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Bond Versus Banks Financing In The Climate Transition: The Role Of Stranded-Asset Risk

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Bond versus banks financing in the climate transition: The role of stranded-asset risk

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Abstract

What role does bond versus bank debt play in the climate transition? We document that fossil fuel firms with greater stranded-asset risk rely less on bond finance and more on bank credit. While bond investors price stranding risk, banks in the syndicated loan market do not. This differential pricing leads to within-firm substitution from bonds to loans, consistent with a relative contraction in bond market credit supply. We also find that large banks are more likely to lend to risk-exposed firms, raising

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questions about how climate risk is distributed and whether credit flows align with transition objectives.
(98 words)

1 Introduction

Transforming the global economy into a sustainable one requires shifting investment away from the fossil fuel industry. The allocation of financial capital shapes both the direction and pace of this transition, placing the financial sector at its center. Among different financing instruments, debt plays a particularly important role: Fossil fuel extraction is highly capital-intensive, and fossil fuel firms traditionally have highly leveraged balance sheets. As a result, bond markets and banks are uniquely positioned to either sustain fossil fuel investments or redirect capital toward more sustainable alternatives.

The transition to a low-carbon economy, however, exposes the financial sector to significant credit risks by limiting the extraction and use of fossil fuel resources by companies to which banks and bondholders are exposed. Meeting the Paris Agreement’s temperature goal—limiting global warming to 2°C—requires leaving a significant portion of current fossil fuel reserves unburned (McGlade & Ekins, 2015), risking billions of dollars in existing investments becoming obsolete (Addison, 2018; Carbon Tracker Initiative, 2017). Stranded-asset risk—the risk of fossil fuel investments losing value due to the transition to a low-carbon economy, particularly as a result of stricter climate policies—stems from constraints on fossil fuel supply (input risk), while broader carbon risk primarily arises from the emissions generated by burning fossil fuels (output risk). There is growing consensus that this risk poses a material threat to fossil fuel companies, likely to materialize as governments enforce stricter environmental policies (Krueger et al., 2020; Meng, 2017). Firms with fossil fuel reserves in jurisdictions with stringent climate policies face a higher likelihood that these assets will become unextractable and lose economic value, increasing the risk of stranding.¹ As carbon regulations tighten, stranded-asset risk increases, prompting lenders to raise interest rates or ultimately restrict credit to risky fossil fuel firms to offset higher default risk. Yet despite growing awareness, the implications of stranded-asset risk for corporate debt financing

¹Stringent climate policies can either directly prohibit the development of certain fossil fuel reserves (e.g., legal caps on gas production at Groningen in the Netherlands or Germany’s coal phase-out) or raise production costs to the point where extraction becomes economically unviable (e.g., Canada’s federal carbon price increases costs for upstream oil sands, reducing the profitability of fossil fuel extraction). While no country has fully banned fossil fuel extraction, current policy stringency reflects political commitment and institutional credibility in pursuing climate goals. This commitment is forward-looking, as countries with stringent policies are more likely to maintain or strengthen them over time. Such path dependence, captured for example by one of the indices of climate policy stringency we deploy, i.e., the Country Climate Policy Index and in particular its Climate Policy subcomponent, makes current stringency a relevant proxy for future stranding risk (to be discussed more below, but notice that this measure captures the expected level of policy commitment, not the uncertainty on future changes—that is, the first-order moment, not its second).

remain insufficiently understood.

This paper investigates how stranded-asset risk—caused by increasingly stringent climate policies—affects the cost and composition of corporate debt financing in the fossil fuel sector, focusing on the distinct roles of bond and bank financing. We combine firm-level data on fossil fuel reserves with country-level climate policy stringency to construct a forward-looking, input-based measure of stranded-asset risk. While previous studies have examined transition risk in financial markets (e.g., Bolton & Kacperczyk, 2023; Sautner et al., 2023), this paper is the first to analyze how stranded-asset risk impacts both market-based and bank-based debt financing, offering a novel approach to understanding how credit responds to policy-driven asset devaluation. Our analysis contributes to the debate on the financial sector’s role in the low-carbon transition by documenting how differences in risk pricing between bond markets and banks shape corporate debt financing in the fossil fuel sector. We show that stranded-asset risk is priced in corporate bond markets, raising borrowing costs relative to syndicated bank lending. Crucially, this pricing differential leads fossil fuel firms to shift from bond financing to bank loans, with large banks playing a central role in sustaining fossil fuel credit.

We construct a measure of stranded-asset risk by combining firm-level fossil fuel reserves by country and year with the stringency of climate policies in each country-year. This measure, which we term climate policy exposure, proxies for the risk of fossil fuel asset stranding due to tightening climate regulation. It is defined as the product of a firm’s fossil fuel reserves in a given country-year and that country’s policy stringency, as captured in our main specifications by the Climate Change Performance Index (CCPI) compiled by Germanwatch (Burck et al., 2016). The CCPI is designed to capture policy-driven climate performance through four weighted components: Climate Policy, GHG Emissions, Renewable Energy, and Energy Use. All components are shaped by national regulatory and political decisions. As such, the CCPI reflects the ambition and implementation of climate policy. Unlike prior studies that measure carbon risk using firms’ emissions data (e.g., Ilhan et al., 2020; Reghezza et al., 2022; Seltzer et al., 2022), our approach captures stranded-asset risk, which more directly reflects the financial risks of future climate policies. This distinction is critical because emissions data may conflate risk exposure with corporate behavior or social responsibility motives, whereas stranded-asset risk isolates financial risk from policy-driven asset devaluation. We confirm the validity of our climate policy exposure measure using alternative indices, component-level validation, and reserve-location strategies.² To assess whether

²These validation exercises include: (i) Using only the Climate Policy sub-component of the CCPI, which is based on expert assessments of countries’ climate policy frameworks and implementation. This sub-index is explicitly forward-looking, as it captures expectations about the direction and credibility of future policy efforts and is less likely to be

climate policy exposure reflects economically meaningful and forward-looking stranded-asset risk, we examine its relationship with firm valuation metrics. Firms with higher exposure trade at significantly lower Tobin's Q and market-to-book ratios, consistent with investor anticipation of reduced asset viability rather than endogenous asset devaluations, as the effect is driven by market—not book—equity.

3

Our dataset combines firm-level data on new corporate bond issuances and syndicated bank loans, the two primary external financing sources for fossil fuel firms. Large fossil fuel companies typically rely less on smaller bilateral loans (Weyzig et al., 2014), while corporate bonds account for a substantial share of their debt financing. Prior research further shows that corporate bonds and syndicated loans often serve as substitutes (Badoer et al., 2019; Becker & Ivashina, 2014; Fabozzi et al., 2019).

Our identification strategy exploits firm-level variation in stranded-asset risk within the fossil fuel sector. We define fossil fuel firms as those with a Standard Industrial Classification (SIC) code between 1200 and 1400, which includes only "pure-play" oil, gas, and coal producers. In the full sample, we define the treatment as the interaction between a fossil fuel sector indicator and firms' exposure to climate policy risk, measured by our climate policy exposure variable. To isolate stranded-asset risk from broader sector effects, we condition on fossil fuel firms and compare those without fossil fuel reserves—who face no stranded-asset risk—to those with reserves, thereby holding sector membership constant and attributing differences in financing conditions to variation in reserve exposure. To further demonstrate that our results capture stranded-asset risk rather than risks related to firms' carbon emissions, we control for firm-level emissions in robustness tests based on a smaller sample with available Trucost data.

The identifying assumption underlying our analysis is that the geographic distribution of firms' fossil fuel reserves is unrelated to unobserved determinants of their financing conditions, encompassing both the cost and composition of corporate debt financing. For this assumption to hold, two conditions must be satisfied. First, the location of fossil fuel reserves—that is, the exposure weights—must be predetermined and uncorrelated with future climate policy shocks. This assumption is plausible in our setting: we focus on proved reserves, which are determined by geological factors and past exploration decisions and are costly to adjust, as proving and developing reserves requires substantial, irreversible

confounded by factors such as geographic endowments (e.g., natural access to hydropower or solar potential); (ii) replacing the CCPI with the Climate Change Cooperation Index (C3I) as an alternative measure of climate policy stringency; and (iii) measuring climate policy exposure at the firm's headquarters location rather than at the reserve location.

³This approach follows a broad literature using firm value as a signal of asset productivity and risk, including Pástor & Pietro (2003) and İmrohoroglu & Tüzel (2014).

capital expenditures over many years. These reserves are capitalized on firms’ balance sheets, reflecting their economic value and reducing firms’ discretion over their classification and disclosure.⁴ We further find no evidence of strategic reallocation of reserves in response to climate policy shocks: Figure 2 shows no correlation between changes in countries’ climate policy stringency and shifts in firms’ fossil fuel reserve locations over time. Second, we assume that climate policy shocks are orthogonal to unobserved firm-specific factors linked to fossil fuel reserve locations. A concern arises when firms hold most of their reserves in their home country, making climate policy exposure mechanically correlated with domestic macroeconomic or political shocks. To address this concern, we construct a leave-one-out measure of climate policy exposure that excludes each firm’s home-country reserves. This “abroad” exposure isolates variation from foreign jurisdictions, helping to ensure that observed financing outcomes are not driven by domestic conditions. To further strengthen identification, we also implement an instrumental variable strategy that leverages plausibly exogenous variation in climate policy exposure across foreign reserve locations.

