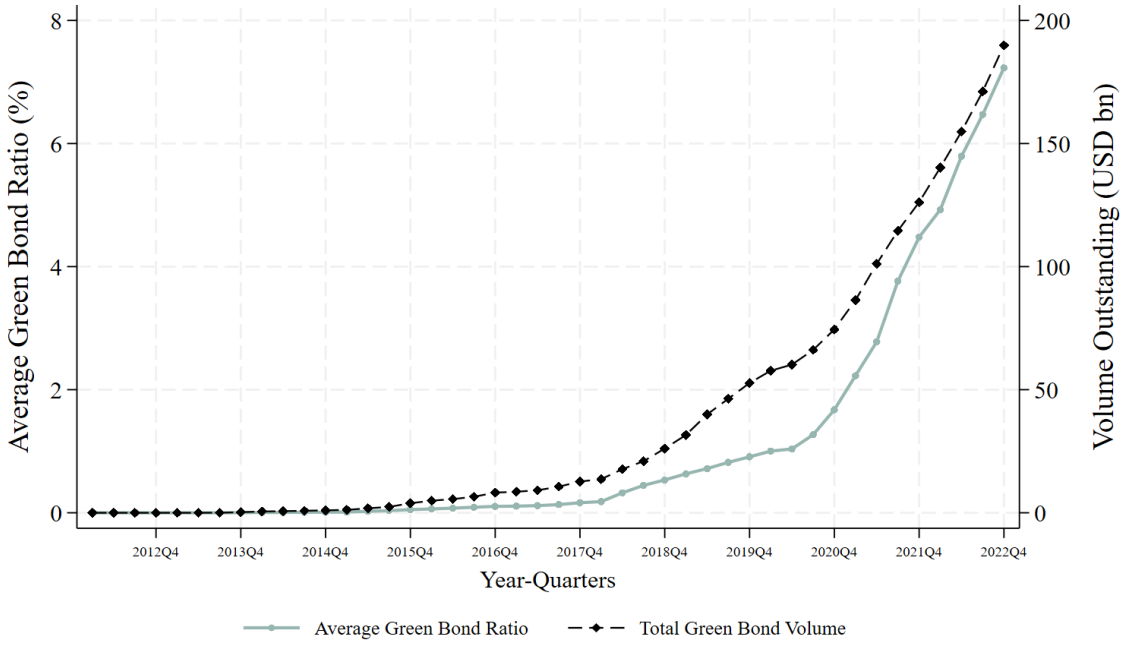
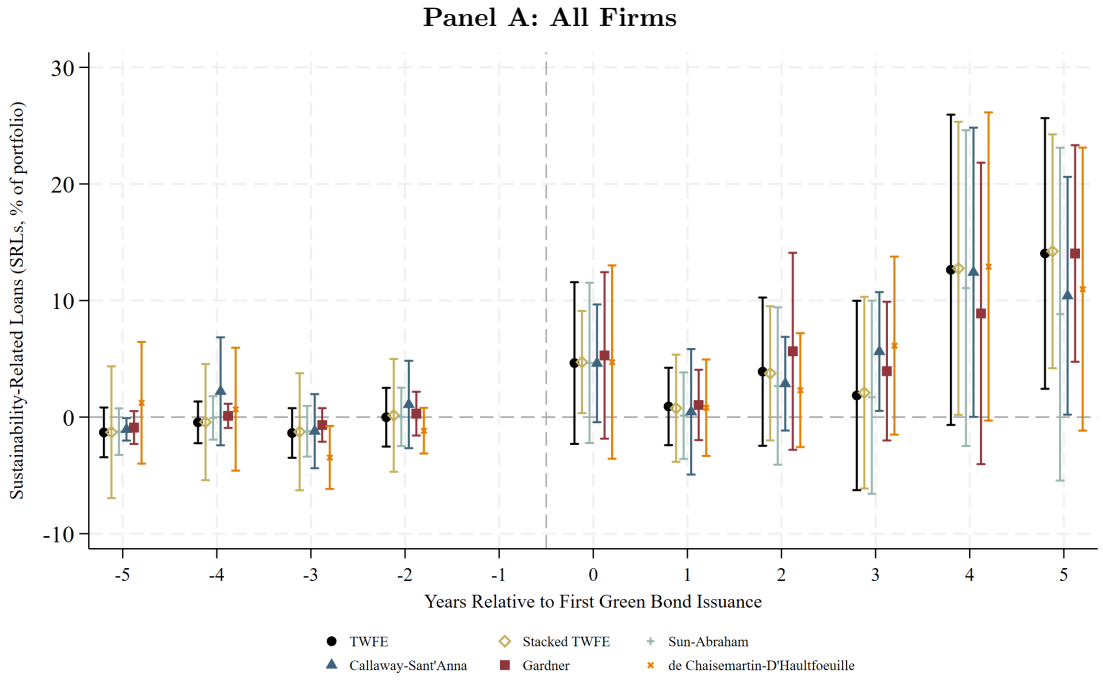
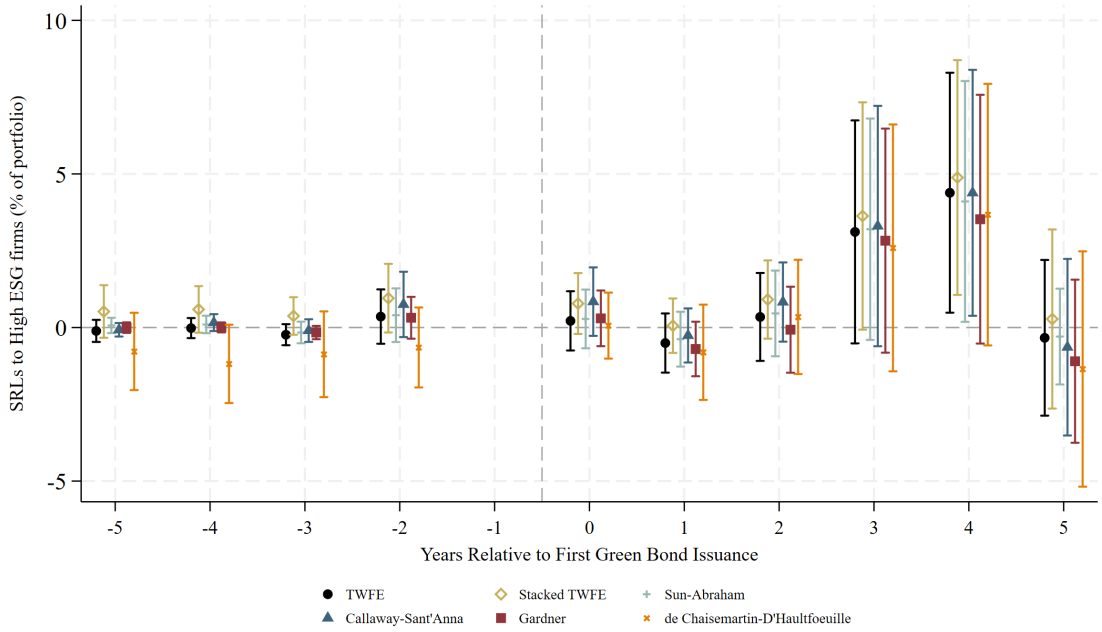


Figure 7. Sustainability-Related Lending: Staggered DiD Estimates

This figure reports dynamic difference-in-differences estimates of the effect of banks' first green bond issuance on sustainability-related lending (SRL). The dependent variable is the number of SRLs as a percentage of banks' syndicated loan portfolios. Panel A includes all borrowers, regardless of ESG rating availability, while Panels B and C separately consider SRLs to high- and low-ESG borrowers, respectively. Treatment begins in the year in which a bank first issues a green bond and is absorbing thereafter. Event-time coefficients are reported for the five years before and after issuance, with the year preceding first green bond issuance omitted as the reference period. All specifications include bank and year fixed effects. We report the conventional two-way fixed effects (TWFE) event-study estimator together with five estimators designed to accommodate heterogeneous treatment effects under staggered adoption: stacked TWFE, Sun and Abraham (2021), Callaway and Sant'Anna (2021), Gardner (2022), and de Chaisemartin and D'Haultfoeuille (2020). Stacked TWFE constructs cohort-specific sub-experiments using never- and not-yet-treated controls and stacks these sub-experiments prior to estimation. Sun and Abraham (2021) estimate cohort-by-event-time effects and aggregate them across treatment cohorts, using never-treated banks as controls. Callaway and Sant'Anna (2021) estimate group-time average treatment effects relative to never-treated banks and aggregate these effects by event time. Gardner (2022) uses a two-stage procedure in which bank and year effects are estimated using untreated observations before treatment effects are estimated in the full sample; both never-treated and not-yet-treated banks contribute to the control group. de Chaisemartin and D'Haultfoeuille (2020) construct treatment effects from changes among switching units relative to units whose treatment status does not change, using never-treated and not-yet-treated as controls. Standard errors are clustered at the bank level for all estimators except Callaway and Sant'Anna (2021), for which confidence intervals are constructed using the wild bootstrap in line with suggested best practices. Vertical bars denote 95% confidence intervals.



