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Financing green transition: The role of bank-nonbank partnerships☆

Angela Gallo [a], Min Park [b],*

[a] Bayes Business School (formerly Cass), 106 Bunhill Row, London EC1Y 8TZ, United Kingdom
[b] University of Bristol Business School, Howard House, Queen's Ave, Bristol BS8 1SD, United Kingdom

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ABSTRACT

We document a significant role for nonbanks in financing the green transition following the Paris Agreement, primarily through lending partnerships with banks. Using textual analysis to identify green loans, we show that nonbanks participate in a greater number of green syndicated loans and commit larger amounts in response to corporate demand for green financing. Such nonbank investment in green loans is associated with more favorable loan terms and is consistent with a nonbank-led expansion in credit supply rather than bank-driven risk offloading. Nonbank investment is highly sensitive to policy signals, suggesting that regulatory transition risk is a key driver. Overall, our findings show the potential for nonbanks to support the transition but only under credible political commitment to climate goals.

1. Introduction

One of the most notable developments in financial intermediation over the past decade has been the expansion of the nonbank financial intermediation (NBFI) sector, encompassing entities such as insurance firms, pension funds, mutual funds, and private equity firms. Since the global financial crisis, this sector has driven much of the growth in global financial assets and now accounts for about 50% of total global financial assets (Financial Stability Board, 2022). At the same time, one of the most pressing challenges of the next decade is mobilizing sufficient financing for the shift to low-carbon production. Banks are expected to play a crucial role; however their balance sheet capacity alone is insufficient to close the substantial investment gap, estimated around USD 8.5 trillion annually until 2030 (CPI, 2025). An emerging policy and market narrative highlights nonbank institutions as essential contributors to closing this gap.

Nonbanks' growing role is most evident in syndicated lending. In the typical structure, banks originate and arrange the loans, while nonbanks increasingly fund a portion through institutional tranches that are actively traded in secondary markets. In the context of green financing, this structure allows banks to leverage their informational advantages to mitigate the heightened adverse selection and moral hazard of such projects, while nonbanks provide additional capital in response to investor demand for sustainable assets. These complementary roles suggest the potential for expanded credit supply to green projects through an increase in bank-nonbank partnerships. However, the role of these partnerships in green financing remains relatively understudied.

In this paper, we study how bank-nonbank partnerships expanded into green financing after the Paris Agreement, which spurred corporate demand for transition capital. Using syndicated loans and a novel measure of greenness of a loan, we document that overall green financing surged by approximately 23% after the Paris Agreement. Notably, nonbanks largely filled in this increase, as their share of participation in green loans rose from 17% before the Paris Agreement to 59% afterward, corresponding to about USD 1.43 trillion of additional green financing (see Fig. 1). In difference-in-differences analyses as well, we

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* Corresponding author.
E-mail addresses: angela.gallo.1@citystgeorges.ac.uk (A. Gallo), min.park@bristol.ac.uk (M. Park).

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show that nonbanks' investment in green loans increased by 69.5% following the Paris Agreement. Notably, nonbanks also increase their within-loan contribution by 32.96%. These results remain robust across specifications and highlight an economically significant increase in nonbank investment in green loans. We then extend the analysis to the pricing of nonbank investments in green loans to evaluate whether increased participation reflects an expansion of green credit supply by nonbanks or banks' efforts to offload risk. We find that nonbank participation is associated with lower spreads and fewer covenants for green loans relative to non-green loans. These pricing and contractual patterns align with a rightward shift in the credit supply curve. They support a nonbank-led expansion rather than a response to bank constraints or risk-shifting motives, suggesting that nonbanks are willing to offer favorable terms to secure green exposure.

The analyses employ an extensive set of fixed effects. In all our estimates, we control for borrower demand by including either the interaction of borrower-industry and quarter fixed effects (Khwaja and Mian, 2008) or the interaction of borrower-industry, borrower-country, and quarter fixed effects (Acharya et al., 2018). To account for the preference of banks in arranging certain types of loans, we use lender fixed effects or the interaction of lender and quarter fixed effects. In our stricter specification, we adopt lender-time and country-industry-time fixed effects. This approach isolates nonbank credit supply by measuring the likelihood of nonbank investment in a green loan syndicated by the same lead arranger, targeting borrowers in the same industry and country within a given quarter, relative to a non-green loan. It accounts for the lead arranger bank's propensity and characteristics in financing green projects, such as preferences and expertise for green activities, policy-driven shifts in green financing, balance sheet capacity, and brown legacy. It also accounts for borrowers' industry- and country-specific characteristics, including both time-variant and time-invariant factors.

A critical challenge in studying green lending lies in the accurate identification of the "greenness" of the loans. Existing research often classifies loans as green based on the environmental characteristics of the borrowing firm using firm-level proxies such as ESG scores or carbon emissions data, e.g., measures that are primarily available for listed firms. Our approach differs fundamentally as it relies on a textual analysis of loan-level qualitative information, specifically the loan purpose remarks recorded in DealScan. These remarks provide a detailed description of the intended use of funds, as reported by the lead arranger based on the contractual agreement between the borrower and the syndicate. An example of a loan remark is: "Proceeds will back the construction of two wind power projects named Alta Wind VII and Alta Wind IX. They will be built in Tehachapi, California. The two projects will produce 300 mw of wind energy combined".

This novel approach offers several advantages. First, it provides greater granularity than existing firm-level greenness proxies (e.g., ESG scores, or carbon emissions), which overlook the specific purpose of individual loans. This granularity allows for the classification of loans to be extended also to private firms, the large majority of borrowers in syndicated lending, which are often excluded from previous studies due to the limited coverage. Second, unlike ESG scores which have been criticized for their opacity and lack of methodological consistency, our measure is a more objective and verifiable indicator of green financing and helps mitigate concerns about greenwashing. Third, we leverage the taxonomy of the Climate Bonds Initiative to identify Paris Agreement-compliant activities, ensuring that our measure aligns with industry standards used by nonbanks.

In further tests, we investigate the underlying drivers of nonbank participation in green lending. We find that green financing by nonbanks is highly sensitive to shifts in the climate policy agenda, showing withdrawals as political commitments to the transition wane. This sensitivity underscores the role of regulatory and transition risk for nonbank investment. We then examine the types of partners nonbanks favor when engaging in green investments, with the aim of uncovering heterogeneity in the formation of bank-nonbank partnerships. We find that nonbanks do not systematically favor banks that specialize in green lending or have formal sustainability commitments. Instead, they are more likely to participate in loans arranged by banks with an established history of syndicating with nonbanks and greater access to the secondary loan market. This evidence suggests that, beyond screening and monitoring, nonbanks prioritize arrangements that facilitate risk-sharing and trading of green loan investments.

Taken together, our findings underscore the dual role of nonbanks in the green lending. While nonbanks can provide significant scale to sustainable finance through partnerships with banks that facilitate risk sharing on inherently uncertain green projects, their participation remains highly sensitive to changes in the regulatory and policy environment. This sensitivity is particularly relevant for private firms, which represent a large share of borrowers and tend to be more financially constrained. Without credible and sustained policy commitments, nonbank participation in green lending is likely to remain volatile, limiting its role as a stable complement to bank-based intermediation in the transition.

Related Literature. Our paper contributes to the literature in several ways. First, we add to the literature documenting financial intermediaries' responses to climate risk (Degryse et al., 2019; Delis et al., 2024; Kacperczyk and Peydro, 2022; Altavilla et al., 2023). While this literature has mostly focused on bank-led green lending, we document a distinct nonbank-led credit supply channel in which banks and nonbanks co-finance newly originated loans, predominantly to private firms. We show that this mechanism operates independently of banks' efforts to offload risk. This evidence complements (Mueller et al., 2025), who document a bank-led reallocation strategy in which banks respond to transition risk by securitizing brown loans to public firms using CLOs. In our study, we shift the focus from nonbanks as recipients of offloaded brown assets to their active role in originating green credit, primarily to private firms. For nonbanks, Liu et al. (2024) show that insurers respond to transition risk by shifting from corporate bonds to CLOs, using market opacity to mask exposures. Similarly, our evidence suggests that nonbank participation in green loans is mostly a short term regulatory response.

Second, we add to the literature on sustainable investing by examining nonbank participation in green corporate lending, an area that has received comparatively less attention than investments in green securities. Existing research has largely focused on how institutional investors reallocate capital in response to climate-related metrics and events. Ramelli et al. (2021) document reallocation following climate-related political events for stocks, while Seltzer et al. (2022) and Bolton and Kacperczyk (2021) find increased investor sensitivity to firms' environmental risk exposure in both bond and equity markets. Our findings extend this evidence to the credit market, showing that nonbanks also actively allocate capital toward green corporate loans, and that their investment is highly sensitive to shifts in the policy agenda.