In the first step of our analysis, we examine how corporate bond spreads and syndicated bank loan spreads respond to fossil fuel firms’ exposure to climate policy risk. We find that firms with higher climate policy exposure—reflecting a greater likelihood of stranded fossil fuel reserves—pay higher yields in the corporate bond market, but not in the syndicated loan market. In other words, stranded-asset risk is priced in bond markets, but not in bank lending. A one-standard-deviation increase in climate policy exposure raises bond yield spreads by approximately 6% relative to the mean with no comparable effect on syndicated loan spreads. To address concerns about the comparability of bonds and loans, we conduct a pooled analysis of bond and loan spreads after coarsened exact matching on debt maturity, loan amount, security status, debt purpose, and issuer ratings. The pricing differential persists in this matched sample, confirming that differences in contract characteristics do not drive our results. We further address the concern that differences in pricing dynamics may reflect renegotiation behavior or shifts in climate risk salience triggered by major climate policy events, such as the Paris Agreement. A within-firm pre/post analysis shows no change in average pricing, consistent with the CCPI’s forward-looking design, which incorporates expected policy trajectories and cross-country variation in credibility

⁴If reserve locations are predetermined and do not predict policy shocks, strategic exploration behavior only affects the level of exposure, not the validity of our estimated effect. We focus on proved oil and gas and probable coal reserves, defined according to standardized reporting rules (e.g., SEC) based on geoscientific and economic criteria. While fossil fuel exploration may be strategically influenced by, e.g., country characteristics (Cust & Harding, 2019), such behavior would only reduce firms’ exposure to policy shocks without biasing our estimates, as long as reserve locations do not predict future policy changes—a condition we test empirically.

and implementation. Our results are consistent with prior evidence on corporate bond pricing of climate risk (Seltzer et al., 2022). In contrast, evidence on bank lending responses is mixed: Ivanov et al. (2024) document higher loan spreads and shorter maturities following cap-and-trade policy announcements, but their findings pertain to private firms, with public firms remaining largely unaffected.

Building on the observed pricing differential, we next examine whether stranded-asset risk affects the composition of fossil fuel firms’ external debt financing. Specifically, we test whether firms shift between corporate bonds and syndicated bank loans in response to climate policy exposure. To this end, we construct a firm-year panel variable capturing firms’ reliance on syndicated bank loans relative to corporate bonds, defined as one if a firm issues only syndicated loans in a given year, zero if it issues only corporate bonds, and intermediate values if both are issued. We restrict the sample to firm-year observations with new debt issuance, excluding cases where firms have no credit demand. Our results show that, within fossil fuel firms, greater exposure to climate policy risk leads to a shift from bond financing toward syndicated bank loans. We identify this substitution effect in a specification that includes firm fixed effects, time-varying firm-level controls, and aggregate loan supply indicators (Becker & Ivashina, 2014). The finding suggests that as stranded-asset risk increases, bond market conditions tighten relative to syndicated loan markets, prompting fossil fuel firms to substitute toward bank credit. The effects we estimate are not only statistically significant but also economically relevant. A one-standard-deviation increase in climate policy exposure increases the share of external debt financing sourced from syndicated bank loans by approximately 7 percent.

This substitution effect persists in a more stringent specification that restricts the sample to banks that both underwrite corporate bonds and lead-manage syndicated bank loans for fossil fuel firms, conditioning on bank and firm fixed effects. We develop this within-bank analysis to compare credit allocation decisions within the same financial institutions, thereby mitigating concerns about unobserved lender characteristics, informational advantages, or systematic differences in the types of firms accessing bond versus loan markets. Specifically, it rules out the possibility that the observed substitution from bonds to loans is driven by bank-specific factors or informational frictions. To further address potential selection concerns, we test whether green innovation mediates the relationship between climate policy exposure and firms’ debt composition. Since our climate policy exposure measure does not account for firms’ green innovation efforts, we proxy green innovation using firms’ green patent output and examine whether the observed substitution effect is driven by firms without green patents. We find no evidence that green innovation affects the relationship between climate policy exposure and firms’ loan-to-bond choices.

To further investigate the bond-to-loan substitution, we examine lender characteristics that may influence banks’ willingness to finance fossil fuel firms with stranded-asset risk—firms the bond market avoids. We find substantial heterogeneity across banks: The largest institutions continue to lend more to these exposed firms. A one-standard-deviation increase in climate policy exposure raises the share of syndicated bank loans in external debt financing by 7%. Within this shift, the share provided by top-20% banks rises by a further 8%. We interpret this pattern as consistent with banks’ ability to absorb or manage climate risk differently, potentially through diversification, risk transfer, and/or expectations of governmental support. These channels may blunt the pricing response and result in incentives that are less aligned with the goals of a low-carbon transition. In line with this view, we find indications that large banks with implicit government support, proxied by Fitch’s Support Rating Floors (SRFs), hold loan portfolios with greater stranded-asset exposure on both extensive and intensive margins.

As discussed earlier, we test whether our results are confounded by country-specific factors, particularly those linked to firms’ home countries. To do this, we construct a leave-one-out measure of climate policy exposure that excludes each firm’s home-country reserves. This “abroad” exposure captures only variation from other jurisdictions, eliminating mechanical correlation with domestic shocks. We find that our main results remain robust to this measure, even when home-country exposure is included in the same specification, suggesting domestic conditions do not bias the findings. To further address potential endogeneity, we use an instrumental variable (IV) strategy based on firms’ reserve-weighted exposure to temperature variability in the countries where their fossil fuel reserves are located, again excluding the home country. Temperature variability is closely linked to the stringency of climate policy, as it influences public opinion and regulatory pressure (Weber, 2016). Because the instrument is based on foreign reserve locations, it is unlikely to affect financing outcomes through reserve-specific channels.⁵ Lastly, we test external validity in a different setting. Analyzing U.S. fossil fuel firms and a news-based index of environmental policy stringency, we find that ownership of oil and gas wells is associated with higher bond spreads, and that the loan-to-bond substitution result persists, reinforcing our main findings.

To frame our findings, if financial markets are efficient and forward-looking, stranded-asset risk

⁵While temperature variability in the countries where fossil fuels are consumed may have an effect on long-run economic development due to larger uncertainty about future temperature realizations (e.g., Linsenmeier, 2023) and high abnormal temperatures may slow concurrent firm productivity, particularly in manufacturing and heat-sensitive industries (e.g. Custódio et al., 2024), there is currently no evidence as far as we know that temperature variability in the countries where the proved fossil fuel reserves are located have affected their rate of extraction. This lack of evidence should not come as a surprise given that these activities are typically extreme weather proofed (hurricanes or winter storms, typically originating elsewhere, have in the past only very temporarily halted fossil fuel extraction in the Gulf of Mexico or the Norwegian Sea for example).

should be reflected in prices. We validate our climate policy exposure measure by showing that fossil-fuel firms with reserves in high-stringency jurisdictions trade at a valuation discount. Focusing on debt—the core of our analysis—we observe a similar pattern in bond markets: Issuers with higher climate policy exposure pay higher spreads, indicating that equity and public debt markets capitalize stranded-asset risk. In contrast, syndicated bank loans show no such comparable pricing response. This divergence does not, on its own, imply inefficiency in lending, as banks may have greater capacity to manage or absorb stranded-asset risk. Yet when capital-market price stranded-asset risk and banks do not, the risk is shifted rather than reduced. We show this substitution effect: As stranded-asset risk rises, banks account for a larger share of fossil fuel firms’ external debt. As a result, bank financing may weaken the transmission of climate policies through capital markets, slowing the reallocation of capital toward cleaner sectors. This tension is evident: Banks with sustainable finance pledges continue to extend fossil fuel credit at levels nearly double their commitments. Given that a substantial share of fossil fuel lending is concentrated among the world’s largest banks, the resulting exposure may carry not only environmental but also financial stability implications.⁶

Related literature. Our paper relates to several strands of literature. First, it contributes to the growing climate finance literature that investigates how financial markets price carbon risk. Prior studies focus primarily on equity markets and emissions-based risk measures, documenting that investors demand compensation for carbon emissions exposure (Bolton & Kacperczyk, 2022; Meng, 2017). More recent work has analyzed climate risk in debt markets, but typically uses emissions data to capture risk exposure (Ilhan et al., 2020; Reghezza et al., 2022; Seltzer et al., 2022). By contrast, we focus on stranded-asset risk, which more directly reflects firms’ vulnerability to future climate policy tightening, conditional on current emissions.