Panel B: High-ESG Firms



Panel C: Low-ESG Firms

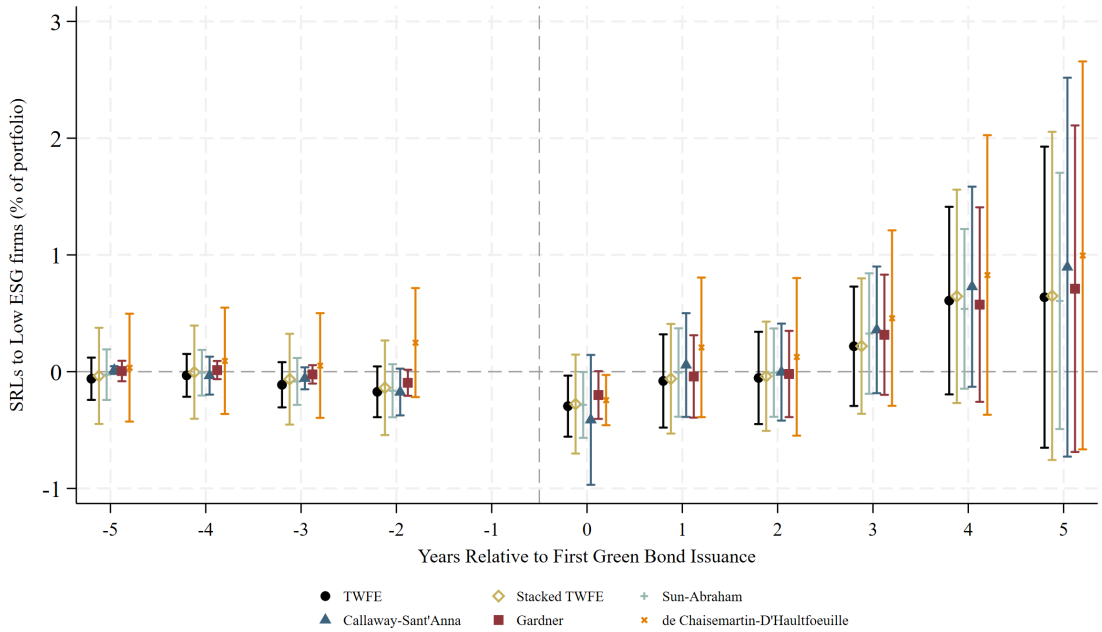
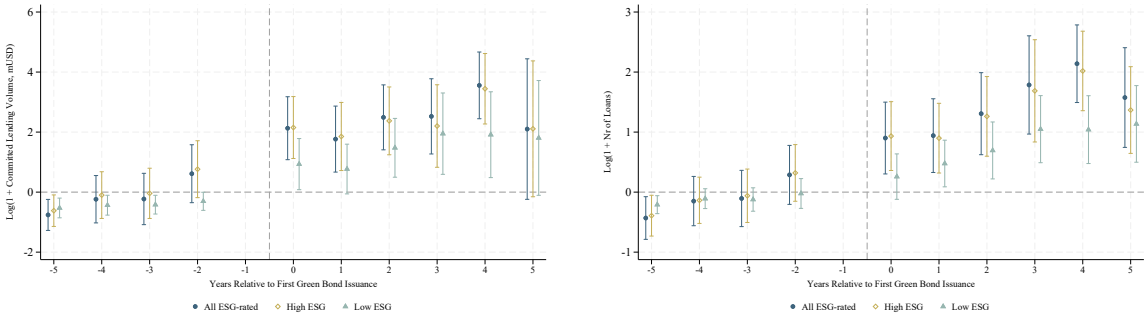


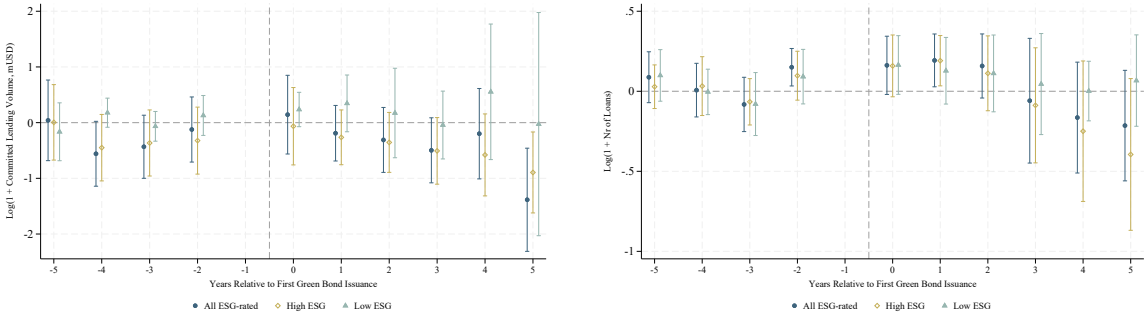
Figure 8. Aggregate Portfolio Adjustments by Loan and Borrower Type

This figure reports dynamic difference-in-differences estimates of the effect of a bank's first green bond issuance on syndicated lending at the bank-year level by borrower's environmental performance. The dependent variables are the log of one plus committed lending volume and the number of loans, reported in the first and second columns, respectively. Panels A and B separately consider sustainability-related loans and conventional loans, while Panel C considers all loans. Treatment begins in the year in which a bank first issues a green bond and is absorbing thereafter. Event-time coefficients are reported for the five years before and after issuance, with the year preceding first green bond issuance omitted as the reference period. All specifications are estimated using two-way fixed effects, including bank and year fixed effects. Standard errors are clustered at the bank level and reported with 95% confidence intervals.

Panel A: Sustainability-Related Lending



Panel B: Conventional Lending



Panel C: Total Lending

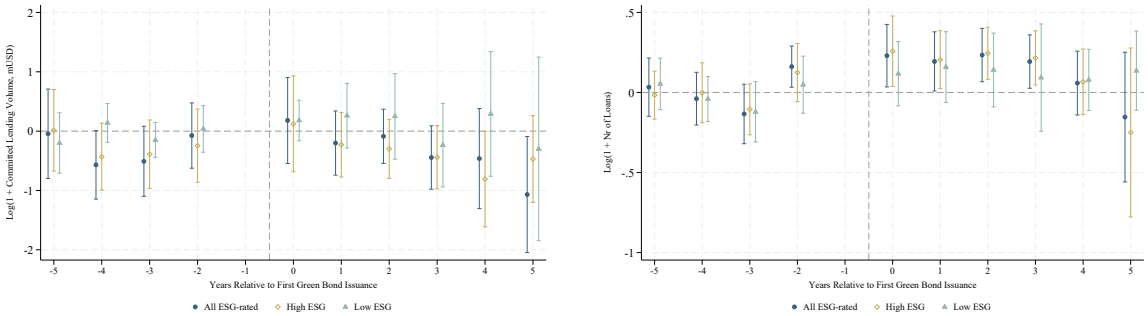


Table 1. First Green Bond: Loan Contracting and Borrower Selection

This table reports results of Eq.(1). Panel A defines green firms using ESG ratings, Panel B using E ratings, and Panel C using CO2 intensity. The dependent variables are: $\mathbb{1}(Refinancing)_{l,f,b,t}$ equals one if the loan refinances an existing loan, and zero if it is a new loan; $\mathbb{1}(SRL)_{l,f,b,t}$ equals one if an existing client receives a sustainability-related loan; $\mathbb{1}(Entry)_{l,f,b,t}$ equals one if the loan is granted to a new client, and zero if it is granted to an existing borrower; $\mathbb{1}(SRL|Entry)_{l,f,b,t}$ equals one if a new client receives a sustainability-related loan. $Green\,Bond_{b,t}$ equals one for the five years after a bank's first green bond issue and zero before issuance, assigned at the calendar-day level. $High\,ESG_{f,t}$ equals one for borrowers with an ESG-score $\geq B+$. $High\,E_{f,t}$ equals one for borrowers with an E-score $\geq B+$. $Low\,CO2_{f,t}$ equals one for borrowers with Scope 1 + 2 emission intensity below their industry-year average. Loan and bank controls include lead bank dummies, log total assets, leverage and ROA (one-year lagged). All regressions include bank, year-quarter, and industry-by-year-quarter fixed effects. The row $\hat{\beta}_1 + \hat{\beta}_2$ reports the combined effect of green bond issuance for greener borrowers. Variables are defined in Appendix Table A1. Summary statistics are reported in Table IA.1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

	Existing Relationships		New Borrowers	
Dep. var.:	$\mathbb{1}(Refinancing)_{l,f,b,t}$	$\mathbb{1}(SRL)_{l,f,b,t}$	$\mathbb{1}(Entry)_{l,f,b,t}$	$\mathbb{1}(SRL\|Entry)_{l,f,b,t}$
	(1)	(2)	(3)	(4)
Panel A: Lending to High ESG Borrowers				
$Green\,Bond_{b,t} \times High\,ESG_{f,t}$	-.017	.066***	-.020	.088***
	(.023)	(.012)	(.013)	(.028)
$Green\,Bond_{b,t}$	.018	-.055***	-.011	-.037*
	(.020)	(.012)	(.011)	(.019)
$High\,ESG_{f,t}$	-.037**	.018***	-.025	-.000
	(.014)	(.005)	(.018)	(.007)
Loan and bank controls	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓
Observations	26,559	26,559	30,807	5,316
$Adj.R^2$	.561	.659	.224	.684
$\hat{\beta}1 + \hat{\beta}2$	.001	.011**	-.031***	.050***
Mean Y	.465	.068	.198	.053
Panel B: Lending to High E Borrowers				
$Green\,Bond_{b,t} \times High\,E_{f,t}$	-.011	.049***	-.002	.091***
	(.020)	(.010)	(.013)	(.030)
$Green\,Bond_{b,t}$	.012	-.037***	-.025**	-.031*
	(.021)	(.010)	(.011)	(.017)
$High\,E_{f,t}$	-.052***	.014***	-.038**	.010
	(.013)	(.003)	(.014)	(.008)
Loan and bank controls	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓
Observations	26,559	26,559	30,807	5,316
$Adj.R^2$	.562	.657	.225	.686
$\hat{\beta}1 + \hat{\beta}2$	.001	.012**	-.027***	.060***
Mean Y	.465	.068	.198	.053
Panel C: Lending to Low CO2 Intensity Borrowers				
$Green\,Bond_{b,t} \times Low\,CO2_{f,t}$	-.012	.013	-.003	.030**
	(.019)	(.011)	(.009)	(.012)
$Green\,Bond_{b,t}$	.001	-.012	-.015	-.011
	(.015)	(.009)	(.010)	(.011)
$Low\,CO2_{f,t}$	-.008	.006**	.004	.006
	(.012)	(.002)	(.006)	(.005)
Loan and bank controls	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓
Observations	27,511	27,511	30,900	4,446
$Adj.R^2$	.563	.618	.244	.606
$\hat{\beta}1 + \hat{\beta}2$	-.011	.001	-.018**	.020
Mean Y	.496	.059	.169	.028