Third, the increasing role in green lending also speaks to the literature on the growing role played by nonbanks in credit markets (among others, Irani et al., 2021; Chernenko et al., 2022; Buchak et al., 2018; Aldasoro et al., 2022). Our evidence adds to this literature by documenting nonbanks' role in financing green corporate loans and introducing a novel loan-level classification. This classification's coverage extend to private firms that account for over 70% of syndicated loan borrowers but are typically excluded due to the limited availability of green metrics. Thus, our approach offers a foundation for future research on green lending across a wider and more representative set of firms.

The remainder of the paper is organized as follows. Section 2 outlines the conceptual framework. Section 3 describes the data and green loan classification. Section 4 presents the main findings. Section 5 examines the drivers of nonbank participation. Section 6 reports additional bank-, borrower-, and loan-level results. Section 7 concludes.

2. Bank-nonbank partnerships in green lending

Banks play a central role in credit markets by mitigating frictions through screening, monitoring, and relationship lending (Diamond, 1984), functions that are particularly valuable when borrower quality is opaque or project risk is difficult to assess. These informational frictions are amplified in green lending. Green investments often involve novel technologies, uncertain and long-dated cash flows, and evolving regulatory benchmarks. These features exacerbate adverse selection by making it difficult to verify borrowers' "green" intent ex ante, and increase moral hazard as outcomes are costly to observe and measure ex post. Therefore, banks are well positioned to originate and monitor green loans; however, capital regulation and concentration limits may constrain the ability of banks to support such financing, particularly when they also hold legacy assets in carbon-intensive sectors (Degryse et al., 2022). These constraints create scope for nonbanks to participate in green loans, especially through structures that allow banks to retain control over origination and monitoring while transferring part of the funding to nonbanks. Nonbanks face fewer capital constraints, exhibit greater flexibility in portfolio reallocation and are under investors' pressure for more sustainable investment portfolios. However, they typically lack the screening capacity and monitoring ability required to manage complex credit exposures (Boot and Thakor, 2010). Moreover, nonbanks' arm's length investment model and limited exposure to corporate lending market may make them more willing to participate in lending when risk-sharing arrangements are in place. As such, bank-nonbank partnerships can be seen as resolving a key intermediation friction: they allow nonbanks to access screened green loans and share the risk and banks to retain their core functions and scale their lending capacity.

The relative importance of each intermediary's motive in driving these partnerships remains an open question, particularly when firms are under stronger regulatory expectations and investor pressure to decarbonize. As demand for green financing grows, it is unclear whether banks form such partnerships to arrange loans while alleviating balance sheet capacity constraints, or whether nonbanks initiate them to gain green credit exposure. If supply were bank-constrained, increased demand would be expected to raise loan spreads on green nonbank investments. If, instead, the supply expansion is driven by nonbanks, we would expect a compression in spreads. The decline in spreads, despite increased demand, would be consistent with an outward shift of the nonbank supply curve. This is aligned with empirical evidence from Ivashina and Sun (2011), showing that robust demand from institutional investors exerts downward pressure on loan spreads.

Evidence of a nonbank-led supply expansion could reflect either a growing awareness of long-term climate-related financial risks or a shorter-term response to regulatory pressure. Nonbanks' increased appetite for green assets may signal a targeted effort to finance firms most in need of transition support, or it may instead be shaped by external forces, particularly investor expectations of regulatory change or evolving industry norms. In the latter case, a supportive policy environment would amplify borrower incentives to undertake green investments and strengthen investor pressure on nonbanks to allocate capital toward sustainable assets. Conversely, when regulatory momentum behind the green transition weakens, nonbanks' participation in the green loan market tends to diminish, and partnerships with banks correspondingly decline.

In our setting, this sensitivity to the policy environment implies that shifts in political commitment can directly affect the formation of bank-nonbank partnerships. This distinction, together with the broader framework outlined above, motivates our empirical analysis of the conditions under which nonbanks contribute to green financing.

3. Empirical strategy

To examine whether, and under what conditions, nonbanks invest in green loans syndicated by banks, we address three key identification challenges: (i) identifying nonbank participation in syndicated loans; (ii) classifying green loans; and (iii) isolating a shock to green financing demand. We detail our approach to each in the sections that follow and then outline the empirical methodology.

3.1. Identifying nonbank investment in syndicated lending

To identify nonbank investment in syndicated loans, we follow a common approach in the literature (e.g., Blickle et al., 2020), which shows that institutional tranches labeled Term Loan B (Term B) are typically sold to nonbank investors shortly after origination. We therefore use the presence of a Term B tranche as our primary proxy for nonbank investment, and additionally employ the ratio of Term B size to total loan size as a measure of the magnitude of nonbank investment. As a secondary proxy, we also examine cases where nonbanks appear as syndicate members at the time of loan origination. However, such direct nonbank participation is rare, rendering Term B a more reliable indicator of nonbank investment. This identification of nonbank investment is grounded in the institutional structure of the syndicated loans. Large corporate loans are typically arranged by one or more lead banks and financed through syndicates of multiple lenders. In deals involving both banks and nonbanks, the syndicate usually includes a Term Loan A (Term A), allocated to banks, and a Term Loan B (Term B or institutional tranche), allocated to institutional investors. Given this segmentation, Term B tranches serve as a natural lens through which to observe nonbank investment in the corporate loan market.

To identify both nonbank investment (e.g., Term B) and nonbank direct investment, we rely on DealScan. The database provides information on loan deal, types of tranches, loan amount, maturity, spread, covenants and the type and identify of the lenders. For nonbank direct investment, the nonbank classification relies on the institutional type reported in the database. We classify lenders as banks if their type includes "Bank", "Thrift", or "S&L". Unclassified institutions with "bank" in their name are also coded as banks following Elliott et al. (2021); all others are treated as nonbanks. In the sample, 37.15% of the loans contain Term B in their structure and only 8.65% of the loans have nonbanks' direct investment. A small minority of the nonbank investment is from pension funds or insurance companies (1% of the total loan sample or 11% of nonbank direct investment). Therefore, the majority of nonbanks in our sample are investment firms with relatively short investment horizons. The lack of distinct lender classifications limits further differentiation among these firms.

After identifying nonbank investment, we restrict the sample to loans that are comparably likely to attract nonbank investments. Specifically, we retain only syndicated loans that include at least one Term A or Term B tranche and exclude those consisting solely of revolving facilities, which are typically used for liquidity management and rarely held by nonbanks. We further focus on loans arranged by banks headquartered in the U.S. or Europe but syndicated in the U.S., where the secondary market for institutional tranches is more active. To ensure comparability across loan types, we also impose a minimum loan size threshold based on the smallest observed loan with a Term B tranche, excluding smaller deals that are unlikely to attract nonbank investment. These restrictions allow us to compare green and non-green loans within a sample where nonbank participation is plausible, helping avoid selection bias that could otherwise reflect preferences for certain loan characteristics (e.g., size, maturity, or structure) rather than for greenness itself. Following these filters, we exclude 6.56% of the initial sample, yielding a final dataset of 11,864 loan-arranger observations. Within this sample, nonbank investment is observed in 6.89% of loans, while direct participation for 5.3% of them.

Table 1
Loan characteristics and difference-in-means test.