Second, we contribute to the literature on the role of financial intermediaries in the climate transition. Existing research suggests that market-based financing may better facilitate decarbonization than bank-based credit (De Haas & Popov, 2023). While green bonds and divestment initiatives have emerged as bottom-up responses to climate risk, banks continue to provide substantial financing to fossil fuel firms. For instance, analysis by the World Resources Institute shows that from 2016 to 2018, banks with sustainable finance commitments extended nearly twice as much credit to fossil fuel companies

⁶Estimated figures on fossil fuel lending show a high degree of concentration among a small number of large banks. For example, in 2023, JPMorgan arranged \$40.8 billion in fossil fuel financing—about 6% of the \$705 billion total provided by the 60 largest global banks (Financial Times, May 2024, citing the Banking on Climate Chaos data). In 2024 JP Morgan arranged almost \$55 billion (see the recently released 2025 Banking on Climate Chaos report).

as their sustainable finance pledges (Banking on Climate Change, 2019; Pinchot & Christianson, 2019). Related research finds that banks may favor brown firms, particularly in industries with high dependence on external financing (Brown et al., 2017; Luneva & Sarkisyan, 2024).

Finally, our findings connect to the broader finance literature on the relative efficiency of market-versus bank-based credit allocation. Banks’ informational advantages and long-term relationships with borrowers allow them to monitor clients effectively, but bank credit supply is often procyclical and exposed to existing borrower risks (Langfield & Pagano, 2016). Although some evidence suggests that banks increasingly consider borrowers’ carbon emissions in loan allocation decisions (Kacperczyk & Peydró, 2021), they may be less inclined to restrict fossil fuel lending in the absence of severe asset devaluation. Our results suggest that large banks, in particular, continue to lend to fossil fuel firms despite rising stranded-asset risk, possibly due to their established relationships, informational advantages, and profitability considerations (Degryse et al., 2020; De Haas & Popov, 2023).

The rest of this paper is organized as follows. Section 2 provides details on the data; section 3 presents the research methodology and results. In Section 3.1, we analyze the effect of *Climate policy exposure* on syndicated bank loan and corporate bond credit spreads. In Section 3.2 we examine how fossil fuel firms substitute between syndicated bank loans and corporate bonds as a response to changing *Climate policy exposure*. In Section 3.2.3 we examine bond-to-bank substitution from the lead bank’s perspective. In Section 3.3 we examine bank heterogeneity in pricing the risk of stranding assets, along with bank size and the role the potential sovereign support plays. Section 4 we present additional robustness tests. In Section 5 we summarize our findings and conclude the paper.

2 Data

2.1 Climate Policy Exposure

Our main analysis examines whether the use of fossil fuel reserves and the associated risk that these reserves will become stranded due to climate policy is reflected in bond and syndicated bank loan financing patterns. Climate policy poses a direct threat to the economic viability of carbon-intensive assets by imposing regulatory costs and accelerating the adoption of low-carbon technologies. As such, the risk of asset stranding is more acute in places where climate policies are more stringent, since stronger policy frameworks increase the likelihood that fossil reserves cannot be profitably extracted or monetized. To capture this mechanism empirically, we construct a measure of stranded-asset risk by combining location of a firm’s fossil fuel reserves across countries and year with the stringency of climate

policies in each country-year.

$$Climate\ Policy\ Exposure_{f,t} = \sum_c Relative\ Reserves_{f,c,t} \times CCPI_{c,t} \quad (1)$$

We construct the variable *Climate Policy Exposure*_{*f,t*} at the firm-year level as a weighted sum of country-level climate policy stringency, where weights reflect the distribution of a firm’s fossil fuel reserves across countries. Specifically, *Relative Reserves*_{*f,c,t*} denotes the share of firm *f*’s total fossil fuel reserves in country *c* in year *t*, and *CCPI*_{*c,t*} measures the stringency of climate policy in country *c* in year *t*, based on the Climate Change Performance Index (Delis et al., 2024). This measure captures stranded-asset risk by leveraging variation in both the geographic allocation of fossil reserves and cross-country differences in climate policy ambition.

We hand-collect data on the amount and location of fossil fuel reserves from firms’ annual reports, 10-K filings, and other regulatory disclosures. Our data covers proved reserves of oil, gas, and coal, which refer to quantities that can be economically produced with reasonable certainty under current economic and regulatory conditions.⁷ Table B.1 provides an overview of the countries where the fossil fuel reserves of firms in our sample are located.

To measure a country’s climate policy stringency, we rely on the Climate Change Performance Index (CCPI) compiled by Germanwatch (Burck et al., 2016). The CCPI aggregates four weighted components—Climate Policy, GHG Emissions, Renewable Energy, and Energy Use—each capturing a distinct dimension of policy-driven climate performance. While some indicators, such as the share of renewable energy, may partly reflect geographic endowments, all components are ultimately shaped by government policy through instruments such as subsidies, regulation, and infrastructure investment. The Climate Policy sub-index is particularly important, as it is forward-looking and based on expert assessments of each country’s regulatory ambition and credibility. Although climate regulations have already tightened in many jurisdictions, no country has fully banned fossil fuel extraction. This underscores that the risk of future policy rendering carbon-intensive assets uneconomic remains both live and forward-looking. A higher CCPI score thus reflects not only existing policy effort but also a heightened probability of future constraints, making the index a conceptually grounded proxy for stranded-asset risk under evolving climate regimes. Moreover, the CCPI is widely utilized by researchers (e.g. Atanasova & Schwartz 2019;

⁷The U.S. Securities and Exchange Commission (SEC) defines these as "proved reserves" for oil and gas, and "proven reserves" for coal. We use the term "proved reserves" to refer to all three fossil fuel types. The detailed data collection procedure is described in Appendix A.

Ehlers et al. 2022), the financial industry (e.g., Blackrock, NN Investment), and policy institutions (e.g., World Bank, Financial Stability Board). Figure 1 illustrates the evolution of the CCPI over time for eight countries, reflecting considerable variation in both the cross sectional and time dimensions.⁸

To reinforce our interpretation that the CCPI captures climate policy stringency and that our climate policy exposure measure proxies for stranded-asset risk, we conduct several robustness checks, detailed in Section 3.1. The key identification assumption is that the geographic distribution of fossil fuel reserves is predetermined relative to changes in climate policy, reflecting the long-term, capital-intensive nature of exploration. We formally justify this assumption and provide empirical support showing that reserve locations do not systematically respond to policy shifts. We also validate the assessment that climate policy exposure captures forward-looking transition risk: Firms with higher exposure trade at lower market valuations, driven by declines in market equity, not book equity. This rules out endogenous write-downs and supports the interpretation of the measure as a forward-looking and exogenous proxy for stranded-asset risk. Finally, we confirm robustness to alternative definitions of climate policy stringency.

Our measure of *Climate policy exposure* differs from common proxies of climate transition risk, which typically rely on firms’ current emissions or carbon intensity (Ilhan et al., 2020; Reghezza et al., 2022; Seltzer et al., 2022). However, a fossil fuel firm’s current environmental footprint does not capture its exposure to the risk of stranded reserves under stricter climate policies. Since the financial impact of these policies depends on the potential for unextracted reserves to lose value, our measure focuses directly on firms’ reserve exposure rather than their current emissions. Moreover, environmental, social, and governance (ESG) measures lack consistency, and Elmalt et al. (2021) shows that ESG scores fail to capture differences in emissions growth among large fossil fuel producers, limiting their usefulness for cross-firm comparisons. We focus on the fossil fuel industry because financing in this sector has a disproportionate impact on global carbon emissions, which can be traced to a relatively small number of firms.

2.2 Corporate Bond and Syndicated Bank Loan Data

Our sample combines corporate bond and syndicated bank loan data for fossil fuel and non-fossil fuel firms over the period 2007–2017. Corporate bond data, including security identifiers and bond characteristics, are obtained from Thomson Reuters Eikon, excluding instrument types such as strip bonds, convertible

⁸The publicly available CCPI scores include changes in the calculation methodology in Germanwatch e.V. from 2013 onward. We are grateful to the Germanwatch team for providing us with a CCPI dataset based on uniform weightings for each index component. However, the CCPI with the old methodology is only available up to 2017.

bonds, and capital securities⁹ Data on syndicated bank loans for the same set of firms, including spread, maturity, and issue amount, are retrieved from DealScan.¹⁰ We restrict the sample to firms that issued at least one corporate bond and one syndicated loan between 2007 and 2017, the period for which CCPI data are available. We further exclude financial firms and debt instruments with maturities of less than one year. Firm-level accounting data are obtained from Compustat to construct control variables in the regression analysis.¹¹

Table B.2 summarizes the number of syndicated bank loans and corporate bond issues in our sample from 2007 to 2017. We initially retrieve 18,044 syndicated loan observations from DealScan but reduce the sample to 10,428 loans after excluding observations without comprehensive debt pricing information. Of these, 963 loans were issued by fossil fuel firms. In syndicated loans, a group of banks extends credit jointly, typically led by one or several lead banks. The dataset identifies lead banks for each facility, which we use in our analysis of bank-level heterogeneity in the pricing of *Climate policy exposure*.¹²

The same set of firms issued 20,667 corporate bonds over the sample period, of which 1,341 were issued by fossil fuel companies. The final bond sample consists of 9,323 observations with available pricing information, including 684 bonds issued by fossil fuel firms. When a firm issues a bond, a lead underwriting bank, for a fee, may purchase the bonds from the issuer and sells them to investors, thereby providing insurance for unsold securities and facilitating the sale of the bonds. Underwriters can seek partnerships with other banks to share the underwriting responsibilities (Yasuda, 2005). We retrieve information about lead underwriting banks from Thomson Reuters. This allows us to match lead underwriter banks with lead banks in the loan dataset. By doing so, we can apply both firm and bank fixed effects when analyzing borrower firm’s *Loan versus bond choice* in Section 3.2. However, unlike for syndicated bank loans, the number of bond issues for which this information is available is very limited.