Table 2. First Green Bond: Committed Loan Shares

This table reports results of Eq.(1), distinguishing between sustainability-related loans (SRLs) and conventional loans. Columns 1 & 4 define green firms using ESG ratings, 2 & 5 using E ratings, and 3 & 6 using CO2 intensity. $Loan\,Share_{l,f,b,t}$ is the loan share of bank b in loan l to firm f, which is an existing client, at time t, and $(Loan\,Share|Entry)_{l,f,b,t}$ is the loan share of bank b in loan l to firm f, which is a new client, at time t. $Green\,Bond_{b,t}$ equals one for the five years after a bank's first green bond issue and zero before issuance, assigned at the calendar-day level. $High\,ESG_{f,t}$ equals one for borrowers with an ESG-score ≥ $B+$. $High\,E_{f,t}$ equals one for borrowers with an E-score ≥ $B+$. $Low\,CO2_{f,t}$ equals one for borrowers with Scope 1 + 2 emission intensity below their industry-year average. Loan and bank controls include number of lenders, lead bank dummies, log total assets, leverage and ROA (one-year lagged). All regressions include bank, year-quarter, and industry-by-year-quarter fixed effects. All single and cross-interaction effects are included in regressions but not all are reported for brevity. Variables are defined in Appendix Table A1. Summary statistics are reported in Table IA.1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

	Existing Relationships			New Borrowers		
Dep. var.:	$Loan\,Share_{l,f,b,t}$			$(Loan\,Share\|Entry)_{l,f,b,t}$		
Green Firm Definition:	High ESG	High E	Low CO_2	High ESG	High E	Low CO_2
	(1)	(2)	(3)	(4)	(5)	(6)
$Green\,Bond_{b,t} \times Green\,Firm_{f,t} \times SRL_{l,f,b,t}$	-.103	-.079	-.131*	-.046*	-.044**	-.019
	(.062)	(.059)	(.073)	(.023)	(.020)	(.020)
$Green\,Bond_{b,t} \times Green\,Firm_{f,t}$	.017	.007	-.000	.030**	.014	.002
	(.011)	(.014)	(.007)	(.014)	(.021)	(.010)
$Green\,Bond \times SRL_{l,f,b,t}$	.077	.057	.035	(.)	(.)	(.)
	(.064)	(.061)	(.044)			
$Green\,Bond_{b,t}$	-.003	.005	.007	-.020	-.006	.002
	(.011)	(.014)	(.007)	(.020)	(.027)	(.010)
$Green\,Firm_{f,t}$	-.000	-.017*	.002	-.054**	-.028*	-.003
	(.010)	(.009)	(.007)	(.024)	(.015)	(.008)
Loan and bank controls	✓	✓	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓	✓	✓
Observations	4,342	4,342	4,406	1,189	1,189	1,043
$Adj.R^2$	.623	.623	.595	.686	.681	.594
$\hat{\beta}_1 + \hat{\beta}_2 + \hat{\beta}_3 + \hat{\beta}_4$	-.013	-.010	-.089*	-.036**	-.036**	-.015
Mean Y	.087	.087	.080	.092	.092	.075

Table 3. Green Bond Certification: Loan Contracting and Borrower Selection

This table reports results of Eq.(1) using subsamples of certified and CBI-aligned green bonds. The dependent variables are: $\mathbb{1}(Refinancing)_{l,f,b,t}$ equals one if the loan refinances an existing loan, and zero if it is a new loan; $\mathbb{1}(SRL)_{l,f,b,t}$ equals one if an existing client receives a sustainability-related loan; $\mathbb{1}(Entry)_{l,f,b,t}$ equals one if the loan is granted to a new client, and zero if it is granted to an existing borrower; $\mathbb{1}(SRL|Entry)_{l,f,b,t}$ equals one if a new client receives a sustainability-related loan. $Green\,Bond_{b,t}$ equals one for the five years after a bank's first green bond issue and zero before issuance, assigned at the calendar-day level. $High\,ESG_{f,t}$ equals one for borrowers with an ESG-score $\geq B+$. Loan and bank controls include lead bank dummies, log total assets, leverage and ROA (one-year lagged). All regressions include bank, year-quarter, and industry-by-year-quarter fixed effects. Variables are defined in Appendix Table A1. Summary statistics are reported in Table IA.1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

	Existing Relationships		New Borrowers	
Dep. var.:	$\mathbb{1}(Refinancing)_{l,f,b,t}$	$\mathbb{1}(SRL)_{l,f,b,t}$	$\mathbb{1}(Entry)_{l,f,b,t}$	$\mathbb{1}(SRL\|Entry)_{l,f,b,t}$
	(1)	(2)	(3)	(4)
Panel A: Third-Party Certified Green Bond Issuers				
$Green\,Bond_{b,t} \times High\,ESG_{f,t}$	-.083*	.065*	.035	.194*
	(.034)	(.022)	(.021)	(.074)
$Green\,Bond_{b,t}$	.011	-.049	-.026	-.088**
	(.055)	(.026)	(.030)	(.026)
$High\,ESG_{f,t}$	.023	.008	-.060**	-.017
	(.016)	(.007)	(.011)	(.024)
Loan and bank controls	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓
Observations	5,953	5,953	6,639	571
$Adj.R^2$	.555	.617	.166	.319
Panel B: CBI-Aligned Green Bond Issuers				
$Green\,Bond_{b,t} \times High\,ESG_{f,t}$	-.012	.074***	-.017	.061*
	(.023)	(.019)	(.017)	(.035)
$Green\,Bond_{b,t}$	.030	-.066**	-.001	-.027
	(.018)	(.024)	(.016)	(.031)
$High\,ESG_{f,t}$	-.030**	.017***	-.038	.003
	(.012)	(.006)	(.033)	(.009)
Loan and bank controls	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓
Observations	15,417	15,417	18,256	3,197
$Adj.R^2$	.584	.683	.215	.739

Table 4. Seasoned Green Bonds: Loan Contracting and Borrower Selection

This table reports results of Eq.(2). Panel A defines green firms using ESG ratings, Panel B using E ratings, and Panel C using CO2 intensity. The dependent variables are: $\mathbb{1}(Refinancing)_{l,f,b,t}$ equals one if the loan refinances an existing loan, and zero if it is a new loan; $\mathbb{1}(SRL)_{l,f,b,t}$ equals one if an existing client receives a sustainability-related loan; $\mathbb{1}(Entry)_{l,f,b,t}$ equals one if the loan is granted to a new client, and zero if it is granted to an existing borrower; $\mathbb{1}(SRL|Entry)_{l,f,b,t}$ equals one if a new client receives a sustainability-related loan. $Green\,Bond\,Ratio_{b,t}$ measures the percentage of the bank's outstanding bond volume issued as green bonds at the year-quarter level. $First\,Green\,Issuance_{b,t}$ is an indicator that is one in the six months after the first green bond issuance, and zero otherwise. Loan and bank controls include lead bank dummies, log total assets, leverage and ROA (one-year lagged). All regressions include bank, year-quarter, and industry-by-year-quarter fixed effects. Variables are defined in Appendix Table A1. Summary statistics are reported in Table IA.1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

	Existing Relationships		New Borrowers	
Dep. var.:	$\mathbb{1}(Refinancing)_{l,f,b,t}$	$\mathbb{1}(SRL)_{l,f,b,t}$	$\mathbb{1}(Entry)_{l,f,b,t}$	$\mathbb{1}(SRL\|Entry)_{l,f,b,t}$
	(1)	(2)	(3)	(4)
Panel A: Lending to High ESG Borrowers				
$Green\,Bond\,Ratio_{b,t} \times High\,ESG_{f,t}$	.004	.023***	-.001	.028***
	(.006)	(.006)	(.003)	(.009)
$Green\,Bond\,Ratio_{b,t}$	-.007	-.015***	-.003	-.014*
	(.004)	(.004)	(.003)	(.008)
$High\,ESG_{f,t}$	-.044***	.042***	-.033**	.016
	(.011)	(.005)	(.016)	(.013)
$First\,Green\,Issuance_{b,t}$	.012	-.009**	-.008	.016
	(.013)	(.004)	(.009)	(.012)
Loan and bank controls	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓
Observations	28,450	28,450	32,984	5,563
$Adj.R^2$	.559	.641	.223	.668
$\hat{\beta}1 + \hat{\beta}2$	-.003	.009**	-.003	.014**
Mean Y	.460	.080	.194	.063
Panel B: Lending to High E Borrowers				
$Green\,Bond\,Ratio_{b,t} \times High\,E_{f,t}$	.012	.010	.003	.015
	(.007)	(.009)	(.004)	(.016)
$Green\,Bond\,Ratio_{b,t}$	-.011*	-.004	-.005	-.005
	(.006)	(.004)	(.003)	(.008)
$High\,E_{f,t}$	-.061***	.038***	-.039***	.031**
	(.013)	(.005)	(.011)	(.014)
$First\,Green\,Issuance_{b,t}$	.011	-.009**	-.009	.018
	(.013)	(.004)	(.009)	(.013)
Loan and bank controls	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓
Observations	28,450	28,450	32,984	5,563
$Adj.R^2$	.559	.638	.223	.667
$\hat{\beta}1 + \hat{\beta}2$	.001	.005	-.002	.010
Mean Y	.460	.080	.194	.063
Panel C: Lending to Low CO2 Intensity Borrowers				
$Green\,Bond\,Ratio_{b,t} \times Low\,CO2_{f,t}$	-.008	.001	.003	.022**
	(.005)	(.006)	(.003)	(.009)
$Green\,Bond\,Ratio_{b,t}$	-.002	.005	-.010***	-.011
	(.003)	(.004)	(.003)	(.008)
$Low\,CO2_{f,t}$	-.006	.010**	.001	.009
	(.013)	(.005)	(.004)	(.006)
$First\,Green\,Issuance_{b,t}$	.002	-.006	-.003	.031*
	(.012)	(.004)	(.008)	(.017)
Loan and bank controls	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓
Observations	29,311	29,311	32,901	4,592
$Adj.R^2$	.562	.606	.243	.611
$\hat{\beta}1 + \hat{\beta}2$	-.010**	.006	-.007	.011
Mean Y	.491	.070	.165	.035