Panel A: All sample	*Non-green loans*		*Green loans*		Diff. test
	Mean	St Dev	Mean	St Dev	
Loan amount (USD million)	800.95	1914.47	607.15	1034.13	193.80*
Spread (bps)	353.04	171.02	309.28	180.63	43.76***
Maturity (months)	71.68	30.33	88.29	56.48	−16.62***
Secured (0 or 1)	0.51	0.50	0.17	0.38	0.33***
Covenant index (0–6)	0.68	0.76	0.26	0.60	0.42***
Number of lenders	6.37	6.16	4.84	3.39	1.53***
Joint lead arrangers (0 or 1)	0.25	0.43	0.48	0.50	−0.23***
Leveraged loans (0 or 1)	0.69	0.46	0.20	0.40	0.49***
Sponsored loans (0 or 1)	0.42	0.49	0.08	0.27	0.34***
Panel B: Loans with nonbank investment					
	Non-green loans		*Green loans*		Diff. test
	Mean	St Dev	Mean	St Dev	
Loan amount (USD million)	1011.42	1319.32	2057.81	1759.91	−1046.38***
Spread (bps)	441.19	144.90	383.13	140.22	58.06**
Maturity (months)	85.38	22.32	88.74	10.64	−3.36
Secured (0 or 1)	0.98	0.14	0.92	0.27	0.06**
Covenant index (0–6)	1.11	0.48	1.05	0.56	0.06
Number of lenders	6.53	6.19	7.18	3.61	−0.65
Joint lead arrangers (0 or 1)	0.41	0.49	0.59	0.50	−0.18**
Leveraged loans (0 or 1)	0.96	0.19	0.90	0.31	0.07**
Sponsored loans (0 or 1)	0.69	0.46	0.51	0.51	0.17**

This table reports summary statistics for the sample of loans in the analyses. The sample excludes syndicated loans that contain revolving tranches only. Panel A presents the summary for all loans and Panel B presents the summary of a subgroup of loans that contain institutional tranche, Term B. In each panel, green loans and non-green loans are compared for the following characteristics: loan amount which is total loan size (sum of all tranches in a loan), spread which is average of spreads of tranches in a loan deal, maturity which is number of months from loan start to end date, number of lenders, secured which is 1 if a loan is collateralized and 0 otherwise, covenant index which is strictness of loan covenant measured according to Bradley and Roberts (2015) and the number of lenders in the syndicate. Additional variables include dummies equal to one for loans with joint lead arrangers, for loans classified as leveraged (based on the market segment), and for those sponsored by private equity firms. T-test results are presented in the final column that show whether the values are statistically different between green and non-green loans. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

3.2. Identifying green financing with textual analysis

Most empirical studies classify green loans based on borrower-level environmental metrics, typically ESG scores or carbon emissions. This firm-level approach assumes that only loans to “green” firms support green activities, overlooking financing extended to high-emitting firms that seek to fund sustainable projects. Moreover, such metrics are often unavailable for private firms, which comprise the majority of syndicated loan borrowers.

We take a loan-level approach by applying textual analysis to the “loan purpose remark” field in DealScan. These remarks, reported by the lead arranger based on contractual agreements, offer a direct and verifiable account of how proceeds will be used. In the spirit of Li (2010), we first construct a dictionary of green keywords based on the Climate Bonds Initiative (CBI) taxonomy (Climate Bonds Initiative, 2021). This widely adopted industry standard defines Paris Agreement-compliant assets, aligned with a 1.5°C decarbonization pathway. Keywords span sectors such as energy (“solar”, “wind”), transport (“electric”, “hydrogen”), and waste management (“recyclable”,). In the next step, we classify a loan as green if its purpose remark includes terms indicating funding of sustainable activities. An example of a green loan remark is: “Proceeds will back the construction of two wind power projects producing 300 MW of energy in Tehachapi, California”.

This method classifies 273 loans as green loans between 2012 and 2019, representing 2.30% of the sample. The most common green loan types reference “solar” and “wind”, followed by “electric”. While the share remains modest, it aligns with estimates of green bond issuance, which accounts for roughly 3% of global bond markets (Syzdykov and Masse, 2019). This similarity is notable given our more restrictive classification, which captures only loans financing core Paris-aligned activities (e.g., renewable energy), whereas green bonds often cover a broader set of sustainable purposes.

Table 1 reports loan characteristics and difference-in-means tests for green and non-green loans. Panel A presents results for the full sample, while Panel B focuses on loans with nonbank investment. In the full sample, green and non-green loans are similar in size, but green loans exhibit significantly lower spreads, by an average of 43 basis points, as well as longer maturities and smaller syndicates. They are also less likely to be collateralized or include multiple covenants, but have more joint lead arrangers. They are also, on average, less likely to be leveraged loans and to be sponsored by private equity firms. In the subsample of loans with nonbank investment, green loans are larger and also priced at significantly lower spreads (58 basis points) than their non-green counterparts. However, there are no significant differences in maturity, covenants and number of lenders. Notably, green loans in this group are also associated with more lead arrangers in the syndicates, but are less likely to be leveraged loans or sponsored.

To ensure a accurate classification of green loans, all loan purpose remarks flagged as green are reviewed manually to correct misclassifications (Type II errors). The potential remains for Type I errors, i.e., cases where green loans are not identified because their purpose remarks lack relevant keywords. We adopt two approaches to assess the accuracy of our classification. First, we manually review three random subsamples (200 loans total) to check for missed green loans and find no evidence of systematic underidentification. Second, we validate externally using macro-level indicators from green bond issuance and the IMF Climate Change Dashboard. Since most green loans finance renewable energy, we expect our green loan measure to correlate with country-level green economy transition metrics. We find a positive and significant correlation between the number of green loans and both the amount of green bonds and measures of renewable energy at country-level.

Another concern is that reporting may have increased over time as attention to the topic grew and banks had incentives to highlight their green initiatives (see Giannetti et al., 2023). Notably, the reporting in DealScan is not part of banks' formal environmental disclosures but is based on contractual loan documentation. Although the concern is limited, we address it empirically by examining whether, after the Paris Agreement, there is an upward trend in the frequency of reported purpose remarks. We find that purpose remarks were reported for 51.3% of loans before the Paris Agreement compared to 43.3% afterward. This decline reduces the likelihood of strategic reporting. Moreover, the share of loans classified as green increased from 1.16% in the pre-agreement period to 2.94% afterward. While we cannot fully separate genuine growth from increased labeling, our keyword based approach limits strategic misreporting by relying on specific terms in loan contracts (for example solar, wind, electric) rather than generic labels (for example ESG). To further mitigate the reporting bias, in unreported tests, we also repeat our main analysis using the subsample of loans for which purpose remarks are available. Similarly, we restrict the sample to loans arranged by top tier arrangers from Bloomberg's Syndicated Loan League Tables, who have strong incentives for consistent reporting.

In Appendix A.1, we present the key elements and checks of our textual approach, namely the keyword dictionary and examples of loan purpose remarks (Table A.1.1). We also report the correlation analysis between country-level green economy transition indicators and the volume of green lending identified by textual analysis (Table A.1.2) and the distribution of green and non green loans over time (Table A.1.3).

3.3. Empirical setting

To examine bank-nonbank partnerships in green lending, we exploit a plausibly exogenous rise in green finance demand following the Paris Agreement in December 2015. The event spurred stricter environmental policies and signaled regulatory shifts, prompting firms to invest in low-carbon technologies and seek external financing. We use this shock to test whether nonbanks increased participation in green loan tranches within syndicated loans

To empirically evaluate this response, we employ a difference-in-differences (DID) framework that compares nonbank participation in green versus non-green loans before and after the Paris Agreement. The analysis spans the 2012–2019 period and incorporates a rich set of fixed effects. First, we include lender or lender-time fixed effects to account for potential changes in banks' lending policies, both with respect to green and brown firms, following the Agreement. Second, borrower-industry and borrower-country fixed effects control for variation in regulatory and macroeconomic conditions affecting firms' financing needs across sectors and regions. The remaining variation comes from differences across green and non-green loans within these tightly defined environments. As such, any differential increase in Term B participation for green loans is more likely to reflect a supply-side response specific to the loans' green classification, rather than industry-wide or geography-wide demand effects. The estimating equation is as follows:

$$Nonbank\ Investment_{i,b,l,t} = \alpha + \beta Post\ PA \cdot Green\ Lending_i + FE + X_i + \varepsilon_{i,b,l,t} \quad (1)$$

$Nonbank\ Investment_{i,b,l,t}$ is equal to 1 if a loan i given to a borrower b by lead arranger l in quarter t contains an institutional tranche (Term B) that is designed to be either invested by or sold to nonbanks. The explanatory variable of interest is an interaction between $Green\ Lending_i$ that is equal to 1 for loans with green purposes, and 0 otherwise, and $Post\ PA$ is equal to 1 for years after the Paris Agreement (after December 12, 2015) and 0 otherwise. X_i represents all standalone variables of the interaction term that are not collinear to fixed effects.

Table 2
Nonbanks' investment in green financing.