⁹Thomson Reuters Eikon provides international deal-level data on new issues of corporate bonds underwritten by an investment bank. The database provides a detailed set of information for each corporate bond issue, including the identity, nationality, and sector of the issuer, as well as the type, interest rate structure, maturity date, rating category of the bond, the amount of, and use of proceeds.

¹⁰The Loan Pricing Corporation DealScan is the leading source of extensive and reliable information on the global commercial loan market, containing information on over 110,000 global loans, high-yield bonds, and private placements dating back to the mid-1980s.

¹¹Compustat is a database of financial, statistical, and market information on active and inactive large companies around the world dating back to 1962.

¹²We classify a lender as the lead lender if the variable *Lead Arranger Credit* (provided by LPC’s DealScan) takes on the value "Yes" or if the lender is the only lender specified in the loan contract. This often leads to multiple lead banks per loan facility (Streitz, 2016; Sufi, 2007).

3 Results

In this section, we proceed in three steps. First, we examine whether stranded-asset risk for fossil fuel firms is priced by the corporate bond market and by banks. Second, having established an association between climate policy exposure and debt pricing, we address our main research question: If the bond market prices stranded-asset risk more than banks, will some firms that would otherwise issue bonds instead seek bank loans? Third, we explore potential reasons for the differential pricing of stranded-asset risk between syndicated bank loans and corporate bonds.

3.1 Climate Policy Exposure and Cost of Debt

3.1.1 Empirical Identification

The climate transition poses a credit risk because increased exposure to climate change raises the likelihood of financial losses from carbon-intensive industries. Consequently, the debt of fossil fuel firms facing potential asset stranding carries higher expected losses. Risk-based pricing would imply that lenders charge higher interest rates to offset these losses, which are linked to the risk of stranded assets. Variations in expected losses and returns are influenced by each firm’s stranded-asset risk, which we proxy in the empirical analysis below with our variable *Climate policy exposure*. Thus, when a fossil fuel firm has increased stranded-asset risk as a consequence of climate policy, lenders are expected to charge a higher risk premium to earn a competitive return.

To test this hypothesis, we examine whether corporate bonds and syndicated bank loans of fossil fuel firms with stranded-asset risk sell at a discount by regressing yield spreads at issuance on the interaction between a fossil fuel dummy and firm’s stranded-asset risk proxy, (*Fossil fuel* \times *Climate policy exposure*). We estimate the same specification separately for bonds and loans, so any differences in pricing are reflected in the respective coefficients. The variable *Climate policy exposure* represents firm f ’s exposure to stringent climate policy based on the location of its reserves at time t . The *Fossil fuel* dummy equals 1 if firm f has a Standard Industrial Classification (SIC) code in the fossil fuel industry and 0 otherwise.¹³ Firms with non-zero *Climate policy exposure* are as a rule fossil fuel firms; therefore, we do not include *Climate policy exposure* separately in the regression to avoid collinearity. If the risk of fossil fuel reserves becoming unburnable affects corporate bond and/or syndicated bank loan pricing, then the coefficient of the interaction term should be positive and significant.

¹³The fossil fuel dummy equals 1 if the firms’ SIC code from DealScan or TR Eikon is 1200-1400.

To identify this association between debt pricing and stranded-asset risk, we exploit variation in firms’ exposure to climate policy, which arises from differences in their fossil fuel reserve holdings and the geographic location of those reserves. First, to isolate the effect of stranded-asset risk from broader fossil fuel sector characteristics and other climate transition risks—such as firms’ carbon footprints that affect the entire sector—we include an interaction term between a fossil fuel firm indicator and the firm-level variable *Climate policy exposure*. This specification restricts the comparison group to fossil fuel firms, allowing us to distinguish between those without reserves (and thus without stranded-asset risk) and those with reserves exposed to climate policy.

Among fossil fuel firms with reserves, stranded-asset risk further varies based on the geographic location of their reserves. Thus, the distribution of firms’ fossil fuel reserves across countries implies a differential, plausibly exogenous exposure to changes in the climate policy stringency across countries. Our identification strategy requires that the location of fossil fuel reserves is predetermined and unrelated to changes in firms’ financing conditions. This assumption is plausible because reserve locations reflect long-term exploration and investment decisions made well before changes in climate policy. In addition, proved reserves are capitalized on firms’ balance sheets, reflecting their economic value and limiting firms’ discretion over their classification and disclosure. Their location is therefore predetermined and largely unaffected by short-term policy shifts, as relocating or adjusting existing reserves would require substantial new investment.¹⁴ We provide empirical support for this assumption in Figure 2, which illustrates the cross-correlation between changes in countries’ climate policy stringency and firms’ adjustments in the relative location of their reserves over multiple lags. Specifically, the figure plots the correlation coefficients and corresponding 95% confidence intervals between annual changes in countries’ CCPI scores and changes in the relative share of firms’ reserves located in those countries. The analysis includes only firms with non-zero reserves in a given country in the previous year. The results show no systematic correlation between policy changes and firms’ reserve locations, both in the years preceding and following changes in climate policy ratings. This suggests that reserve location is not a strategic response to climate policy shifts. The location of these reserves is therefore relatively fixed in the short run and unlikely to adjust in response to annual changes in climate policy. As additional support, a validation check in Section 3.1. shows that firms with higher climate policy exposure trade at lower

¹⁴While exploration activities may respond to country characteristics, this does not affect our identification strategy, which relies exclusively on proved reserves capitalized on firms’ balance sheets prior to changes in climate policy. Any systematic selection in reserve exploration would affect the distribution of exposure but not bias the estimated marginal effect of exposure on debt pricing.

market valuations, with no corresponding change in book equity. This rules out the concern that the measure is driven by endogenous write-downs or balance sheet adjustments, reinforcing the assumption that reserve location is predetermined.

We formally estimate the causal effect of stranded-asset risk on debt pricing using the following specification:

$$\begin{aligned} \text{Cost of debt}_{i,f,t} = & a + \beta_1 \text{Fossil fuel}_{f,t} + \beta_2 (\text{Fossil fuel}_{f,t} \times \text{Climate policy exposure}_{f,t}) + \\ & \lambda I_i + \gamma F_{f,t} + \epsilon_{i,f,t} \end{aligned} \quad (2)$$

For the syndicated bank loan specifications, our main outcome variable is the all-in spread drawn (*AISD*), which equals the spread of the loan facility over LIBOR plus any facility fee. Hence, in Equation (2), *Cost of Debt* is defined as the all-in spread drawn of a loan facility i received by borrower f in year t . To examine corporate bond credit spreads, we define *Cost of Debt* as the corporate bond benchmark spread at issuance, which represents the yield differential between the bond redemption yield and the Treasury curve, taking into account maturity and compounding frequency. I is a vector of debt issue-specific characteristics. In the corporate bond regressions, I consists of the bond characteristics, bond amount, and bond maturity. In the model with the all-in spread drawn as the dependent variable, we control for the loan amount, the maturity of the loan facility, whether a loan has collateral, the number of lenders in the syndicate, whether a loan includes performance pricing provisions, and the number of general covenants. Furthermore, a is a vector of fixed effects. In the corporate bond regression, we utilize the use of proceeds, instrument type, seniority type, and firms' country-year fixed effects. For the syndicated bank loan regression, we similarly apply loan purpose, loan type, and bank-year fixed effects. F is a vector of firm-level controls, including firm size, leverage, market-to-book ratio, and asset tangibility. ϵ is the error term. Variable definitions and summary statistics are provided in Table B.3.