Table 5. Seasoned Green Bonds: Committed Loan Shares

This table reports results of Eq.(2), distinguishing between sustainability-related loans (SRLs) and conventional loans. Columns 1 & 4 define green firms using ESG ratings, 2 & 5 using E ratings, and 3 & 6 using CO2 intensity. $Loan\,Share_{l,f,b,t}$ is the loan share of bank b in loan l to firm f, which is an existing client, at time t, and $(Loan\,Share|Entry)_{l,f,b,t}$ is the loan share of bank b in loan l to firm f, which is a new client, at time t. $Green\,Bond\,Ratio_{b,t}$ measures the percentage of the bank's outstanding bond volume issued as green bonds at the year-quarter level. $First\,Green\,Issuance_{b,t}$ includes first green-labeled bond issue fixed effects. $High\,ESG_{f,t}$ equals one for borrowers with an ESG-score ≥ $B+$. $High\,E_{f,t}$ equals one for borrowers with an E-score ≥ $B+$. $Low\,CO2_{f,t}$ equals one for borrowers with Scope 1 + 2 emission intensity below their industry-year average. Loan and bank controls include number of lenders, lead bank dummies, log total assets, leverage and ROA (one-year lagged). All regressions include bank, year-quarter, and industry-by-year-quarter fixed effects. All single and cross-interaction effects are included in regressions but not all are reported for brevity. Variables are defined in Appendix Table A1. Summary statistics are reported in Table IA.1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

	Existing Relationships			New Borrowers		
Dep. var.:	$Loan\,Share_{l,f,b,t}$			$(Loan\,Share \mid Entry)_{l,f,b,t}$		
Green Firm Definition:	High ESG	High E	Low CO_2	High ESG	High E	Low CO_2
	(1)	(2)	(3)	(4)	(5)	(6)
$Green\,Bond\,Ratio_{b,t} \times Green\,Firm_{f,t} \times SRL_{l,f,b,t}$	.001	.013	-.008	-.016***	-.017***	-.037*
	(.011)	(.012)	(.008)	(.003)	(.005)	(.020)
$Green\,Bond\,Ratio_{b,t} \times Green\,Firm_{f,t}$	-.011**	-.014*	.011**	.002	.002	.009
	(.005)	(.008)	(.004)	(.004)	(.004)	(.010)
$Green\,Bond\,Ratio_{b,t} \times SRL_{l,f,b,t}$	.013	.004	.018***	.009**	.010*	.022***
	(.011)	(.009)	(.006)	(.004)	(.005)	(.007)
$Green\,Bond\,Ratio_{b,t}$	.006	.008	-.012***	-.000	.000	.000
	(.004)	(.007)	(.004)	(.004)	(.005)	(.003)
$Green\,Firm_{f,t}$	.003	-.015*	.001	-.049*	-.026*	-.004
	(.010)	(.008)	(.007)	(.024)	(.015)	(.008)
$First\,Green\,Issuance_{b,t}$	.011*	.011*	.001	.018	.017	.015
	(.006)	(.006)	(.005)	(.020)	(.020)	(.016)
Loan and bank controls	✓	✓	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓	✓	✓
Observations	4,504	4,504	4,569	1,221	1,221	1,062
$Adj.R^2$	.633	.634	.630	.712	.708	.602
$\hat{\beta}_1 + \hat{\beta}_2 + \hat{\beta}_3 + \hat{\beta}_4$	.010	.011	.008	-.005**	-.005*	-.005
Mean Y	.087	.087	.080	.094	.094	.076

Table 6. Green Bond Issuers *vs.* Never-treated Banks

This table reports results of Eq.(3) at the bank-year level. The dependent variable is either the number or volume of sustainability-related loans (SRLs) as a share of bank b loan portfolio in year y, expressed in decimals. $Green\,Bond\,Issuer_b$ equals one for a bank that will or has issued its first green bond. Panel A includes the five years after the first green bond issuance year. Panel B includes the six years prior to and including the first green bond issuance year. Across the different columns, regressions include year and lender country fixed effects. In SRL volume specifications, we additionally control for the loan book size in logs. Variables are defined in Appendix Table A1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

Dep. var.:	$SRL\,Portfolio\,Nr_{b,y}$			$SRL\,Portfolio\,Volume_{b,y}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: [+1,+5] Years After First Green Bond Issuance						
$Green\,Bond\,Issuer_b$	.114***	.046***	.030***	.122**	.028	.015
	(.024)	(.005)	(.006)	(.043)	(.019)	(.016)
$Log\,Total\,Credit_{b,y}$				-.003	-.002	-.001
				(.003)	(.003)	(.003)
Year fixed effects		✓	✓		✓	✓
Country fixed effects			✓			✓
Observations	5,492	5,492	5,477	2,395	2,395	2,379
$Adj.R^2$	.010	.194	.198	.013	.234	.244
Panel B: [-5,0] Years Before First Green Bond Issuance						
$Green\,Bond\,Issuer_b$	-.017	.009	.008	-.011	.017	.019
	(.017)	(.007)	(.008)	(.015)	(.010)	(.011)
$Log\,Total\,Credit_{b,y}$				-.001	-.000	.000
				(.002)	(.002)	(.002)
Year fixed effects		✓	✓		✓	✓
Country fixed effects			✓			✓
Observations	6,611	6,611	6,594	3,036	3,036	3,020
$Adj.R^2$	.000	.187	.191	-.000	.224	.229

Table 7. Green Bond Issuers *vs.* Never-treated Banks: Demand for SRL

This table reports results of estimating Eq.(1) using the sample of green bond issuers and never-treated banks. In Panel A, the dependent variable is $\mathbb{1}(SRL)_{l,f,b,t}$ which equals one if an existing client receives a sustainability-related loan. In Panel B, $\mathbb{1}(SRL|Entry)_{l,f,b,t}$ equals one if a new client receives a sustainability-related loan. $Green\,Bond_{b,t}$ equals one for the five years after a bank's first green bond issue and zero before issuance, assigned at the calendar-day level. $High\,ESG_{f,t}$ equals one for borrowers with an ESG-score $\geq B+$. Loan controls include lead bank dummies. If indicated, regressions include bank-by-year-quarter, industry-by-year-quarter, bank-by-borrower, bank-by-industry, firm-by-five-years fixed effects. Variables are defined in Appendix Table A1. Summary statistics are reported in Table IA.1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

Dep. var.:	$\mathbb{1}(SRL)_{l,f,b,t}$				
	(1)	(2)	(3)	(4)	(5)
Panel A: Existing Relationships and Sustainability-Related Loans					
$Green\,Bond_{b,t} \times High\,ESG_{f,t}$	.099***	.097***	.072***	.082***	.040***
	(.018)	(.016)	(.012)	(.013)	(.010)
$Green\,Bond_{b,t}$	.051***	-.052***	-.040**	-.042**	-.003
	(.011)	(.012)	(.018)	(.021)	(.020)
$High\,ESG_{f,t}$	.013***	.011***	.018***	-.167	
	(.004)	(.003)	(.005)	(.195)	
Loan controls	✓	✓	✓	✓	✓
Bank × time fixed effects		✓	✓	✓	✓
Industry × time fixed effects			✓	✓	✓
Bank × firm fixed effects				✓	✓
Firm × period fixed effects					✓
Observations	33,734	33,657	32,931	30,969	29,806
$Adj.R^2$	.080	.240	.660	.813	.861
Panel B: New Borrowers and Sustainability-Related Loans					
$Green\,Bond_{b,t} \times High\,ESG_{f,t}$	.129***	.110***	.089***	.088**	.019*
	(.023)	(.017)	(.030)	(.035)	(.010)
$Green\,Bond_{b,t}$	.063***	-.040	-.035	-.044*	-.015
	(.012)	(.044)	(.027)	(.024)	(.014)
$High\,ESG_{f,t}$	.004	.003	.003	-.002	
	(.003)	(.002)	(.004)	(.003)	
Loan controls	✓	✓	✓	✓	✓
Bank × time fixed effects		✓	✓	✓	✓
Industry × time fixed effects			✓	✓	
Bank × industry fixed effects				✓	
Firm × period fixed effects					✓
Observations	7,598	7,420	6,284	4,791	5,719
$Adj.R^2$	.110	.251	.723	.668	.901

Table 8. Environmental Effects: Emission Intensity in 3-Year Horizon

This table reports results of estimating Eq.(4) at the firm-year level. The dependent variable is the log-difference in emission intensity of firm f between loan origination year y and $y+3$. $Green\,Credit_{f,y}$ measures the loan amount received from green-bond-issuing banks divided by total amount of loans received in calendar year y. $Green\,Loan_{f,y}$ equals one if firm f received at least one sustainability-related loan in calendar year y. Columns (1)-(2) define green firms based on their ESG rating ($High\,ESG_{f,t}$ equals one for borrowers with an ESG-score ≥ B+), columns (3)-(4) based on their E rating ($High\,E_{f,t}$ equals one for borrowers with an E-score ≥ B+), and columns (5)-(6) based on their CO2 intensity ($Low\,CO2_{f,t}$ equals one for borrowers with Scope 1 + 2 emission intensity < their industry-year average). Firm controls include log total assets and ROA (one-year lagged). All regressions include firm and year fixed effects. Variables are defined in Appendix Table A1. Summary statistics are reported in Table IA.1. Firm-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