	Nonbank investment			
	(1)	(2)	(3)	(4)
Green Lending	−0.032***	−0.117***	−0.087***	−0.087***
	(0.009)	(0.009)	(0.006)	(0.003)
Post-PA × Green Lending	0.044***	0.090***	0.103***	0.107***
	(0.007)	(0.026)	(0.010)	(0.007)
Lender FE	Y	N	N	N
Lender-time FE	N	Y	Y	Y
Industry FE	N	Y	N	N
Industry-time FE	Y	N	Y	N
Country FE	N	Y	N	N
Country-time FE	Y	N	Y	N
Country-industry-time FE	N	N	N	Y
Observations	11 864	11 864	11 864	11 864
Adjusted R^2	0.367	0.355	0.387	0.391

This table reports the regression results of Eq. (1). The sample consists of all syndicated loans between 2012 and 2019 except revolving-only loans. The main explanatory variable is *Post-PA* X *Green Lending*, an interaction term between *Post-PA*, which is equal to 1 for the period after the Paris Agreement (December 12, 2015) and 0 otherwise, and *Green Lending*, which is equal to 1 if a loan is for green purposes and 0 otherwise. The dependent variable is *Nonbank Investment* which is a binary variable that is equal to 1 if the loan contains institutional tranche and 0 otherwise. Various combinations of lender, borrower industry, borrower country and time fixed effects are included. Standard errors are clustered by borrower-country. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The unit of observation is at the lead arranger-loan level, and for loans with multiple lead arrangers, one observation for each lead arranger is included as in Gopalan et al. (2011).

β measures whether a green-purpose loan is more likely to have nonbank investment post-PA. Lender-time (quarter), borrower-country, borrower-industry fixed effects, and combinations of these are included. In the additional tests, we replace the dependent variable, $Nonbank\ Investment$, with either $Share\ of\ Nonbank\ Investment$, which measures the magnitude of nonbank contribution to green loans, or $Nonbank\ Direct\ Lending$, which captures whether a nonbank participates in green loans as a direct provider of funds. $Share\ of\ Nonbank\ Investment$ is defined as the ratio of the Term B size to the total deal size. $Nonbank\ Direct\ Lending$ equals 1 if any syndication member in a loan deal is a nonbank. Consequently, β captures whether an increase in demand for green financing is absorbed by nonbanks through increased contribution per loan or through their direct lending post-PA.

Before conducting the main analysis, we explore the parallel trend of nonbank investments in the green and non-green loans within the sample using a dynamic differences-in-differences model in Fig. 2. The dependent variable equals 1 for nonbank investment in a loan, and the plotted coefficients are from interactions between the green loan indicator and half-year indicators, relative to 2015 H2 with 95% confidence intervals shown as vertical lines. Pre-shock coefficients are small and insignificant, supporting parallel trends prior to the Paris Agreement. The red dashed line marks the first post-shock period. After the Agreement, despite a one-period lag likely due to the time required to originate syndicated loans, coefficients rise sharply in 2016 H2 (0.439***) and 2017 H1 (0.286***), indicating increased nonbank investment in green loans. The lack of significance in 2017 H2 and 2018 H1 may be linked to policy shifts during the Trump administration, as discussed in Section 5. Overall, the figure suggests that state or international initiatives and market momentum toward green financing were fostered by the Paris Agreement.

4. Main results

4.1. Nonbank investment in green financing

We estimate the baseline difference-in-differences model in Eq. (1) and report the results in Table 2. A post-Agreement increase in nonbank

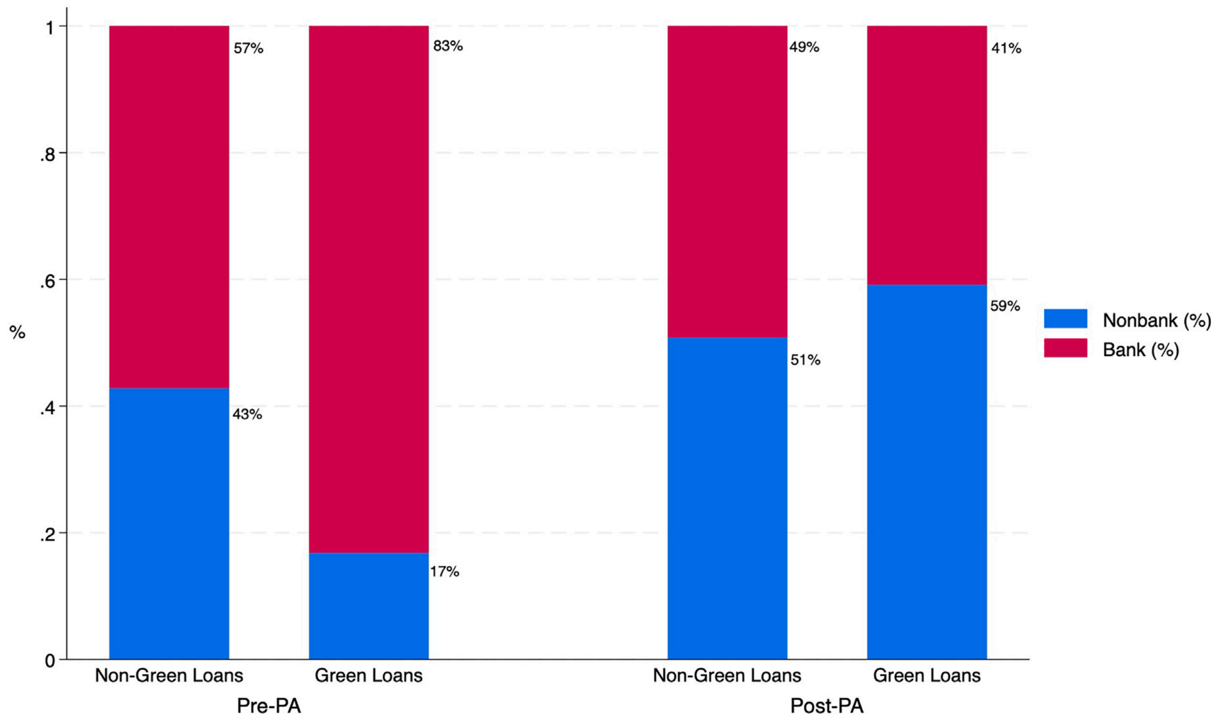

Fig. 1. Financing by banks and nonbanks: Pre- and post-Paris agreement.
Note: The graph presents a comparison of financing volumes provided by banks and nonbanks for green and nongreen loans before and after the Paris Agreement. Bank financing is calculated as the sum of revolving tranche amounts and Term Loan A amounts, while nonbank financing is represented by the sum of Term Loan B amounts. The Paris Agreement, adopted as a legally binding international treaty on climate change on December 12, 2015, serves as a key point of reference in the analysis. In the graph, "Pre-PA" indicates loan originations up to December 11, 2015, and "Post-PA" includes loan originations from December 12, 2015, through 2019. For comparability, all values are expressed as a percentage of the total amount of green and nongreen loans.

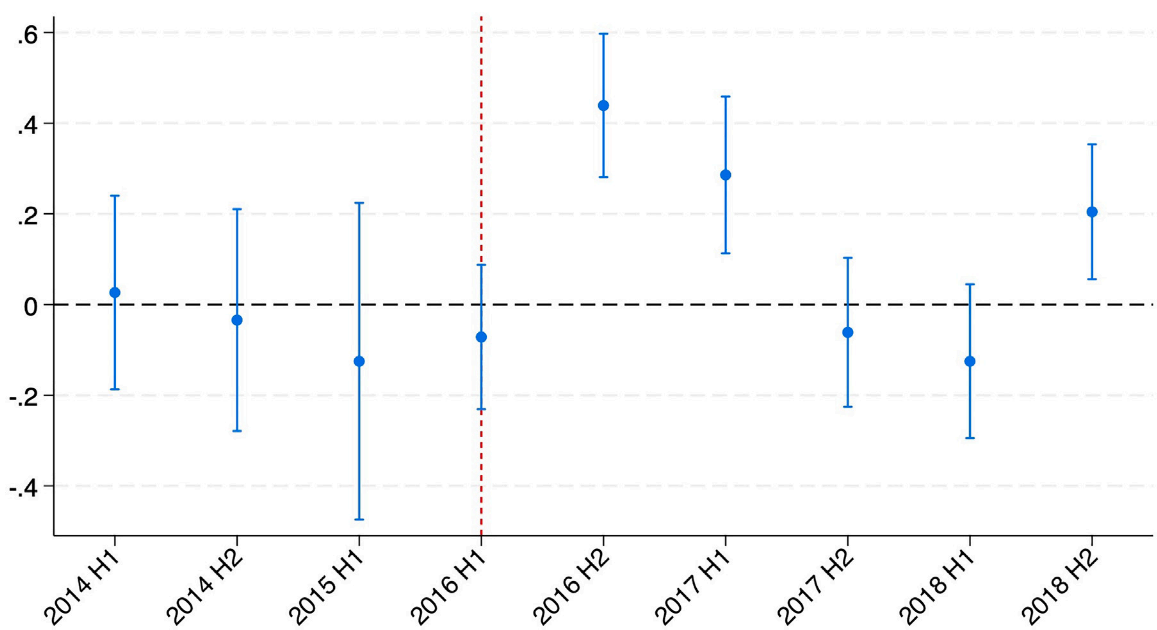

Fig. 2. Dynamic DID: Nonbank financing of green loans.
Note: This figure presents dynamic difference-in-differences estimates based on interactions between half-year indicators and the green loan dummy, designed to assess the parallel trend assumption underlying the DID approach. The dependent variable is nonbank investment. Coefficients are normalized relative to 2015 H2, the period of the regulatory shock. The vertical dotted red line indicates the beginning of the post-shock period (2016 H1). Vertical bars denote 95% confidence intervals. All coefficients in pre-shock period are not significantly different from zero, supporting the parallel trends assumption. In the post-shock periods, the estimates for 2016 H2, 2017 H1, and 2018 H2 are statistically significant at the 1% level, indicating a meaningful impact of the shock.