3.1.2 Estimation Results

Table 1 reports summary statistics of the key variables used in our analysis, with Panel A focusing on corporate bonds and Panel B on syndicated bank loans. Column (3) in both panels presents t -tests comparing fossil fuel and non-fossil fuel firms. In Panel B, the average all-in spread on syndicated loans is 230 basis points (bps), while the mean spread for fossil fuel firms is 250 bps—significantly higher than for non-fossil fuel firms. Fossil fuel loans are also larger on average but have shorter maturities

by approximately half a year. In Panel A, we find that newly issued corporate bonds in the fossil fuel sector yield significantly higher credit spreads compared to non-fossil fuel firms. The average spread at issuance is 196 bps overall, but rises to 377 bps for fossil fuel firms, a difference larger than that observed in the syndicated loan market. The indicator of whether a bond is secured is based on the *Seniority* variable from Thomson Reuters Eikon, which reflects the repayment order of an asset in the event of liquidation or a change in ownership. While a larger share of loans in the fossil fuel subsample is secured by collateral, the opposite holds for bonds. On average, bond maturities are twice as long as syndicated loan maturities. Table 1 also shows that a large fraction of bonds in our sample are exchange-listed. Differences in firm characteristics underscore structural differences between fossil fuel and non-fossil fuel firms. In both samples, fossil fuel firms have lower average market-to-book ratios and leverage, but higher asset tangibility.

Table 2 presents our findings on the pricing of *Climate policy exposure*, as measured by the CCPI in syndicated bank loans; we find that fossil firms' *Climate policy exposure* is not priced. Column (1) includes only loan-level controls. To eliminate the impact of these potentially "bad controls," Column (2) utilizes only firm-level controls and the crude oil price; Columns (3) and (4) employ the full set of controls. The results are robust with different combinations of fixed effects and clustered standard errors. Because lead bank information is largely available, we include bank-year fixed effects. Accordingly, we restrict the sample to loans with at least one lead bank. Each loan facility is repeated in the dataset depending on the number of lead banks. On average, a loan has four lead banks. To account for this multiplicity, 1) we cluster the standard errors at both the borrower firm level and the bank level; 2) we adjust the point estimates by weighting each observation by the inverse of its multiplicity, hence 1 over the total number of lead banks per loan. In Column (4), we additionally report loan-level clustered standard errors. We do not find any evidence that the syndicated loan market prices *Climate policy exposure* throughout the period 2007 to 2017.

Table 3 reports the results of the bond spread regression on *Climate policy exposure*. Firms' country-year fixed effects saturate the model with time-varying supply-side characteristics that are determined by macroeconomic conditions and may affect credit spreads. We include fixed effects for instrument type, seniority, and use of proceeds to control for bond-specific credit risk. Because these variables are only sporadically available, the sample size is smaller than in Table 1. Given the limited availability of information on lead underwriting banks, we are unable to include bank or bank-year fixed effects in these specifications. Columns (1) to (3) use the full sample of bond observations. In Column (4), we restrict the sample to exchange-listed bonds to better account for differences in bondholder char-

acteristics in public debt markets. As in the syndicated loan regressions, we control for the crude oil price, as lower energy prices may amplify the risk of stranded assets.

The regression results in Table 3 show that an increase in *Climate policy exposure* results in an increase in corporate bond spreads. A one-standard-deviation change in *Climate policy exposure* results in an increase on average in the cost of credit of a little less than approximately 10 bps, which is equivalent to a 5% change in the cost of credit relative to the mean.¹⁵ An example illustrates this further: Canada and Norway both possess substantial quantities of fossil fuels, but because Norway has a higher CCPI, the probability that the Norwegian government will strand its assets to meet its carbon dioxide emission target is higher than in Canada. For this reason, for a company that has all its fossil fuel reserves in Canada, the cost of bonds would be lower by over 20 bps in 2014 relative to Norway.

In Column (4) of Table 3 we look at the subsample of bonds listed on exchange markets; these bonds make up over 60% of the whole sample. The impact of *Climate policy exposure* on bond pricing is even larger for exchange-listed bonds. A one-standard-deviation increase in *Climate policy exposure* leads to an average increase in cost of bonds of approximately 13 bps. A one-standard-deviation increase in *Climate policy exposure* is equivalent to an approximately 5.6% change in cost of bonds relative to the mean. This finding potentially highlights the relative importance of retail investors as opposed to institutional investors in pricing *Climate policy exposure* in bonds, considering that institutional investors and dealers are much more dominant in the OTC market (Biais & Green, 2019). First, environmental and sustainability issues are more dominant decision factors for retail investors (Berry & Junkus, 2013). Second, retail investors often trade in smaller amounts, making them less exposed to the risk of devaluing existing fossil fuel legacy positions (Degryse et al., 2020).

3.1.3 Pooling of Bond and Loan Pricing

Table 4 presents the results from pooling corporate bond and syndicated bank loan data issued by the same firms to estimate the relative pricing of *Climate policy exposure*. To account for key differences in credit risk characteristics between bonds and loans—particularly differences in average maturity and the associated timeframes for stranded-asset risk realization, as shown in Table 1—we first match the two datasets using a coarsened exact matching approach (Blackwell et al., 2010). Bonds and loans are matched on maturity, issuance year, amount, secured status, debt purpose, and issuer rating. In

¹⁵The standard deviation for *Climate policy exposure* in the bond sample is 7.3 when debt pricing is available for 2007-2017.

Appendix C, we provide a more detailed description of the matching procedure and subsequent regression analysis. To compare pricing between bond and loan observations, we estimate a model with a triple interaction term: *Fossil fuel* \times *Loan-dummy* \times *Climate policy exposure*.

Typically bonds pay a fixed coupon rate, while loans have a fixed spread over LIBOR. To account for this and further ensure the comparability of the change of the relative costs along firms' *Climate policy exposure* for syndicated bank loans and corporate bonds in Table 4, we use for the bond observations the bond LIBOR swap spread instead of the simple credit spread as dependent variable (Becker & Ivashina, 2014; Schwert, 2020).¹⁶ We then estimate the following model using the matched data to compare the pricing differential between bond and loan observations.

$$\begin{aligned}
Cost\ of\ debt_{i,f,t} = & a + \beta_1 Fossil\ fuel_{f,t} + \beta_2 (Fossil\ fuel_{f,t} \times Loan_i) + \\
& \beta_3 (Fossil\ fuel_{f,t} \times Climate\ policy\ exposure_{f,t}) + \\
& \beta_4 (Fossil\ fuel_{f,t} \times Loan_i \times Climate\ policy\ exposure_{f,t}) + \\
& \lambda I_i + \gamma F_{f,t} + \epsilon_{i,f,t}
\end{aligned} \tag{3}$$

The estimates in Table 4 corroborate that fossil fuel firms' *Climate policy exposure* is priced less in syndicated loans than in bonds. A one standard deviation increase in *Climate policy exposure* implies an increase in bond pricing by approximately 20 bps relative to syndicated bank loan pricing. This difference in pricing is robust to debt characteristics.

Controlling for time-varying yield curve dynamics. A potential concern is that changes in market-wide yield curve dynamics over the sample period (2007–2017) may confound our results. This is relevant not only for the comparison between bonds and loans—given their different maturity profiles—but also within each market, as substantial shifts in the term structure occurred during this period. To address this, we include maturity fixed effects (in months) interacted with year fixed effects in all pooled regressions reported in Table 4. This ensures that our estimates are not driven by time-varying interest rate dynamics unrelated to credit risk.

Pre- and post-2015 Paris Climate Change Agreement. The ratification of the 2015 Paris Climate Agreement represents a major milestone in international climate policy and is commonly used to assess financial market responses to climate commitments (Monasterolo & De Angelis, 2020; Pham et

¹⁶We retrieve the bond LIBOR swap spread by subtracting from the bond-yield-to maturity at issuance the LIBOR swap rate matched by closest maturity. In Appendix Table B.7, we examine the bond LIBOR swap spread instead of the simple credit spread as the dependent variable. The results show a similar size effect of *Climate policy exposure*

al., 2019). In Appendix Table B.6, we extend our bond and syndicated loan pricing models by interacting climate policy exposure with a post-2015 indicator. The results show no significant change in pricing following the Paris Agreement. If banks were responding to abrupt shifts in borrower risk through renegotiation, we would expect a discrete adjustment in loan pricing, especially given the contractual flexibility of syndicated loans. The absence of such a shift suggests that renegotiation dynamics are not driving our results.

More broadly, the lack of a pricing break supports the forward-looking design of our climate policy exposure measure. The CCPI is updated annually and incorporates expected policy trajectories set in motion by events such as the Paris Accord, reflecting anticipated regulatory developments. Moreover, it also accounts for cross-country differences in credibility and implementation, as assessed by experts.

Comparability of bond and loan spreads: Renegotiated loans. Bond and loan spreads are not directly comparable due to differences in contractual flexibility. Unlike bonds, syndicated bank loans can be renegotiated during their term, allowing lenders to revise conditions in response to new information, while bond terms are fixed at issuance. This flexibility could explain why loan spreads do not reflect *Climate policy exposure* upfront, as lenders may anticipate the ability to adjust terms ex post. In Appendix Table B.6, Panel C, we examine this possibility by restricting the sample to firms that issued debt both before and after the 2015 Paris Agreement. This restriction allows us to compare bond and loan spreads for the same set of firms around a well-defined increase in climate policy commitment. If the absence of pricing in syndicated loans were driven by renegotiation flexibility, we would expect banks to begin pricing *Climate policy exposure* in new loans issued after 2015, when transition risk became more salient. However, we find no evidence of increased pricing sensitivity in the post-2015 period, suggesting that renegotiation dynamics do not account for the observed differences in the pricing of stranded-asset risk between loans and bonds.