Dep. var.:	$\Delta Emission\,Intensity_{f,y}$					
Green Firm Definition:	$High\,ESG_{f,y}$		$High\,E_{f,y}$		$Low\,CO2_{f,y}$	
	(1)	(2)	(3)	(4)	(5)	(6)
$Green\,Credit_{f,y} \times Green\,Firm_{f,y}$	.000	.000	-.000	.000	.001**	.001**
	(.001)	(.001)	(.001)	(.001)	(.000)	(.000)
$Green\,Credit_{f,y} \times Green\,Firm_{f,y} \times Green\,Loan_{f,y}$		-.016***		-.009**		-.010*
		(.003)		(.004)		(.006)
$Green\,Credit_{f,y} \times Green\,Loan_{f,y}$		.015***		.008**		.005
		(.001)		(.003)		(.004)
$Green\,Firm_{f,y} \times Green\,Loan_{f,y}$		.045		.045		.451
		(.304)		(.304)		(.470)
$Green\,Credit_{f,y}$	-.001	-.001	-.001	-.001	-.001**	-.001***
	(.001)	(.001)	(.001)	(.001)	(.000)	(.000)
$Green\,Firm_{f,y}$	-.111	-.112	-.235	-.238	.165***	.165***
	(.151)	(.151)	(.218)	(.218)	(.030)	(.030)
$Green\,Loan_{f,y}$		-.040		-.039		-.225
		(.077)		(.077)		(.197)
Firm controls	✓	✓	✓	✓	✓	✓
Firm fixed effects	✓	✓	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓	✓	✓
Observations	5,126	5,126	5,126	5,126	6,224	6,224
$Adj.R^2$	.186	.187	.187	.187	.205	.206
Mean Y	-.055	-.055	-.055	-.055	-.043	-.043

Internet Appendix

for

Do Green Bonds Change How Banks Lend? Evidence from Post-Issuance Credit Allocation

Internet Appendix A. Tables and Figures

Table IA.1. Summary Statistics

	Mean	SD	Min	Max	Obs.
Panel A: First green bond issuance					
$Green\,Bond_{b,t}$	0.4		0.0	1.0	42,514
$\mathbb{1}(Refinancing)_{l,f,b,t}$	0.4		0.0	1.0	42,514
$\mathbb{1}(SRL)_{l,f,b,t}$	0.1		0.0	1.0	42,514
$\mathbb{1}(Entry)_{l,f,b,t}$	0.2		0.0	1.0	39,771
$Loan\,Share_{l,f,b,t}$	0.1	0.1	0.0	1.0	7,470
$High\,ESG_{f,t}$	0.7		0.0	1.0	33,679
$High\,E_{f,t}$	0.6		0.0	1.0	33,679
$Low\,CO2_{f,t}$	0.6		0.0	1.0	33,623
$Lead\,Bank_{l,b}$	0.7		0.0	1.0	42,514
$Nr\,of\,Lenders_{l,f,t}$	14.2	10.3	1.0	78.0	42,514
$Log\,Total\,Assets_{b,t-1}$	6.8	0.8	-5.1	8.0	42,514
$Leverage_{b,t-1}$	432.4	177.8	-199.8	1,777.1	42,514
$ROA_{b,t-1}$	0.2	0.2	-2.0	1.8	42,514
Panel B: Seasoned green bond issuance					
$Green\,Bond\,Ratio_{b,t}$	0.5	1.2	0.0	20.7	45,058
$\mathbb{1}(Refinancing)_{l,f,b,t}$	0.4		0.0	1.0	45,058
$\mathbb{1}(SRL)_{l,f,b,t}$	0.1		0.0	1.0	45,058
$\mathbb{1}(Entry)_{l,f,b,t}$	0.2		0.0	1.0	42,315
$Loan\,Share_{l,f,b,t}$	0.1	0.1	0.0	1.0	7,696
$High\,ESG_{f,t}$	0.7		0.0	1.0	35,827
$High\,E_{f,t}$	0.6		0.0	1.0	35,827
$Low\,CO2_{f,t}$	0.6		0.0	1.0	35,604
$First\,Green\,Issuance_{b,t}$	0.0		0.0	1.0	45,058
$Lead\,Bank_{l,b}$	0.7		0.0	1.0	45,058
$Nr\,of\,Lenders_{l,f,t}$	14.2	10.2	1.0	78.0	45,058
$Log\,Total\,Assets_{b,t-1}$	6.9	0.8	-5.1	8.0	45,058
$Leverage_{b,t-1}$	436.1	174.5	-199.8	1,777.1	45,058
$ROA_{b,t-1}$	0.2	0.2	-2.0	1.8	45,058
Panel C: Borrowers' environmental performance					
$\Delta Emission\,Intensity_{f,y,y+3}$	-0.0	0.6	-7.9	4.4	6,224
$Green\,Credit_{f,y}$	21.4	40.1	0.0	100.0	6,224
$High\,ESG_{f,y}$	0.8		0.0	1.0	4,876
$High\,E_{f,y}$	0.6		0.0	1.0	4,876
$Low\,CO2_{f,y}$	0.6		0.0	1.0	6,224
$Green\,Loan_{f,y}$	0.0		0.0	1.0	6,224
$Log\,Total\,Assets_{f,y-1}$	9.2	1.5	2.5	12.9	6,224
$ROA_{f,y-1}$	4.2	6.3	-74.1	31.5	6,224

Table IA.2. First Green Bond: Committed Loan Shares within Loans

This table reports results of Eq.(1), distinguishing between sustainability-related loans (SRLs) and conventional loans. Columns 1 & 4 define green firms using ESG ratings, 2 & 5 using E ratings, and 3 & 6 using CO2 intensity. $Loan\,Share_{l,f,b,t}$ is the loan share of bank b in loan l to firm f, which is an existing client, at time t, and $(Loan\,Share|Entry)_{l,f,b,t}$ is the loan share of bank b in loan l to firm f, which is a new client, at time t. $Green\,Bond_{b,t}$ equals one for the five years after a bank's first green bond issue and zero before issuance, assigned at the calendar-day level. $High\,ESG_{f,t}$ equals one for borrowers with an ESG-score ≥ $B+$. $High\,E_{f,t}$ equals one for borrowers with an E-score ≥ $B+$. $Low\,CO2_{f,t}$ equals one for borrowers with Scope 1 + 2 emission intensity below their industry-year average. Loan and bank controls include lead bank dummies, log total assets, leverage and ROA (one-year lagged). All regressions include bank, year-quarter, industry-by-year-quarter fixed effects, and loan fixed effects. All single and cross-interaction effects are included in regressions but not all are reported for brevity. Variables are defined in Appendix Table A1. Summary statistics are reported in Table IA.1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

	Existing Relationships			New Borrowers		
Dep. var.:	$Loan\,Share_{l,f,b,t}$			$(Loan\,Share \mid Entry)_{l,f,b,t}$		
Green Firm Definition:	High ESG	High E	Low CO_2	High ESG	High E	Low CO_2
	(1)	(2)	(3)	(4)	(5)	(6)
$Green\,Bond_{b,t} \times Green\,Firm_{f,t} \times SRL_{l,f,b,t}$	-.084	-.071	-.072	-.038**	-.039**	(.)
	(.062)	(.059)	(.065)	(.014)	(.014)	
$Green\,Bond_{b,t} \times Green\,Firm_{f,t}$	.003	.000	.014***	-.005	-.001	.000
	(.007)	(.007)	(.004)	(.011)	(.009)	(.004)
$Green\,Bond_{b,t} \times SRL_{l,f,b,t}$	.066	.053	.056	(.)	(.)	(.)
	(.065)	(.062)	(.043)			
$Green\,Bond_{b,t}$	.004	.006	-.003	.011	.008	-.003
	(.007)	(.007)	(.004)	(.015)	(.013)	(.004)
Loan and bank controls	✓	✓	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓	✓	✓
Loan fixed effects	✓	✓	✓	✓	✓	✓
Observations	3,883	3,883	3,976	1,032	1,032	923
Adj. R^2	.731	.731	.743	.843	.843	.858
$\hat{\beta}_1 + \hat{\beta}_2 + \hat{\beta}_3 + \hat{\beta}_4$	-.012	-.012	-.006	-.032**	-.032**	-.003
Mean Y	.075	.075	.071	.081	.081	.072

Table IA.3. First Green Bond: Participant Lenders Only

This table reports results of Eq.(1) using the sample of participant lenders only. The dependent variables are: $\mathbb{1}(Refinancing)_{l,f,b,t}$ equals one if the loan refinances an existing loan, and zero if it is a new loan; $\mathbb{1}(SRL)_{l,f,b,t}$ equals one if an existing client receives a sustainability-related loan; $\mathbb{1}(Entry)_{l,f,b,t}$ equals one if the loan is granted to a new client, and zero if it is granted to an existing borrower; $\mathbb{1}(SRL|Entry)_{l,f,b,t}$ equals one if a new client receives a sustainability-related loan; $Loan\,Share_{l,f,b,t}$ is the loan share of bank b in loan l to firm f, which is an existing client, at time t; and $(Loan\,Share|Entry)_{l,f,b,t}$ is the loan share of bank b in loan l to firm f, which is a new client, at time t. $Green\,Bond_{b,t}$ equals one for the five years after a bank's first green bond issue and zero before issuance, assigned at the calendar-day level. $High\,ESG_{f,t}$ equals one for borrowers with an ESG-score $\geq B+$. Loan and bank controls include nr of lenders, log total assets, leverage and ROA (one-year lagged). All regressions include bank, year-quarter, and industry-by-year-quarter fixed effects. Loan share regressions include loan fixed effects as well. All single and cross-interaction effects are included in regressions but not all are reported for brevity. Variables are defined in Appendix Table A1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