Table 3
Size of nonbanks' investment in green financing.

Panel A: Share of nonbank investment				
	Share of investment			
	(1)	(2)	(3)	(4)
Green Lending	−0.031***	−0.087***	−0.080***	−0.079***
	(0.005)	(0.007)	(0.002)	(0.004)
Post-PA × Green Lending	0.000	0.024	0.032***	0.035***
	(0.005)	(0.014)	(0.008)	(0.006)
Lender FE	Y	N	N	N
Lender-time FE	N	Y	Y	Y
Industry FE	N	Y	N	N
Industry-time FE	Y	N	Y	N
Country FE	N	Y	N	N
Country-time FE	Y	N	Y	N
Country-industry-time FE	N	N	N	Y
Observations	11 864	11 864	11 864	11 864
Adjusted R^2	0.254	0.225	0.274	0.277

Panel B: Nonbank direct participation				
	Direct participation			
	(1)	(2)	(3)	(4)
Green Lending	−0.018***	0.011***	−0.017***	−0.015***
	(0.002)	(0.003)	(0.004)	(0.002)
Post-PA × Green Lending	0.026***	0.011***	0.026***	0.022***
	(0.004)	(0.003)	(0.003)	(0.003)
Lender FE	Y	N	N	N
Lender-time FE	N	Y	Y	Y
Industry FE	N	Y	N	N
Industry-time FE	Y	N	Y	N
Country FE	N	Y	N	N
Country-time FE	Y	N	Y	N
Country-industry-time FE	N	N	N	Y
Observations	5175	5175	5175	5175
Adjusted R^2	0.429	0.419	0.471	0.476

This table replicates the regressions from Table 2, with Panel A replacing the dependent variable with *Share of Nonbank Investment*, defined as the ratio of the institutional tranche size (Term B) to the total deal size, and Panel B replacing it with *Nonbank Direct Investment*, defined as an indicator equal to 1 if a loan includes nonbank participants and 0 otherwise. The sample consists of all syndicated loans between 2012 and 2019 except revolving-only loans. The main explanatory variable is *Post-PA* X *Green Lending*, an interaction term between *Post-PA*, which is equal to 1 for the period after the Paris Agreement (December 12, 2015) and 0 otherwise, and *Green Lending*, which is equal to 1 if a loan is for green purposes and 0 otherwise. Various combinations of lender, borrower industry, borrower country and time fixed effects are included. Standard errors are clustered by borrower-country. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

participation in green loans, relative to non-green loans, would be consistent with nonbanks accommodating rising corporate demand for climate-related credit.

The coefficient of interests, the interaction between *Post-PA* and *Green Lending*, is positive and significant at 1% in all specifications with different sets of fixed effects, indicating that nonbanks are more likely to invest in green loans after the Paris Agreement. Before the Paris Agreement, 15.4% of green loans were structured with nonbank investment. Therefore, the 10.7 percentage point increase in column (4) under the stricter specification with lender-time and borrower country-industry-time fixed effects represents a proportional rise of 69.5%, highlighting a substantial economic impact. A simple calculation based on sample totals indicates that nonbank investment in green loans increased approximately 2.7 times following the Paris Agreement, as the total volume of nonbank green loans, proxied by the sum of all Term B amounts, rose from USD 7160 million before the Agreement to USD 19,177 million afterward. It is also noteworthy that the coefficient for *Green Lending* is negative and significant, indicating that before the Paris Agreement green loans were less likely to be financed by nonbanks. This proves how dramatically the event changed nonbanks' supply of green lending.

These results are robust to a battery of alternative tests. To address potential reporting bias, we replicate Table 2 using two subsamples: loans with reported purposes and loans arranged by top-tier arrangers from Bloomberg's League Tables. Results, available upon request, remain consistent. We also restrict the sample to loans with sizes and spreads within the ranges observed for green loans, which confirms the main results. The robustness of our textual identification approach is also further validated using an alternative green finance taxonomy from the International Capital Market Association (Pfaff et al., 2021), which employs a more conservative classification and identifies 1.67% of loans as green, compared to 2.3% under our baseline definition. The results remain robust. Also, using an industry-stacked DID design (Cengiz et al., 2019), we confirm robustness to industry heterogeneity and compositional bias. Additional robustness checks, including a placebo shock and estimation using a Poisson model, also produce results consistent with the baseline. All robustness tests are summarized in Table A.3.1, which serves as a guide for the robustness analyses conducted. While the tables are omitted for brevity, the underlying results are available from the authors upon request.

In addition to examining the likelihood of nonbank investment in green lending (extensive margin), we test whether the size of nonbank investments is also increasing in green loans (intensive margin). In Table 3 Panel A, we replace the dependent variable with *Share of Nonbank Investment* and replicate the baseline model. *Share of Nonbank Investment* is measured as the ratio of the amount of the

Table 4
NonBank investment: Spread, Covenant, Joint Lead Arrangers (JLAs).

	Spread		Covenant		JLAs	
	(1)	(2)	(3)	(4)	(5)	(6)
Green Lending	75.742***	81.330***	−0.025	0.001	−0.575***	−0.360***
	(5.528)	(6.995)	(0.041)	(0.022)	(0.180)	(0.023)
Post-PA × Green Lending	−100.615***	−108.162***	−0.322***	−0.351***	2.327***	2.181***
	(6.662)	(5.697)	(0.027)	(0.021)	(0.149)	(0.114)
Lender-time FE	Y	Y	Y	Y	Y	Y
Industry-time FE	Y	N	Y	N	Y	N
Country-time FE	Y	N	Y	N	Y	N
Country-industry-time FE	N	Y	N	Y	N	Y
Controls	Y	Y	Y	Y	Y	Y
Observations	3746	3746	3847	3847	3847	3847
Adjusted R^2	0.356	0.359	0.197	0.206	0.688	0.739

This table reports the regression results on post-PA loan conditions of green purpose loans that carry institutional tranches. In columns (1) and (2), the dependent variable is spread, measured in basis points, charged on institutional tranches. In columns (3) and (4), the dependent variable is covenant strictness index that is between 0 and 6 constructed by counting the number of financial covenants included in a loan deal following Bradley and Roberts (2015). In columns (5) and (6), the dependent variable is joint lead arrangership, measured by the number of lead arrangers involved in the deal to which the institutional tranche belongs. In all regressions, the following control variables are included whose results are not tabulated: loan amount that is log-transformed total size of loan and maturity that is log-transformed number of months between start and end of a loan deal. The main explanatory variable is the interaction term between *Post-PA*, which equals 1 for the period after the Paris Agreement (December 12, 2015) and 0 otherwise, and *Green Lending*, which equals 1 if the loan is designated for green purposes and 0 otherwise. Various combinations of lender, borrower industry, borrower country and time fixed effects are included. Standard errors are clustered by borrower country. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

nonbank investment (Term B) to total loan amount. This variable captures the size of nonbank investment per loan. In columns (3) and (4), which use more restrictive fixed effects, the coefficients of the interaction terms are positive and significant, indicating that a larger portion of green loans are financed by nonbanks after the Paris Agreement. According to column (4), nonbanks' contribution size increases by 3.5 percentage points, representing a 33% increase relative to the pre-PA level, as the mean of nonbank contribution size was 10.6% of the total deal amount. Given that the average size of a Term B green loan is USD 769.93 million, the additional 3.5% contribution translates into the USD 27 million increase per loan. In Panel B, we further explore another dimension of nonbank involvement by examining their direct investment in green loans in the primary market. The dependent variable is set as $Nonbank\ Direct\ Investment$, which is equal to 1 if a loan contains nonbanks as participating lenders and 0 otherwise. Results show that direct nonbank financing also increases after the Agreement by 2 percentage points.

Together, these results show that credit supply by nonbanks in green lending expands both in number of loans and in terms of within-loan contribution.