Alternative definitions of *Climate policy exposure*. While, based on the results above, we exclude the possibility that differences in debt and firm characteristics drive why fossil fuel firms exposed to stranded-asset risk experience higher interest rates in the corporate bond market compared to the syndicated bank loans market, we also address several other identification concerns that could bias the results. In Appendix D, we report several robustness tests with regard to the measure of *Climate policy exposure*. Our results are robust to alternative specifications of the measure, as well as of the regression models. First, we test the robustness of our measure of *Climate policy exposure* to an alternative measure of climate policy stringency. The Climate Change Cooperation Index by Bernauer & Boehmelt (2013) evaluates countries' overall climate policy performance, as well as performance in

terms of political behavior and emissions. Second, we construct firms' *Climate policy exposure* based on the CCPI of the headquarter countries to investigate the relevancy of the climate policies of countries where firms sell their fossil fuel reserves as opposed to where the their reserves are located. Third, we isolate the impact of national and international climate policy stringency from the other elements of the CCPI.

Validating *Climate policy exposure* as a forward-looking proxy for stranded-asset risk. To validate that our climate policy exposure measure captures stranded-asset risk, we regress Tobin's Q and the market-to-book ratio on climate policy exposure, controlling for firm fixed effects, country-year fixed effects, and number of time-varying firm fundamentals (size, leverage, asset tangibility). Firm fixed effects absorb all time-invariant differences across firms, while country-year fixed effects soak up global and macro shocks, including policy and business-cycle changes common to firms headquartered in the same country and year. Consequently, identification rests on within-firm movements in the interaction between reserve locations and changes in climate-policy stringency across countries. Table 5 shows that higher climate policy exposure is associated with lower Tobin's Q and market-to-book ratios, suggesting that investors discount the expected productivity of reserves facing stranding risk. A one-unit increase in exposure is linked to a 0.003 decline in both valuation ratios, which implies a 1.4 percent drop at the sample mean of climate policy exposure (7 units) and a mean valuation ratio of 1.46—an economically meaningful effect in the corporate finance literature (e.g., İmrohoroglu & Tüzel, 2014; Pástor & Pietro, 2003). The negative interaction term indicates that markets internalize asset quality risk stemming from climate policy exposure. A decomposition into market and book equity confirms that this effect is driven by a decline in market equity, with no significant change in book equity, validating climate policy exposure as a forward-looking risk measure rather than an accounting artifact. The lack of a contemporaneous book equity response indicates that the climate policy exposure metric operates as a forward-looking indicator of transition risk. Since the identification strategy leverages the pre-determined spatial distribution of reserves, market reactions reflect anticipatory expectations rather than reactive balance sheet adjustments. This spatial exogeneity supports the interpretation of the exposure measure as exogenous, capturing investor beliefs about the likelihood and impact of stranded assets from future policy shifts. As a result, the measure serves as a robust proxy for latent transition risks embedded in evolving climate policy trajectories.

3.2 Climate Policy Exposure and Bond-to-Loan Substitution

3.2.1 Empirical Identification

Our finding that *Climate policy exposure* is priced in corporate bonds but not in syndicated loans suggests that banks may continue to finance fossil fuel projects with stranded-asset risk, while the bond market does not. To test this empirically, we examine whether stranded-asset risk affects the composition of bond versus syndicated loan financing among fossil fuel firms. This mechanism rests on the assumption that changing credit conditions modify the relative costs between different forms of financing, thus requiring firms to rebalance their debt structures. If the bond market prices *Climate policy exposure* higher than the loan market does, *ceteris paribus*, some firms that would issue bonds might instead receive bank loans. Such a substitution mechanism between bond and bank financing could mitigate the capital constraints on fossil fuel firms.

A large literature documents the substitutability between corporate bonds and syndicated bank loans (Crouzet, 2018; Faulkender & Petersen, 2006; Kashyap et al., 1994), though primarily from the perspective that bond issuance increases when loan supply tightens. In contrast, we explore whether the relative cost of financing associated with stranded-asset risk leads firms to shift from bonds to loans.

To study this substitution, we use firm-level data, which includes firms that have access to syndicated bank loans and to the bond market, and that raise new debt financing with a maturity of at least one year between 2007 and 2017. We employ the same identification strategy as in Section 3.1 to analyze firms' financing choices in relation to stranded-asset risk. However, the dependent variable is now a dummy variable, *Loan versus bond choice*, which equals zero when a firm issues only bonds, one when it issues only syndicated loans, and takes values between zero and one when a firm uses a mix of both instruments. This approach accounts for partial substitution. We also construct a stricter binary version of the *Loan versus bond choice* variable, which equals one when firms rely solely on loans and zero when they rely solely on bonds. These variables are structured as a panel of firm-year observations to capture firms' (partial) substitution between syndicated loans and bonds over time.

$$Loan\ versus\ bond\ choice_{f,t} = \begin{cases} 1 & \text{if new Loan} \\ 0 & \text{if new Bond} \\ 0 < \frac{\sum_{i=1}^n Loan_{i,f,t}}{\sum_{i=1}^n Loan_{i,f,t} + \sum_{i=1}^n Bond_{i,f,t}} < 1 & \text{if a mix of Loan and Bond} \end{cases}$$

$$\text{Loan versus bond choice (binary)}_{f,t} = \begin{cases} 1 & \text{if new Loan} \\ 0 & \text{if new Bond} \end{cases}$$

We exclude firm-year observations where neither syndicated bank loans nor bonds are issued; this is to rule out a lack of demand for either type of credit (Becker & Ivashina, 2014; Ruggiero, 2018). Thereby, the identification strategy untangles the effect of the demand for and supply of credit in the analysis and rules out the hypothesis that a change in the firms financing composition is due to lack of credit demand rather than a shrinkage in bond or syndicated bank loan supply.

As in Section 3.1, our identification strategy exploits plausibly exogenous variation in firms' *Climate policy exposure*, determined by the ex-ante geographic distribution of their fossil fuel reserves. We again interact this measure with a fossil fuel firm indicator to isolate the effect of stranded-asset risk. The identification assumption is that the location of fossil fuel reserves—reflecting past exploration and investment decisions—is predetermined and unrelated to changes in firms' financing choices, except through exposure to climate policy. In Section 4, we address potential endogeneity concerns related to this condition.

We estimate the following specification:

$$\begin{aligned} \text{Loan versus bond choice}_{f,t} = & a + \beta_1 \text{Fossil fuel}_{f,t} + \beta_2 \text{Climate policy exposure}_{f,t} + \\ & \beta_3 (\text{Fossil fuel}_{f,t} \times \text{Climate policy exposure}_{f,t}) + \\ & \lambda I_{f,t} + \gamma F_{f,t} + \delta Z_t + \epsilon_{f,t} \end{aligned} \quad (4)$$

where a denotes fixed effects and ϵ is the error term. I represents the variable *Debt amount*, which is the log of the total amount of loans and/or bonds issued in a year. We control for this variable to further account for potential differences in the nature of bond and syndicated loan issuances. Firm-level controls in F include firm size, leverage, market-to-book ratio, and asset tangibility. Z represents all wider economy control variables such as credit supply indicators.

To link changes in firms' *Loan versus bond choice* to variation in *Climate policy exposure*, we control for potential confounding effects from economy-wide or regional loan supply shocks. Theoretical frameworks and policies that stimulate bank lending suggest that loan supply tends to be procyclical—higher in good times and lower in bad times. We therefore include syndicated loan supply indicators to account for fluctuations in credit availability. *Non-performing loans* measure, at a country level, the

share of nonperforming loans to total gross loans, while *Lending growth* measures the growth rate of loans to non-financial corporations. The literature suggests that belonging to a certain class of firms with specific characteristics (e.g., a high level of log-assets) is relevant for receiving additional credit.

We include firm and year fixed effects to account for unobserved, time-invariant firm characteristics and common time trends that may influence financing choices. Including firm fixed effects implies that identification relies only on within-firm variation in *Loan versus bond choice*, meaning the analysis focuses on firms that switch between bond and loan financing over time. Firms that never switch between bond and loan financing, or that appear only once in the sample, do not contribute to the estimation, as their outcomes are absorbed by firm fixed effects. Although the fossil fuel indicator is collinear with firm fixed effects, it does not drop out of the regression, as some firms change their primary SIC code during the sample period.