	Existing Relationships		New Borrowers		Existing Relationships		New Borrowers	
Dep. var.:	$\mathbb{1}(Refinancing)_{l,f,b,t}$	$\mathbb{1}(SRL)_{l,f,b,t}$	$\mathbb{1}(Entry)_{l,f,b,t}$	$\mathbb{1}(SRL\|Entry)_{l,f,b,t}$	$Loan\,Share_{l,f,b,t}$		$(Loan\,Share\|Entry)_{l,f,b,t}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Green\,Bond_{b,t} \times High\,ESG_{f,t}$	.011	.022**	-.022	.072*	-.001	-.001	.008	.008
	(.041)	(.010)	(.025)	(.040)	(.006)	(.006)	(.006)	(.007)
$Green\,Bond_{b,t}$	-.019	-.019***	-.012	-.050*	.002	.003	-.008	-.007
	(.034)	(.006)	(.025)	(.026)	(.004)	(.004)	(.006)	(.006)
$High\,ESG_{f,t}$	-.054*	.016	-.034	.009				
	(.028)	(.009)	(.025)	(.009)				
$Green\,Bond_{b,t} \times High\,ESG_{f,t} \times SRL_{l,f,b,t}$						-.010		-.012
						(.009)		(.012)
Loan and bank controls	✓	✓	✓	✓	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓	✓	✓	✓	✓
Loan fixed effects					✓	✓	✓	✓
Observations	6,811	6,811	8,140	1,404	1,334	1,334	383	383
$Adj.R^2$	.646	.678	.219	.762	.683	.683	.761	.761
$\hat{\beta}1 + \hat{\beta}2$	-.008	.003	-.034**	.021	.001		-.000	
$\hat{\beta}1 + \hat{\beta}2 + \hat{\beta}4$						-.009		-.011
Mean Y	.517	.040	.227	.041	.043	.043	.048	.048

Table IA.4. Seasoned Green Bonds: Excluding First Issuance

This table reports results of Eq.(2). The dependent variables are: $\mathbb{1}(Refinancing)_{l,f,b,t}$ equals one if the loan refinances an existing loan, and zero if it is a new loan; $\mathbb{1}(SRL)_{l,f,b,t}$ equals one if an existing client receives a sustainability-related loan; $\mathbb{1}(Entry)_{l,f,b,t}$ equals one if the loan is granted to a new client, and zero if it is granted to an existing borrower; $\mathbb{1}(SRL|Entry)_{l,f,b,t}$ equals one if a new client receives a sustainability-related loan. $Subsequent\,GB\,Ratio_{b,t}$ measures the percentage of the bank's total outstanding bond volume attributable to green bonds issued after its first green bond issuance, excluding all bonds issued on the initial issuance date from the numerator. $High\,ESG_{f,t}$ equals one for borrowers with an ESG-score $\geq B+$. Loan and bank controls include lead bank dummies, log total assets, leverage and ROA (one-year lagged). All regressions include bank, year-quarter, and industry-by-year-quarter fixed effects. Variables are defined in Appendix Table A1. Summary statistics are reported in Table IA.1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

	Existing Relationships		New Borrowers	
Dep. var.:	$\mathbb{1}(Refinancing)_{l,f,b,t}$	$\mathbb{1}(SRL)_{l,f,b,t}$	$\mathbb{1}(Entry)_{l,f,b,t}$	$\mathbb{1}(SRL\|Entry)_{l,f,b,t}$
	(1)	(2)	(3)	(4)
$Subsequent\,GB\,Ratio_{b,t} \times High\,ESG_{f,t}$	.004	.022***	-.002	.031***
	(.007)	(.006)	(.003)	(.010)
$Subsequent\,GB\,Ratio_{b,t}$	-.006	-.015***	-.001	-.012
	(.005)	(.004)	(.003)	(.009)
$High\,ESG_{f,t}$	-.044***	.047***	-.033**	.018
	(.011)	(.005)	(.015)	(.014)
Loan and bank controls	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓
$Adj.R^2$	.559	.640	.223	.668
Observations	28,450	28,450	32,984	5,563
$\hat{\beta}1 + \hat{\beta}2$	-.002	.007*	-.003	.019*
Mean Y	.460	.080	.194	.063

Table IA.5. Seasoned Green Bonds: Committed Loan Shares within Loans

This table reports results of Eq.(2), distinguishing between sustainability-related loans (SRLs) and conventional loans. Columns 1 & 4 define green firms using ESG ratings, 2 & 5 using E ratings, and 3 & 6 using CO2 intensity. $Loan\,Share_{l,f,b,t}$ is the loan share of bank b in loan l to firm f, which is an existing client, at time t, and $(Loan\,Share|Entry)_{l,f,b,t}$ is the loan share of bank b in loan l to firm f, which is a new client, at time t. $Green\,Bond\,Ratio_{b,t}$ measures the percentage of the bank's outstanding bond volume issued as green bonds at the year-quarter level. $First\,Green\,Issuance_{b,t}$ includes first green-labeled bond issue fixed effects. $High\,ESG_{f,t}$ equals one for borrowers with an ESG-score ≥ $B+$. $High\,E_{f,t}$ equals one for borrowers with an E-score ≥ $B+$. $Low\,CO2_{f,t}$ equals one for borrowers with Scope 1 + 2 emission intensity below their industry-year average. Loan and bank controls include lead bank dummies, log total assets, leverage and ROA (one-year lagged). All regressions include bank, year-quarter, industry-by-year-quarter fixed effects, and loan fixed effects. All single and cross-interaction effects are included in regressions but not all are reported for brevity. Variables are defined in Appendix Table A1. Summary statistics are reported in Table IA.1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

	Existing Relationships			New Borrowers		
Dep. var.:	$Loan\,Share_{l,f,b,t}$			$(Loan\,Share \mid Entry)_{l,f,b,t}$		
Green Firm Definition:	High ESG	High E	Low CO_2	High ESG	High E	Low CO_2
	(1)	(2)	(3)	(4)	(5)	(6)
$Green\,Bond\,Ratio_{b,t} \times Green\,Firm_{f,t} \times SRL_{l,f,b,t}$	-.018**	-.014**	-.012**	-.008**	-.008**	-.013
	(.008)	(.007)	(.005)	(.004)	(.003)	(.011)
$Green\,Bond\,Ratio_{b,t} \times Green\,Firm_{f,t}$	.000	.001	.009**	-.005	-.005	-.000
	(.004)	(.003)	(.003)	(.004)	(.004)	(.002)
$Green\,Bond\,Ratio_{b,t} \times SRL_{l,f,b,t}$	.018**	.013*	.016**	.006	.006	.008
	(.009)	(.008)	(.006)	(.004)	(.004)	(.009)
$Green\,Bond\,Ratio_{b,t}$	-.002	-.003	-.009**	.006	.006	.001
	(.004)	(.003)	(.003)	(.004)	(.004)	(.001)
$First\,Green\,Issuance_{b,t}$	.006*	.006*	.003	.001	.001	-.003
	(.003)	(.003)	(.003)	(.007)	(.007)	(.003)
Loan and bank controls	✓	✓	✓	✓	✓	✓
Bank, time, industry × time FE	✓	✓	✓	✓	✓	✓
Loan fixed effects	✓	✓	✓	✓	✓	✓
Observations	4,041	4,041	4,131	1,061	1,061	941
$Adj.R^2$	.732	.731	.743	.847	.847	.862
$\hat{\beta}_1 + \hat{\beta}_2 + \hat{\beta}_3 + \hat{\beta}_4$	-.002	-.003	.004	-.000	-.000	-.004
Mean Y	.074	.074	.071	.082	.082	.072

Table IA.6. Green Bond Issuers *vs.* Never-Treated Banks

This table reports results of Eq.(1) using the sample of green bond issuers and never-treated banks. Panel A defines green firms using ESG ratings, Panel B using E ratings, and Panel C using CO2 intensity. The dependent variables are: $\mathbb{1}(Refinancing)_{l,f,b,t}$ equals one if the loan refinances an existing loan, and zero if it is a new loan; $\mathbb{1}(SRL)_{l,f,b,t}$ equals one if an existing client receives a sustainability-related loan; $\mathbb{1}(Entry)_{l,f,b,t}$ equals one if the loan is granted to a new client, and zero if it is granted to an existing borrower; $\mathbb{1}(SRL|Entry)_{l,f,b,t}$ equals one if a new client receives a sustainability-related loan. $Green\,Bond_{b,t}$ equals one for the five years after a bank's first green bond issue and zero before issuance, assigned at the calendar-day level. $High\,ESG_{f,t}$ equals one for borrowers with an ESG-score ≥ $B+$. $High\,E_{f,t}$ equals one for borrowers with an E-score ≥ $B+$. $Low\,CO2_{f,t}$ equals one for borrowers with Scope 1 + 2 emission intensity below their industry-year average. Loan controls include lead bank dummies. All regressions include bank-by-year-quarter, and industry-by-year-quarter fixed effects. Variables are defined in Appendix Table A1. Summary statistics are reported in Table IA.1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