4.2. Loan pricing effects of nonbank investment

In this section, we examine how nonbank participation affects loan terms to identify whether partnerships are bank- or nonbank-initiated. As discussed in Section 2, if nonbanks actively seek green assets, their involvement should be associated with more favorable pricing, such as lower spreads. In contrast, if banks initiate partnerships to offload risk, we would not expect systematically more favorable loan terms.

We run the regression in Eq. (1) by replacing the dependent variables with loan conditions and report the results in Table 4.

In columns (1) and (2), we find that, before the Paris Agreement, green loans, on average, demanded higher spreads than similar tranches of non-green loans. However, there is a significant reduction in spreads following the Paris Agreement, as the coefficients for the interaction terms show a reduction of 100–108 basis points. This evidence confirms the role of nonbank credit supply in driving the increase in bank-nonbank partnerships.

Loan pricing decisions are complemented by decisions on covenants, which are often used as a proxy for the intensity of loan monitoring. Existing studies have argued that loans securitized or sold to the market tend to have loose covenants (Wang and Xia, 2014). Similarly, we hypothesize that demand pressure from nonbanks for green loans should lead to a reduction in loan monitoring. In columns (3) and (4) of Table 4, we observe that green loans with nonbank investment have, on average, a similar number of covenants compared to non-green loans before the Agreement. However, following the event, green loans are subject to comparatively less stringent covenants, implying reduced ex-post monitoring.

Finally, we test whether nonbanks prefer loans with greater risk-sharing by using the number of joint lead arrangers (JLAs) as a proxy. As shown in columns (5) and (6) of Table 4, green loans with nonbank investment were associated with fewer JLAs before the Paris Agreement, but more JLAs afterward. This shift suggests that as nonbanks expand their green lending, they increasingly rely on larger syndicates to share risks.

5. What drives nonbank investment in green loans?

While our earlier results show that nonbanks increased their investment in green lending following the Paris Agreement, the underlying drivers remain unclear. Their response may reflect a growing investor awareness of long-term climate-related financial risks, or a short-term response to regulatory pressure. To explore this distinction, we examine whether nonbank investment is sensitive to major political events. If regulatory expectations are a key driver, we expect green lending by nonbanks to respond to changes in the climate policy stance of the party in power. Such sensitivity would imply that shifts in political commitment can directly influence the formation of bank-nonbank partnerships and the supply of green credit.

Following Ramelli et al. (2021), we use shifts in U.S. climate policy to test whether nonbanks' investments in green loans are driven by concerns about regulatory transition risk, defined as the risk that financial institutions will face costly portfolio adjustments due to stricter requirements to support green activities or limit exposure to carbon-intensive sectors. Our first test exploits an event around the 2016 election of Donald Trump as president. This election signaled a reduction in regulatory transition risk due to the relaxed climate position taken by the incoming administration during the campaign. We treat this event as a reverse treatment of the Paris Agreement, and specifically focus on

Trump administration's appointment of an anti-climate change official to lead the Environmental Protection Agency (EPA). While Trump's election had been used in previous studies, this appointment was the first direct effect that materially conveyed a strong message regarding the U.S.'s new environmental policy, later confirmed by the subsequent U.S. withdrawal from the Paris Agreement. As a second test, we explore the subsequent reversal of this shock, using the presidential election in 2020, during which the incoming president, Joe Biden, vowed to rejoin the climate treaty and reversed the prior administration's executive orders.

If driven by long-term climate risk, nonbank investment should remain stable following the U.S. government's anti-climate stance. If instead motivated by transition risk, we would expect a decline in nonbank participation after the appointment of a climate-skeptic EPA head. To test this, we focus on U.S. loans arranged by U.S. lead banks for U.S. borrowers and restrict the sample to the post-Paris period (December 2015-December 2018), covering 18 months before and after the December 2016 EPA nomination.

We follow a similar model to our baseline regression, and report the results in Table 5. In Panel A, the coefficient for the interaction term between *Anti-climate change* and *Green Lending* shows that green loans no longer attract nonbank investments after the reverse policy shock; the coefficients are negative and significant, implying that there is a clear reversal. In magnitude, nonbanks are 26.4% less likely to participate in green loans. This result demonstrates that the interests of nonbanks were transient and primarily motivated by the presence of regulatory transition risks. In Panel B of Table 5, we present the results for the U.S. presidential election on November 7, 2020. The sample period ranges from 2019 to 2022, and *Pro-climate change* is equal to 1 for the period after November 7, 2020, which corresponds to two years before and two years after the event. The interaction term between *Pro-climate change* and *Green Lending* being the main explanatory variable. We find evidence that nonbank interest in green lending returns following the change. Overall, the results show that nonbanks respond to shifts in perceived climate policy and intentionally direct funds toward green loans to demonstrate political alignment. Consistent with this behavior, we observe that these allocations are clustered at quarter-end following the Paris Agreement, reversing the pattern observed prior to its adoption (results available upon request).

Table 5
Reverse treatment: U.S. climate policy changes around the Paris Agreement (U.S. Sample).

Panel A: Anti-climate change shock Republican EPA leader appointment			
	Nonbank investment		
	(1)	(2)	(3)
Green Lending	0.055	0.143**	0.127*
	(0.083)	(0.070)	(0.067)
Anti-climate change × Green Lending	−0.174*	−0.278**	−0.264**
	(0.100)	(0.111)	(0.131)
Lender FE	Y	N	N
Lender-time FE	N	Y	Y
Industry FE	N	Y	N
Industry-time FE	Y	N	Y
Observations	2594	2594	2594
Adjusted R^2	0.356	0.409	0.424

Panel B: Pro-climate change shock Democrats' win in presidential election			
	Nonbank investment		
	(1)	(2)	(3)
Green Lending	−0.189***	−0.157***	−0.132**
	(0.039)	(0.048)	(0.061)
Pro-climate change × Green Lending	0.256***	0.178***	0.144**
	(0.056)	(0.059)	(0.072)
Lender FE	Y	N	N
Lender-time FE	N	Y	Y
Industry FE	N	Y	N
Industry-time FE	Y	N	Y
Observations	9473	9473	9473
Adjusted R^2	0.394	0.470	0.553

This table reports the regression results of Eq. (1) based on the U.S. government's appointment of an anti-climate change action EPA leader (Panel A) and the U.S.'s change of government which turned itself back to pro-climate change action position in 2020 (Panel B). In Panel A, the sample consists of all U.S. syndicated loan deals between December 2015 and December 2018 except revolving-only loans. The main explanatory variable is the interaction term between *Anti-climate change* and *Green Lending*. *Anti-climate change* is equal to 1 for the period after December 7 2016, which is the date that the U.S. government appointed an EPA leader who is against climate change actions. *Green Lending* is equal to 1 if a loan is for green purposes and 0 otherwise. The dependent variable is $Nonbank\ Investment$ which is a binary variable that is equal to 1 if the loan contains institutional tranche and 0 otherwise. In Panel B, the sample consists of all U.S. syndicated loans in the U.S. between 2019 and 2022 except revolving-only loans. *Pro-climate change* is equal to 1 for the period after 7 November 2020, which is the election date that the U.S. government had a new president who is pro-climate change actions and regulations. The rest of the regression models are analogous to those in Panel A. Various combinations of lender, borrower industry and time fixed effects are included. Standard errors are clustered by lenders. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6. Exploring heterogeneity: Bank, borrower, and loan characteristics

This section examines how nonbank participation in green lending varies across bank attributes, borrower profiles, and loan characteristics. We aim to understand which banks attract nonbank participation, which borrowers benefit most, and whether certain deal structures shape these partnerships. We extend Eq. (1) to a triple-difference setting and perform split-sample analyses to capture these sources of heterogeneity.

To explore bank heterogeneity, we focus on two dimensions of banks' green origination: prior specialization in green lending and commitment to global climate targets. Specifically, we construct two proxies for bank greenness: $Green\ Portfolio$, equal to one if the bank's number of green loans originated before the Paris Agreement is above the sample median, and $Green\ Commitment$, equal to one for banks committed to the Science-Based Targets initiative (Kacperczyk and Peydro, 2022). Nonbanks may prefer partnering with more specialized banks because green projects involve informational frictions and monitoring challenges. Conversely, SBTi-committed banks may devote more of their balance sheet capacity to directly financing green projects, reducing their need for nonbank participation. As shown in Table A.2.1 columns (1) and (2), the triple-interaction terms for $Green\ Portfolio$ are negative while insignificant, and those for $Green\ Commitment$ are negative and significant at the 1% level, indicating that nonbanks are less likely to co-finance loans with committed banks. Given that SBTi-committed banks originate a substantially higher share of green loans (9% versus 2.5%), this pattern suggests that committed banks rely less on nonbank funding in their green activities.