3.2.2 Estimation Results

Panel C of Table 1 contains the summary statistics of the outcome variables. We report the results in Table 6. The estimations with respect to our explanatory variable of interest, *Climate policy exposure* interaction, show a positive and significant impact in all specifications. The estimate in the main specification in Column (3) implies that a one-standard-deviation increase in *Climate policy exposure* reduces the fraction of external debt financing from bonds by approximately 6%.¹⁷ In other words, firms appear to substitute bonds with syndicated bank loans when *Climate policy exposure* is high. As an example, we can infer that a fossil fuel firm that has reserves in Canada is more likely to issue bonds than is a fossil fuel firm with reserves in Norway, ceteris paribus. In Panel B of Table 6 we investigate firms' bond-to-loan substitution while not allowing for partial substitution between the two forms of debt; we observe a similar economic significance within this more stringent setting. We derive from this finding that the differential pricing between bonds and loans prompts fossil fuel firms with *Climate policy exposure* to seek syndicated loans instead of bonds.

3.2.3 Within Bank Analysis - Matching Lead Underwriter and Lead Manager

In this section, we extend our analysis to examine firms' *Loan versus bond choice* in an empirical model with bank fixed effects. Therefore, we focus on the restricted dataset of banks that both underwrite corporate bonds and lead-manage syndicated loans. Differences in lead bank opinions about a firm's

¹⁷The standard deviation for *Climate policy exposure* in this dataset is 6.977 for 2007-2017

riskiness might affect the differential pricing of stranded assets risk in the bond and loan markets. If a lead bank underwrites or lead manages debt for a fossil fuel firm, the private information that this lead bank has obtained through previous loan transactions may provide more precise expectations regarding a fossil fuel firm's ability to mitigate its stranded-assets risk (Takaoka & McKenzie, 2006). Therefore, the endogeneity of lead bank choice could lead to better sorting of fossil fuel firms in the syndicated loan market.

To show that our results on bond-to-bank substitution are unlikely to arise from differences in banks that underwrite corporate bonds from banks that lead manage syndicated bank loans and ultimately from differences in borrower quality, we undertake the following analysis. In a first step, we combine the corporate bond and the syndicated loan subsets for which information on the lead underwriter and lead arranger is available. We then match lead banks based on name. Following this matching, we identify banks that engage in corporate bonds and in syndicated loans as lead managers. Table B.4 presents an overview of these lead arrangers during the period 2007-2017.

Our empirical model becomes

$$\begin{aligned} \text{Loan versus bond choice}_{f,b,t,i} = & a + \beta_1 \text{Fossil fuel}_{f,t} + \beta_2 \text{Climate policy exposure}_{f,t} + \\ & \beta_3 (\text{Fossil fuel}_{f,t} \times \text{Climate policy exposure}_{f,t}) + \\ & \lambda I_{i,t} + \gamma F_{f,t} + \delta B_{b,t} + \zeta Z_t + \epsilon_{f,b,t,i} \end{aligned} \quad (5)$$

The dependent variable *Loan versus bond choice* is now a dummy variable that equals 1 if a lead manager bank b has underwritten a loan i for firm f at time t and 0 if the lead manager bank b has underwritten a bond. Each loan or bond observation can appear multiple times depending on the number of lead manager or underwriter banks per facility. We weigh each observation by 1 over the total number of lead managers per loan or bond. The parameter a is a vector of fixed effects, particularly firm fixed effects, and lead manager fixed effects; ϵ is the remainder disturbance. I represents the bond or loan-specific controls (debt amount and maturity). Firm-level variables, F , include firm size, leverage, market-to-book ratio, and asset tangibility. B is a vector of bank characteristics. Bank controls include the following metrics: The basic earnings power (BEP) ratio, which equals earnings before interest and taxes (EBIT) divided by total assets; cash over total assets; bank deposits over total assets; and nonperforming assets over total assets. Macro controls, Z , include GDP growth, nonperforming loans over total loans, and the lending growth rate.

The estimations in Table 7 show that the coefficient for $(\text{Fossil fuel} \times \text{Climate policy exposure})$ is positive and significant with a point estimate of 0.007. For a standard deviation increase in the CCPI,

the probability that a bank underwrites a syndicated loan instead of a corporate bond changes by over 5 percentage points. Table 7 indicates that, in a model incorporating both bank and firm fixed effects, as well as in a model with bank×firm fixed effects, an increase in a firm’s *Climate policy exposure* is associated with banks being more likely to underwrite syndicated bank loans rather than corporate bonds. Hence, our results in Table 6 are unlikely to arise from differences in banks’ opinions about a given firm’s risk.

We conduct several additional tests to exclude alternative explanations of our findings regarding the financing choices of fossil fuel firms. These include whether our results are driven by (i) fossil fuel firms that promote green innovation, (ii) firms’ current emissions as a measure of the environmental footprint (environmental output), and (iii) banks’ green preferences.

"Green innovative" fossil fuel firms. Some fossil fuel firms may actively engage in green innovation, potentially mitigating their exposure to climate policy risk. Cohen et al. (2020) show that green innovation is largely driven by energy firms, which are among the worst environmental performers. If banks are better informed about borrowers’ technological capabilities, they may be more willing to finance fossil fuel firms that invest in green technologies, which could affect firms’ relative reliance on syndicated bank loans versus bond financing.

To test this, we extend our analysis of financing substitution by interacting firms’ *Climate policy exposure* and fossil fuel status with a proxy for green innovativeness. As a proxy for green innovativeness, we use firms’ green patent output (Huij et al., 2021). We acquire information on patents issued by the U.S. Patent and Trademark Office (USPTO) from 2010 to 2017 and link their patent classes to green patent classification schemes.¹⁸ We generate a green patent dummy that equals one if a firm has issued a patent classified as green in a given year, and zero otherwise. We then interact the green patent dummy with *Climate policy exposure* and the fossil fuel dummy.

The results, reported in Appendix Table B.9, show no evidence that green innovation mitigates the bond-to-loan substitution effect documented in Section 3.2. If anything, we find a weak tendency for green innovators to rely more heavily on bond financing. This suggests that banks do not systematically accommodate fossil fuel firms’ green innovation efforts in their lending decisions.

Risks related to carbon footprint as potential confounders. The main findings in this paper are based on the assumption that the coefficients on the interactions (*Fossil fuel*×*Climate policy exposure*)

¹⁸We rely on the International Patent Classification (IPC) Green Inventory provided by the World Intellectual Property Organization. See: World Intellectual Property Organization. (n.d.). *IPC green inventory*. Retrieved from <https://www.wipo.int/classifications/ipc/green-inventory/home>

reveal the effect of having fossil fuel reserves exposed to different levels of climate policy stringency within the fossil fuel sector. In Table 8, we provide evidence that the interaction term coefficient captures the effect of stranded-asset risk, rather than factors related to a firm’s carbon footprint. This distinction is made clear as we control for carbon emissions using data from Truecost. However, due to the limited availability of this data, our analysis is executed using a smaller sample.

Banks’ green preferences. We also investigate whether banks’ environmental preferences influence the observed bond-to-loan substitution effect. Specifically, we test whether banks that commit to environmental goals price *Climate policy exposure* differently. As a proxy for banks’ environmental stance, we use their membership in the United Nations Environment Programme Finance Initiative (UNEP FI), which requires signatory banks to integrate sustainability principles into their business practices, including lending decisions.¹⁹ We exploit cross-sectional variation in bank membership and interact the UNEP membership indicator with firms’ *Climate policy exposure*. The results, reported in Appendix Table B.10, show no evidence that banks’ UNEP membership affects their consideration of stranded-asset risk in lending decisions.

3.3 Climate Policy Exposure and Large Banks

Recent reports indicate that even after the 2015 Paris Agreement, particularly the largest banks continued financing fossil fuel firms, with levels in 2020 surpassing those in 2016 (Banking on Climate Change, 2019). The World Resources Institute found that from 2016 to 2018, the average annual financing for fossil fuel companies from these banks—despite their sustainable finance commitments—was nearly double the annualized amount of those commitments. Table B.5 lists the 20 banks most active in syndicated loans to fossil fuel firms with *Climate policy exposure*.

We first assess whether fossil fuel firms with high *Climate policy exposure* are more likely to receive financing from large banks and whether bank size influences the pricing of that exposure. We then explore potential reasons for this phenomenon, noting that the too-big-to-strand effect suggests large banks take on more climate policy risk than non-systemically important banks (Afonso et al., 2015; Kaufman, 2014).

Climate policy exposure pricing and bank size. We begin by examining whether the effect of *Climate policy exposure* on loan pricing is homogeneous along bank size. The empirical model

¹⁹United Nations Environment Programme Finance Initiative. (n.d.). *Principles for responsible banking*. Retrieved April 3, 2025, from <https://www.unepfi.org/banking/bankingprinciples/>

includes loan-level, firm, and bank characteristics, along with macro-level controls. Fixed effects are for bank country or bank, as well as loan purpose and type. Table B.8 shows that for all syndicated loans, larger banks charge lower credit spreads. For a fossil fuel firm borrowing from a large bank, a one-standard-deviation increase in *Climate policy exposure* results in a loan rate reduction of about 70 bps compared to borrowing from a small bank.²⁰ These findings are therefore consistent with the exposure estimates discussed earlier. In further unreported analyses, we also show that this discounting is not modulated by bank industry specialization and/or prior engagement with the (fossil fuel) firm in question.