	Existing Relationships		New Borrowers	
Dep. var.:	$\mathbb{1}(Refinancing)_{l,f,b,t}$	$\mathbb{1}(SRL)_{l,f,b,t}$	$\mathbb{1}(Entry)_{l,f,b,t}$	$\mathbb{1}(SRL\|Entry)_{l,f,b,t}$
	(1)	(2)	(3)	(4)
Panel A: Lending to High ESG Borrowers				
$Green\,Bond_{b,t} \times High\,ESG_{f,t}$	-.014	.072***	-.020*	.089***
	(.021)	(.012)	(.011)	(.030)
$Green\,Bond_{b,t}$	-.014	-.040**	.025	-.035
	(.040)	(.018)	(.023)	(.027)
$High\,ESG_{f,t}$	-.039***	.018***	-.026	.003
	(.010)	(.005)	(.016)	(.004)
Loan controls	✓	✓	✓	✓
Bank × time, industry × time FE	✓	✓	✓	✓
Observations	32,931	32,931	37,713	6,284
$Adj.R^2$	.556	.660	.229	.723
$\hat{\beta}1 + \hat{\beta}2$	-.028	.031*	.005	.054*
Mean Y	.473	.069	.193	.053
Panel B: Lending to High E Borrowers				
$Green\,Bond_{b,t} \times High\,E_{f,t}$	-.004	.052***	-.007	.104***
	(.018)	(.011)	(.012)	(.030)
$Green\,Bond_{b,t}$	-.023	-.023	.014	-.033
	(.040)	(.016)	(.022)	(.027)
$High\,E_{f,t}$	-.049***	.015***	-.035***	.010*
	(.011)	(.003)	(.013)	(.005)
Loan controls	✓	✓	✓	✓
Bank × time, industry × time FE	✓	✓	✓	✓
Observations	32,931	32,931	37,713	6,284
$Adj.R^2$	.556	.657	.229	.727
$\hat{\beta}1 + \hat{\beta}2$	-.027	.029**	.006	.070**
Mean Y	.473	.069	.193	.053
Panel C: Lending to Low CO2 Intensity Borrowers				
$Green\,Bond_{b,t} \times Low\,CO2_{f,t}$	.000	.004	-.007	.001
	(.014)	(.008)	(.008)	(.014)
$Green\,Bond_{b,t}$	-.001	.007	.026	.023
	(.037)	(.013)	(.022)	(.029)
$Low\,CO2_{f,t}$	-.005	.006***	.003	.006
	(.010)	(.002)	(.006)	(.006)
Loan controls	✓	✓	✓	✓
Bank × time, industry × time FE	✓	✓	✓	✓
Observations	34,131	34,131	37,918	5,180
$Adj.R^2$	.557	.624	.250	.647
$\hat{\beta}1 + \hat{\beta}2$	-.001	.011	.019	.024
Mean Y	.501	.060	.164	.027

Table IA.7. Green Bond Issuers *vs.* Never-Treated Banks: Loan Shares

This table reports results of estimating Eq.(1) using the sample of green bond issuers and never-treated banks, distinguishing between sustainability-related loans (SRLs) and conventional loans. Columns 1 & 4 define green firms using ESG ratings, 2 & 5 using E ratings, and 3 & 6 using CO2 intensity. $Loan\,Share_{l,f,b,t}$ is the loan share of bank b in loan l to firm f, which is an existing client, at time t, and $(Loan\,Share|Entry)_{l,f,b,t}$ is the loan share of bank b in loan l to firm f, which is a new client, at time t. $Green\,Bond_{b,t}$ equals one for the five years after a bank's first green bond issue and zero before issuance, assigned at the calendar-day level. $High\,ESG_{f,t}$ equals one for borrowers with an ESG-score ≥ $B+$. $High\,E_{f,t}$ equals one for borrowers with an E-score ≥ $B+$. $Low\,CO2_{f,t}$ equals one for borrowers with Scope 1 + 2 emission intensity below their industry-year average. Loan controls include number of lenders and lead bank dummies. All regressions include bank-by-year-quarter, and industry-by-year-quarter fixed effects. All single and cross-interaction effects are included in regressions but not all are reported for brevity. Variables are defined in Appendix Table A1. Summary statistics are reported in Table IA.1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

	Existing Relationships			New Borrowers		
Dep. var.:	$Loan\,Share_{l,f,b,t}$			$(Loan\,Share \mid Entry)_{l,f,b,t}$		
Green Firm Definition:	High ESG	High E	Low CO_2	High ESG	High E	Low CO_2
	(1)	(2)	(3)	(4)	(5)	(6)
$Green\,Bond_{b,t} \times Green\,Firm_{f,t} \times SRL_{l,f,b,t}$	-.054	-.029	-.192***	-.034***	-.030**	.008**
	(.070)	(.064)	(.065)	(.009)	(.011)	(.003)
$Green\,Bond_{b,t} \times Green\,Firm_{f,t}$	.026*	.006	.002	.063**	.066*	.004
	(.013)	(.018)	(.009)	(.026)	(.033)	(.006)
$Green\,Bond_{b,t} \times SRL_{l,f,b,t}$	.012	-.006	.097**	(.)	(.)	(.)
	(.068)	(.063)	(.038)			
$Green\,Bond_{b,t}$	.017	.031	.016	-.053**	-.057*	.007
	(.036)	(.039)	(.027)	(.025)	(.033)	(.015)
$Green\,Firm_{f,t}$	-.005	-.022*	.009	-.040*	-.032**	-.004
	(.011)	(.011)	(.011)	(.021)	(.015)	(.008)
Loan controls	✓	✓	✓	✓	✓	✓
Bank × time, industry × time FE	✓	✓	✓	✓	✓	✓
Observations	4,230	4,230	4,278	966	966	846
$Adj.R^2$	.641	.642	.619	.651	.652	.516
$\hat{\beta}_1 + \hat{\beta}_2 + \hat{\beta}_3 + \hat{\beta}_4$	.002	.002	-.077	-.025***	-.021*	.019
Mean Y	.087	.087	.079	.086	.086	.074

Table IA.8. Bond Certification: Loan Contracting and Borrower Selection

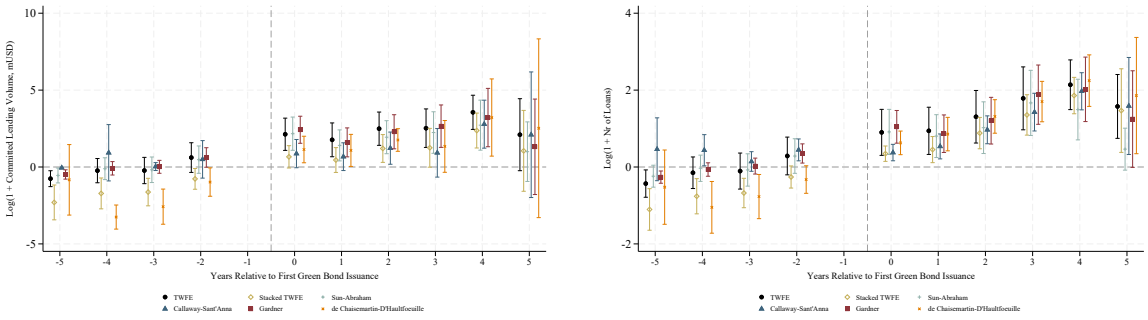
This table reports results of Eq.(1) using the sample of green bond issuers and never-treated banks. The dependent variables are: $\mathbb{1}(Refinancing)_{l,f,b,t}$ equals one if the loan refinances an existing loan, and zero if it is a new loan; $\mathbb{1}(SRL)_{l,f,b,t}$ equals one if an existing client receives a sustainability-related loan; $\mathbb{1}(Entry)_{l,f,b,t}$ equals one if the loan is granted to a new client, and zero if it is granted to an existing borrower; $\mathbb{1}(SRL|Entry)_{l,f,b,t}$ equals one if a new client receives a sustainability-related loan. $Green\,Bond_{b,t}$ equals one for the five years after a bank's first green bond issue and zero before issuance, assigned at the calendar-day level. $High\,ESG_{f,t}$ equals one for borrowers with an ESG-score $\geq B+$. In Panel A, the sample is limited to green bonds that received third-party certification. In Panel B, the sample is limited to green bonds that are CBI-aligned. Loan controls include lead bank dummies. All regressions include bank-by-year-quarter, and industry-by-year-quarter fixed effects. Variables are defined in Appendix Table A1. Summary statistics are reported in Table IA.1. Bank-clustered standard errors are reported in parentheses. *, **, *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

	Existing Relationships		New Borrowers	
Dep. var.:	$\mathbb{1}(Refinancing)_{l,f,b,t}$	$\mathbb{1}(SRL)_{l,f,b,t}$	$\mathbb{1}(Entry)_{l,f,b,t}$	$\mathbb{1}(SRL\|Entry)_{l,f,b,t}$
	(1)	(2)	(3)	(4)
Panel A: Third-Party Certified Green Bond Issuers vs. Never Treated				
$Green\,Bond_{b,t} \times High\,ESG_{f,t}$	-.081***	.079**	-.007	.179*
	(.014)	(.020)	(.010)	(.074)
$Green\,Bond_{b,t}$	.033	-.050*	.067	-.086*
	(.118)	(.016)	(.036)	(.034)
$High\,ESG_{f,t}$	.003	.007	-.036**	-.008
	(.014)	(.005)	(.007)	(.017)
Loan controls	✓	✓	✓	✓
Bank × time, industry × time FE	✓	✓	✓	✓
Observations	9,005	9,005	10,006	920
$Adj.R^2$	.512	.591	.175	.312
Panel B: CBI-Aligned Green Bond Issuers vs. Never Treated				
$Green\,Bond_{b,t} \times High\,ESG_{f,t}$	-.009	.075***	-.003	.056
	(.025)	(.019)	(.019)	(.038)
$Green\,Bond_{b,t}$	.041	-.061**	-.002	-.012
	(.047)	(.026)	(.040)	(.035)
$High\,ESG_{f,t}$	-.022**	.018***	-.051	.007
	(.010)	(.006)	(.032)	(.004)
Loan controls	✓	✓	✓	✓
Bank × time, industry × time FE	✓	✓	✓	✓
Observations	17,561	17,561	20,818	3,459
$Adj.R^2$	.585	.688	.217	.745