We further consider bank experience in nonbank financing by constructing two proxies: $NB\ Experience$, equal to one if the number of pre-Paris loans originated by a bank with nonbank investment is in the top quartile, and $CLO\ Access$, equal to one if the bank has served as an underwriter or collateral manager for a collateralized loan obligation (CLO) vehicle. Banks with stronger connections to nonbanks or access to the CLO market may provide better risk-sharing and distribution opportunities. Results in Table A.2.1 columns (3) and (4) confirm that both variables positively influence nonbank lending. Overall, the results on bank heterogeneity indicate that nonbanks favor partnerships with banks offering close relationships and trading opportunities rather than green specialization.

Next, we examine borrower heterogeneity along two key dimensions: ownership status and environmental exposure. Public and private

Table A.1.1
Green keywords dictionary.

Include words:	ecolo	solar	wind	environment	environmental
	environmentally	global warming	climate	pollution	sustainable
	sustainability	clean energy	photovoltaic	pv cells	csp dishes
	inverters	transformers	electric	electricity	turbines
	geotheramal	ghp	heat pump	emissions	bioenergy
	biofuel	biomass	biogas	biorefinery	cogeneration
	sustainable	energy efficiency	hydro	hydropower	hydrogen
	hydroelectric	run of river	impoundment	pumped storage	carbon cooling
	tidal	ocean thermals	decarbonization	electrified	hybrid vehicles
	ghg	drought	flood	rainwater	recycling
	wastewater	ecological	forest	erosion	evotranspiration
	wetland	recyclable	reusable	landfill	re use
	composting	renewable			
Exclude words:	unwind	anhydrous	windows	kokusai electric corp	wind point partners
	tailwind	windoor	highground	windjammer	windstream
	windsor	social	esg	ethical	

This table lists the keywords extracted from the Climate Bonds Taxonomy issued by the Climate Bonds Initiative. These keywords form the basis of our textual analysis of the "Loan Purpose Remark" field reported in DealScan. A loan is classified as green if this field contains at least one of these keywords. We exclude vague terms such as "ESG" and "ethical" that do not specify the use of proceeds. In cases where multiple loan remarks are reported, we classify the loan as green if at least one remark contains a keyword. In cases where a loan remark is not available, we classify the loans as non green. We exclude cases where a loan purpose remarks contains green keywords but the loan is unrelated to environmental purposes. Common false positives occur when company names contain keywords such as "Tailwind", "Windoor", or "Windsor", or when the description contains unrelated words such as "unwind", "anhydrous", or "windows". Examples from pf loan purpose remarks from DealScan are: "Credit backs the acquisition of a 1.19 GW portfolio of **renewable** operating assets inclusive of 7 **wind** projects and a 50 percent interest of 3 **solar** projects located across the 10 states of Nevada, Iowa, North Dakota, Illinois, Michigan, Arizona, Washington, Oregon, New Mexico and Minnesota."; "Credit provides long term, non recourse financing for the 30 MW Mckenzie **solar** project, that will be located in Sacramento County, California. The project has already begun construction and cod is expected by December 2012.";

Table A.1.2
Validation tests: Green loans and green economy transition indicators (Renewable).

	1	2	3	4	5	6	7
1 Number of green loans	1.0000						
	(0.0000)						
2 Share of green loans (%)	0.0726	1.0000					
	(0.4919)	(0.0000)					
3 Amount of green bonds	0.3035**	0.1004	1.0000				
	(0.0033)	(0.3408)	(0.0000)				
4 Electricity installed capacity (GWh)	0.7900***	0.0213	0.4095***	1.0000			
	(0.0000)	(0.8456)	(0.0001)	(0.0000)			
5 Share of electricity (%)	0.7532***	0.0056	0.3298**	0.9861***	1.0000		
	(0.0000)	(0.9592)	(0.0019)	(0.0000)	(0.0000)		
6 Electricity generation (GWh)	0.7542***	0.0140	0.3136**	0.9555*	0.9487***	1.0000	
	(0.0000)	(0.8980)	(0.0033)	(0.0000)	(0.0000)	(0.0000)	
7 Share of electricity generation (%)	0.7243***	0.0033	0.2570**	0.9417***	0.9547***	0.9924***	1.0000
	(0.0000)	(0.9760)	(0.0169)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

This table presents the correlations between green loan, classified using textual analysis of DealScan data and indicators of green economy transition at country-level. Both variables are measured at the country level. Green loans are captured using two metrics: the number of green loans identified in each country and the share of green loans in a given country relative to the total green loans issued globally in a specific year. To validate our identification of green loans in DealScan, we examine their correlation with the issuance of green bonds at the country level and with energy transition indicators. The latter are measured by the installed capacity of renewable energy and the amount of renewable energy generated. These indicators are sourced from the Economic Transition Indicators in the IMF Climate Change Dashboard, which relies on data from the International Renewable Energy Agency (IRENA) (2022), Renewable Energy Statistics 2022. Renewable energy quantities are measured across ten technologies, including bioenergy, geothermal, hydropower, marine energy, solar energy, and wind energy. For variables 4 and 6, we use economic transition indicators expressed in gigawatt-hours per country. For variables 5 and 7, we scale the indicators to reflect the proportion of installed capacity or generated energy relative to global totals. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.1.3
Time trend of green and non-green lending.

All sample	2012	2013	2014	2015	2016	2017	2018	2019	Total
No of loans	1413	1518	1674	1406	1395	1508	1558	1392	11 864
No of non-green purpose loans	1400	1510	1638	1361	1366	1474	1498	1344	11 591
No of green purpose loans	13	8	36	45	29	34	60	48	273
as % to all loans	0.92%	0.53%	2.15%	3.20%	2.08%	2.25%	3.85%	3.45%	2.30%
by "green" keywords (selection):									
"Solar"	0	1	18	16	15	23	18	26	0.99%
"Wind"	8	5	5	23	15	6	23	22	0.90%
"Electric"	1	5	9	10	4	6	12	6	0.45%
"Photovoltaic"	0	0	1	0	1	4	7	1	0.12%
"Hydro"	0	1	0	0	1	4	0	4	0.08%
"Renewables"	0	0	0	1	0	1	3	1	0.05%
Sub-sample: Private firms	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**
No of loans	1135	1212	1352	1095	1176	1274	1270	1188	9702
No of non-green purpose loans	1122	1207	1327	1054	1147	1241	1213	1140	9451
No of green purpose loans	13	5	25	41	29	33	57	48	251
as % to all loans	1.15%	0.41%	1.85%	3.74%	2.47%	2.59%	4.49%	4.04%	2.59%
by "green" keywords (selection):									
"Solar"	0	1	13	14	15	23	18	26	1.13%
"Wind"	8	5	4	19	13	6	23	22	1.03%
"Electric"	1	2	3	10	4	6	10	5	0.42%
"Photovoltaic"	0	0	1	0	1	4	7	1	0.14%
"Hydro"	0	0	0	0	1	3	0	4	0.08%
"Renewables"	0	0	0	1	0	1	3	1	0.06%

This table reports yearly statistics of green and non-green loans for the sample period. Number of loans is the count of each type of loans while percentage is yearly proportion of each type of loan in the year's sample. Statistics are also provided for the most frequent keywords. Notice that a loan can have more than one "green" keyword in the loan purpose remarks in DealScan. Green Keywords from Climate Bonds Initiative Taxonomy are listed in the Table A.1.1.

Table A.2.1
Bank heterogeneity.

	Nonbank investment			
	(1)	(2)	(3)	(4)
Post-PA × Green Lending × Green Portfolio	−0.011			
	(0.021)			
Post-PA × Green Lending × Green Commitment		−0.078***		
		(0.017)		
Post-PA × Green Lending × NB Experience			0.137***	
			(0.012)	
Post-PA × Green Lending × CLO Access				0.261***
				(0.017)
Lender-time FE	Y	Y	Y	Y
Country-industry-time FE	Y	Y	Y	Y
Observations	11 864	11 864	11 864	11 864
Adjusted R^2	0.391	0.391	0.391	0.391

This table reports the regression results of Eq. (1) augmented with interaction terms. The sample consists of all syndicated loan deals between 2012 and 2019 except revolving-only loans. The main explanatory variable is the triple-interaction terms, where $Post\text{-}PA$ X $Green\ Lending$ is interacted with the following four different variables: $Green\ Portfolio$ in column (1), which is equal to 1 for the arranger bank whose number of green loan origination was above median before the Paris Agreement, $Green\ Commitment$ in column (2) which is equal to 1 if the arranger bank made a Science Based Targets initiatives (SBTi) commitment, $NB\ Experience$ in column (3), which is equal to 1 for the arranger bank whose number of institutional tranche origination was in upper quartile in the pre-PA period and $CLO\ Access$ in column (4), which is equal to 1 for the arranger bank who act as a CLO underwriter or collateral manager. The dependent variable is $Nonbank\ Investment$ which is equal to 1 if the loan contains institutional tranche and 0 otherwise. Lower-order interaction coefficients are omitted for brevity. Lender and time fixed effects and country-industry-time fixed effects are included. Standard errors are clustered by borrower-country. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.2.2
Borrower heterogeneity.