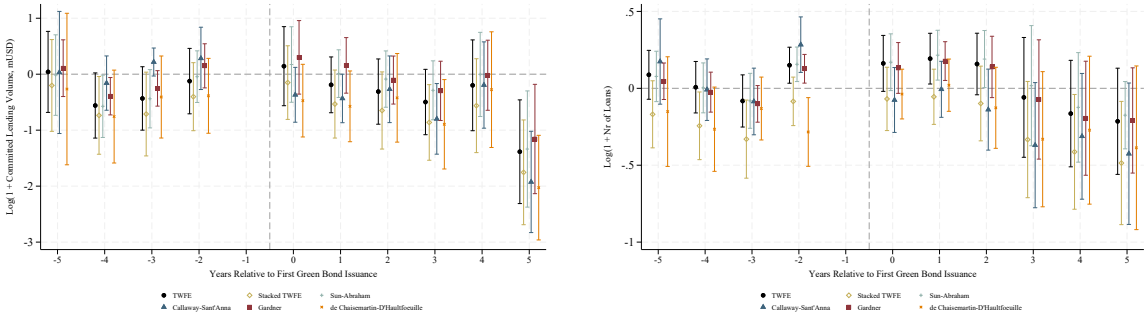
Figure IA.1. Aggregate Portfolio Adjustments: Staggered DiD Estimators

This figure reports dynamic difference-in-differences estimates of the effect of a bank's first green bond issuance on syndicated lending at the bank-year level using all borrowers with ESG-ratings available. The dependent variables are the log of one plus committed lending volume and the number of loans, reported in the first and second columns, respectively. Panels A and B separately consider sustainability-related loans and conventional loans, while Panel C considers all loans. Treatment begins in the year in which a bank first issues a green bond and is absorbing thereafter. Event-time coefficients are reported for the five years before and after issuance, with the year preceding first green bond issuance omitted as the reference period. All specifications include bank and year fixed effects. We report the conventional two-way fixed effects (TWFE) event-study estimator together with five estimators designed to accommodate heterogeneous treatment effects under staggered adoption: stacked TWFE, Sun and Abraham (2021), Callaway and Sant'Anna (2021), Gardner (2022), and de Chaisemartin and D'Haultfoeuille (2020). Stacked TWFE constructs cohort-specific sub-experiments using never- and not-yet treated controls and stacks these sub-experiments prior to estimation. Sun and Abraham (2021) estimate cohort-by-event-time effects and aggregate them across treatment cohorts, using never-treated banks as controls. Callaway and Sant'Anna (2021) estimate group-time average treatment effects relative to never-treated banks and aggregate these effects by event time. Gardner (2022) uses a two-stage procedure in which bank and year effects are estimated using untreated observations before treatment effects are estimated in the full sample; both never-treated and not-yet-treated banks contribute to the control group. de Chaisemartin and D'Haultfoeuille (2020) construct treatment effects from changes among switching units relative to units whose treatment status does not change, using never-treated and not-yet treated as controls. Standard errors are clustered at the bank level for all estimators except Callaway and Sant'Anna (2021), for which confidence intervals are constructed using the wild bootstrap in line with suggested best practices. Vertical bars denote 95% confidence intervals.

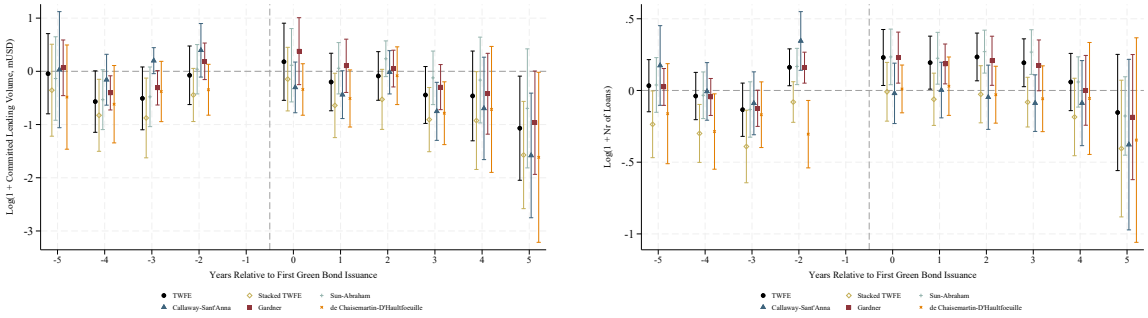
Panel A: Sustainability-Related Lending



Panel B: Conventional Lending



Panel C: Total Lending



Internet Appendix B. Examples of Syndicated SRLs

Renewables Infrastructure secures innovative ESG linked debt funding

18 December 2020 QuotedData Global Investment Companies Renewable energy infrastructure

The Renewables Infrastructure Group : TRIG James Carthew



Renewables Infrastructure secures innovative ESG linked debt funding – The Renewables Infrastructure Group Limited has successfully refinanced and expanded its revolving credit facility (RCF) at lower rates to support its investment in new renewable energy projects. The facility is used for short-term financing of acquisitions. The renewed RCF of £500m has been made available to TRIG for a three-year term and the larger size of the facility reflects the increased scale of acquisitions being made by thecompany. TRIG's intention remains to pay back the money it borrows by issuing new shares. The RCF is currently undrawn.

The interest charged in respect of the renewed RCF is linked to the TRIG's ESG performance. The interest rate and commitment fee vary based on performance against defined sustainability targets. Those targets include:

- Environmental: increase in the number of homes powered by clean energy from TRIG's portfolio
- Social: increase in the number of community funds supported by TRIG
- Governance: maintaining a low Lost Time Accident Frequency Rate (LTAFR)

Siemens Gamesa arranges sustainability linked syndicated guarantee with a premium to be allocated to cancer research

Press release May 18, 2020

- The syndicated guarantee of up to €600m led by BNP Paribas covers the construction of components for Hornsea 2, the world's largest offshore wind farm to date
- The deal is linked to fulfilment of ESG criteria and it channels funds to a breast cancer research project at Hospital La Paz Institute for Health Research in Madrid

Siemens Gamesa has signed a bank guarantee line for up to €600m to cover the construction of components for Hornsea 2, the largest offshore wind farm to be announced to date. Located in the North Sea and owned by Danish utility company Ørsted, the farm will consist of 165 Siemens Gamesa wind turbines (1.4 GW), capable of producing enough clean energy to power 1.3 million UK households. BNP Paribas lead managed the deal, in which BBVA, Mizuho and Santander also participated.

Siemens Gamesa's commitment to sustainability extends to all areas of the company, including finance; as a result, its funding is tied to ESG (environment, social and governance) criteria. Under this agreement, the company will pay a premium in the event that it fails to achieve the defined ESG targets; otherwise, the premium will be paid by BNP Paribas, together with BBVA and Santander.

In either case, the established premium on the deal will be used to finance a cancer research project directed by Eduardo López Collazo, Scientific Director of Hospital La Paz Institute for Health Research (Madrid, Spain), that seeks to identify sources of metastasis in breast cancer with a view to preventing tumour cells from spreading. "We are in the midst of an emergency — one in which science has taken on a very prominent role, in both political and social terms. After COVID-19, there will still be other health problems that were here before and will not have gone away. My group has been seeking an explanation for metastasis for the last two decades; it's a task that needs funding, and one whose success is synonymous with life," said Dr. López Collazo.

Iberdrola signs its largest green loan in the amount of €1 billion with the guarantee of an Export Credit Agency

- The funds will mainly finance the purchase of turbines for both onshore and offshore wind farms for Iberdrola's projects in Spain, Poland, Greece, Germany and the UK.
- This green loan facility, guaranteed by a European Export Credit Agency and funded by Banco Santander, will strengthen the diversification of Iberdrola's sources of financing.

26/04/2022

Iberdrola is once again taking a decisive step towards green financing. The company chaired by Ignacio Galán has signed its largest green loan with Banco Santander for an amount of €1 billion, which in turn is backed by an Export Credit Agency (ECA). The loan has a maximum term of 15 years.

The funds will be used mainly to finance Iberdrola's orders to suppliers of turbines for offshore and onshore wind farms for Iberdrola's projects in Spain, Poland, Greece, Germany and the UK.

Export Credit Agencies (ECAs) exclusively manage credit and investment insurance on behalf of States, covering political, commercial and extraordinary risks associated with internationalisation.

The guarantee mechanism for the green loan will be provided by the Export Credit Agency, while the funds for the operation will come from Banco Santander. This green loan will strengthen the diversification of Iberdrola's financing sources.

Iberdrola reaffirms its global leadership in green finance

With this new loan, Iberdrola continues to consolidate its leadership in ESG financing, with more than €41 billion in signed operations, of which more than €23 billion correspond to green financing and around €18 billion to credit lines, loans or commercial paper programmes subject to compliance with sustainability objectives. The transaction represents the largest green loan signed by Iberdrola to date.

The projects to which the resources obtained from these placements are allocated are aligned with the following Sustainable Development Goals (SDGs) of the United Nations, on which Iberdrola focuses its efforts: number 7 - Affordable and Clean Energy - and number 13 - Climate Action.

Strong momentum for wind energy

Two decades ago, the group was a pioneer in onshore wind power and now it is also a pioneer in offshore wind power. Iberdrola has more than 30,000 MW of operational capacity, in the pipeline and in early-stage developments. Focused on countries with ambitious targets, the company expects to have 12,000 MW of offshore wind energy in operation by 2030 and cumulative investments of over €30 billion worldwide.



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