	Nonbank investment			
	Public (1)	Private (2)	Polluting (3)	Other (4)
Green Lending	0.053	−0.129***	−0.123***	−0.031
	(0.049)	(0.004)	(0.001)	(0.018)
Post-PA × Green Lending	−0.694***	0.117***	0.167***	−0.151***
	(0.044)	(0.011)	(0.002)	(0.017)
Lender-time FE	Y	Y	Y	Y
Country-industry-time FE	Y	Y	Y	Y
Diff. in coefficients (*p-value*)	0.000		0.000	
Observations	1534	9551	2397	8760
Adjusted R^2	0.257	0.446	0.354	0.409

This table replicates the main analysis in Table 2 for a split sample of public and private firm borrowers in columns (1) and (2) and for polluting industry borrowers and other industry borrowers in columns (3) and (4). We classify agriculture, construction, manufacturing, mining, oil and gas, textile and apparel, transportation and utilities industries as polluting industries (Causa et al., 2024). The sample consists of all syndicated loans between 2012 and 2019 except revolving-only loans. The explanatory variable is $Post\text{-}PA$ in columns (1), which is equal to 1 for the period after the Paris Agreement (December 12, 2015) and 0 otherwise. The main explanatory variable is the interaction term between $Post\text{-}PA$ and $Green\ Lending$, which is equal to 1 if a loan is for green purposes and 0 otherwise. The dependent variable is $Nonbank\ Investment$ which is a binary variable that is equal to 1 if the loan contains institutional tranche and 0 otherwise. Chow-tests are performed to test the difference in coefficients between columns (1) and (2) and between columns (3) and (4). Lender and time fixed effects and country-industry-time fixed effects are included. Standard errors are clustered by borrower-country. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

firms differ in their access to external financing. Public firms can raise funds in capital markets, including green bonds, whereas private firms depend primarily on banks. For nonbanks, investing in loans to private firms offers diversification beyond listed entities but may involve greater opacity and risk. The direction of the effect is therefore ambiguous: nonbanks may prefer private borrowers for diversification or public borrowers for transparency. Results reported in Table A.2.2 columns (1) and (2) show that nonbank participation in green lending increases for private firms and decreases for public firms, with the difference statistically significant based on a Chow test ($p < 0.001$). We also compare polluting industries such as agriculture, construction, manufacturing, mining, oil and gas, textiles, transportation, and utilities with other sectors following Causa et al. (2024). These industries face greater regulatory pressure and transition risk but also offer the potential for larger environmental impact. Table A.2.2 columns (3) and (4) shows that the post-Paris increase in nonbank financing is concentrated among polluting industry borrowers, whereas nonbank participation in green loans to non-polluting industries declines. The results on borrower heterogeneity thus suggest that nonbanks channel funds toward firms most in need of transition financing.

Finally, we assess whether differences in loan structure explain the observed patterns. Nonbanks may be more active in leveraged or private equity-sponsored deals, which typically involve larger and more complex transactions. To examine this, we split the sample by loan type (leveraged versus investment grade) and sponsorship status (sponsored versus unsponsored). As shown in Table A.2.3, nonbank participation in green loans remains statistically and economically significant across all subsamples. This finding indicates that our main results are not driven by deal complexity or institutional involvement.

7. Conclusion

This paper examines the role of nonbank financial intermediaries (NBFIs) in the syndication of green loans, focusing on the post-Paris Agreement period as a structural shift in climate finance. Utilizing a novel loan-level classification based on the stated use of proceeds in syndicated loan contracts, we provide new evidence on how bank-nonbank partnerships have evolved in response to rising demand for transition capital.

Our findings yield three main contributions. First, we document a marked increase in nonbank participation in green loans following the Paris Agreement. Second, we show that nonbanks act as marginal suppliers of green credit rather than passive recipients of bank-offloaded risk. Their participation is associated with more favorable loan terms, consistent with an expansion in credit supply. This evidence shifts the focus from nonbanks' role in absorbing brown assets in secondary markets to their active origination of green loans. In this context, we provide new evidence on the intermediation channels through which nonbanks deploy capital to support green investment. Third, our novel approach to green loans identification that extends to private firms, reveals that high-emission sectors and private firms are the principal recipients of nonbank capital in green loan syndication.

These findings establish the salience of NBFIs in scaling transition finance, but also reveal important limitations. We document that nonbank investment is highly sensitive to changes in the climate policy environment, as participation declines during periods of diminished regulatory momentum. These results underscore both the capacity and conditionality of nonbank finance in supporting the low-carbon transition. NBFIs' sustained participation appears contingent on the presence of a stable and credible climate policy framework. Strengthening regulatory coherence, improving disclosure standards, and integrating transition risk into supervisory architectures may increase the reliability of nonbank capital in green credit markets.

CRediT authorship contribution statement

Angela Gallo: Writing – review & editing, Writing – original draft, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Min Park:** Writing – review & editing, Writing – original draft, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

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

Appendix

A.1. Textual classification tests

See Tables A.1.1–A.1.3.

A.2. Heterogeneity tests

See Tables A.2.1–A.2.3.

A.3. Guidance for robustness tests

See Table A.3.1.

Data availability

The data that has been used is confidential.

Table A.2.3
Loan heterogeneity.

	Nonbank investment			
	Leveraged (1)	Investment-grade (2)	Sponsored (3)	Unsponsored (4)
Green Lending	−0.051***	−0.018***	0.193***	−0.131***
	(0.002)	(0.001)	(0.010)	(0.005)
Post-PA × Green Lending	0.355***	0.022***	0.052*	0.151***
	(0.006)	(0.001)	(0.028)	(0.010)
Lender-time FE	Y	Y	Y	Y
Country-industry-time FE	Y	Y	Y	Y
Observations	7759	3245	4392	6679
Adjusted R^2	0.337	0.342	0.391	0.364

This table reports results from split-sample regressions. Columns (1) and (2) divide the sample based on loan grade: loans with a market segment description containing 'Leveraged' are classified as leveraged loans (column 1), while all others are treated as investment-grade loans (column 2). Columns (3) and (4) classify loans based on private equity sponsor involvement: loans with a market segment description containing 'Sponsored' are treated as sponsored loans (column 3), and the rest as unsponsored (column 4). The main explanatory variable remains consistent with the baseline analysis, which is an interaction term between *Post-PA* and *Green Lending*. The dependent variable, *Nonbank Investment*, equals 1 if the loan includes an institutional tranche and 0 otherwise. All regressions include lender-time fixed effects and borrower country-industry-time fixed effects. Standard errors are clustered at the borrower-country level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.3.1
Summary of robustness tests.

Potential concern	Test	Location
Main results		
Loan purpose reporting bias	Consistent results when restricting to loans with purpose remarks.	Unreported
Loan purpose reporting bias	Consistent results when restricting to top-tier arrangers on Bloomberg's syndicated loan league tables.	Unreported
Industry heterogeneity	Consistent results in Cengiz et al. (2019) style industry-stacked DID design.	Unreported
Sample comparability	Consistent results when restricting to loans with sizes and spreads within ranges observed for green loans.	Unreported
Time trend in green lending	No results with a placebo test that advances the Paris Agreement date by three years.	Unreported
Model specification	Consistent results using a Poisson model.	Unreported
Strategic behavior	Additional evidence of window dressing: nonbanks' green financing is clustered at quarter-end.	Unreported
Textual analysis		
Validation of textual analysis	Positive correlation between the number of green loans identified and green bond issuance and renewable energy expansion at the country level.	Table A.1.2
Validation of green dictionary	Consistent results when using an alternative ICMA taxonomy.	Unreported

This table summarizes all robustness tests for the main results and the tests for validation of the textual analysis. It serves as a structured reference linking each potential concern discussed in the paper to the corresponding tests performed to address them. For brevity, most tables are not reported, but all results are available upon request.

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