Small to large banks substitution. To examine whether fossil fuel firms with high *Climate policy exposure* are more likely to receive financing from large banks, we construct a dependent variable that identifies borrowers' choices between large and small banks. We classify lead managers in two groups using a dummy variable for size: *Large* equals 1 in a given year if the firm's total assets are, depending on the specification, either in the top 1/5, top 1/4, or top 1/3 of the distribution of total assets of all lead manager banks in that particular year (equals 0 otherwise).²¹

Applying Equation (4), we obtain the following specification:

$$\begin{aligned} \text{Large versus small bank choice}_{f,t} = & a + \beta_1 \text{Fossil fuel}_{f,t} + \beta_2 \text{Climate policy exposure}_{f,t} + \\ & \beta_3 (\text{Fossil fuel}_{f,t} \times \text{Climate policy exposure}_{f,t}) + \\ & \lambda I_t + \gamma F_{f,t} + \delta Z_t + \epsilon_{f,t} \end{aligned} \quad (6)$$

The main dependent variable is the dummy variable *Large versus small bank choice*. When the dependent variable equals 1, a firm receives a loan from a syndication group with at least one lead manager from the large bank group. The variable equals 0 when a firm receives a loan from a syndication group without any large lead manager. Additionally, a is a vector of firm fixed effects, and ϵ is the remaining disturbance; I represents the variable debt amount, which is the total loan amount issued in a year i by firm t . Firm-level controls, F , include firm size, leverage, market-to-book ratio, and asset tangibility. Z includes the annualized GDP growth and crude oil prices.

²⁰[Difference largest and smallest bank size (15.20- 6.15)] * [Standard deviation *Climate policy exposure*] * [Coefficient of the triple interaction]

²¹This table presents an overview of the bank size median (total assets in USD mil.) in the large and not large bank groups.

median top 1/3 vs. median bottom 2/3	2,415,689 vs. 1,069,268
median top 1/4 vs. median bottom 3/4	2,480,411 vs. 1,318,624
median top 1/5 vs. median bottom 4/5	2,521,772 vs. 1,496,633

Table 9 presents the estimation results from 6. Column (1) defines lead banks as large if their total assets rank in the top 1/3 of all lead arrangers for that year. Columns (2) and (3) define large banks in the top 1/4 and top 1/5 percentiles, respectively. In Column (3), the interaction term for fossil fuel and *Climate policy exposure* indicates that a one-standard-deviation increase in *Climate policy exposure* (7.033) raises the fraction of syndicated loans from banks in the top 1/5 percentile by about 8% relative to the mean. In Column (2), the coefficient remains positive but is smaller and statistically insignificant. In Column (1), the interaction term is negative, smaller, and shows statistically insignificant impact on bank choice. We conclude that there is a shift toward the largest lead managers based on fossil fuel firms' *Climate policy exposure*, underscoring the importance of bank size in shaping the relationship between *Climate policy exposure* and debt financing for fossil fuel firms. Panel B of Table 9 shows results for the non-binary dependent variable *Large versus small bank Choice*.

Too-big-to-strand: Bank's weighted Climate policy exposure and potential sovereign support. A plausible explanation on why excessive risk-taking could be rational for banks is that they can rely on explicit and implicit bank guarantees such as deposit insurance, central bank liquidity, and government bailouts due to how their failure may affect the national and global economy (Freixas et al., 2000; Morrison, 2011). Large banks that are considered too-big-to-fail (TBTF) may expect to be shielded from the negative consequences of transition risks; therefore, they have a greater incentive to take on transition risks compared to bondholders or smaller banks. This could lead to a too-big-to-strand (TBTS) situation, where the price of bank loans from large banks does not fully reflect their risk.²²

In Equation (7), we calculate for each bank the annual weighted *Climate policy exposure* of the fossil fuel firms with positive *Climate policy exposure* to which the bank has provided a syndicated bank loan, *Bank's weighted climate policy exposure*. This measure serves as a proxy for banks' fossil fuel exposure on the intensive margin. To be able to differentiate potential sovereign support for banks from bank size and other external sources, we utilize Fitch's Support Rating Floors (SRFs) that assess sovereign support independently of banks' intrinsic credit quality or institutional support Afonso et al. (2015); IMF (2022); King et al. (2020). SRFs reflect the likelihood that a bank will receive government

²²Future work could consider whether fossil fuel firms in some countries are also too big to strand. In this case, stringency should not matter in bank or bond markets.

assistance in distress.²³²⁴

$$\text{Bank's weighted Climate policy exposure}_{b,t} = \sum_i \frac{\text{Loan exposure}_{b,i,t}}{\text{Total loan exposure}_{b,c}} \times \text{Climate policy exposure}_{i,t} \quad (7)$$

To show the association between government support and banks' fossil fuel lending under climate policy, we regress banks' SRFs against their *Climate policy exposure* in Columns (1) to (3) of Table 10. Banks with higher SRFs typically have greater weighted *Climate policy exposure* in their syndicated loan portfolios. Specifically, a one-notch increase in SRF corresponds to an average increase of 1.242 in weighted *Climate policy exposure*, with a mean of 5.4. In Columns (4) to (6), we regress bank size and SRFs on the share of fossil fuel loans in banks' total syndicated loan portfolios for a given year. This is done to also observe the change in bank exposure on the intensive margin. For a one-notch increase in SRF, the share of fossil fuel financing increases on average by 0.6 percentage points. At the same time, we observe that bank size has a negative, although insignificant, impact on banks' fossil fuel financing share.

These results are broadly in line with the TBTS argument that banks with implicit and explicit government support are more likely to take on risky fossil fuel financing. In our view, this is an important result, particularly from a policy perspective.

4 Robustness Checks

4.1 Endogeneity of *Climate Policy Exposure*

"Abroad" *Climate policy exposure*. Our baseline identification strategy relies on the assumption that the location of fossil fuel reserves implies exogenous variation of stranded-asset risk exposure. Thereby, we require randomness with respect to the characteristics of the location where these firms have fossil fuel reserves, to the extent that these characteristics affect changes on firm's financing conditions and

²³SRFs employ the AAA long-term scale, with AAA indicating a very high probability of government support. An SRF of 'No Floor' (NF) is given when no reasonable assumption of sovereign aid exists, corresponding to a probability of less than 40 percent. There are 21 notches in total. Limited variation hinders the extraction of a component independent of countries' sovereign ratings.

²⁴In Figure B.3, we plot, on the bank-year-level, banks' weighted *Climate policy exposure* along with their bank size and SRFs. On the left side, we plot bank size along with average weighted *Climate policy exposure*. Loans with high *Climate policy exposure* tend to be concentrated among large banks. Furthermore, there is a strong positive relationship between bank size and government support ratings, implying large implicit subsidies for banks that are TBTF, as not all banks are given an SRF. The figure on the right side plots banks' weighted *Climate policy exposure* corresponding to their SRFs. Looking at the subsample of bank-year observations for which SRFs are available, there is a dichotomy. Banks that provide loans to firms with *Climate policy exposure* > 0 tend to have either a SRF of A- and higher or, on the other hand, BBB- and NF.

consequent financing choice. A potential concern in this respect is reserves held in the country where a fossil fuel firm is headquartered. Particularly, given that small to mid-sized firms in our sample often hold all their reserves in their home country, resulting not only in limited variation stranded-asset risk exposure but also in concerns that *Climate policy exposure* might be driven by the unobserved variables related to fossil fuel firm's home country. Shocks to the CCPI in a fossil fuel firm's headquarters country c in a given year t may directly affect the profitability and financing costs of firm f in country c , particularly through demand. Suppressed demand for fossil fuel in country c is likely correlated with both the firm's profitability and the CCPI. Other factors to consider include the regulatory or political environment in country c .

To mitigate endogeneity concerns when location shares may be endogenous, we ideally identify exogenous CCPI shocks that do not affect fossil fuel firms in their home country. To achieve this, we calculate the "abroad" *climate policy exposure* for firm f in country c , excluding the climate policy exposure in country c if the fossil fuel firm has reserves in its home country.

$$Abroad\ Climate\ policy\ exposure_{f,t,c} = \sum_{j \neq c} Relative\ reserves_{f,t,j} \times CCPI_{j,t}$$

The results are presented in Table 11. The location shares of firms do not sum to 1 within each location and time period. For this reason, in Panel B of Table 11, we include the "inland" *Climate policy exposure*. The correlation coefficients for firms' "inland" and "abroad" *Climate policy exposure* are below 0.3, indicating minimal linear correlation. Applying the abroad *Climate policy exposure* of fossil fuel firms does not significantly affect the point estimates in the specification where we also include inland *Climate policy exposure* (compare with the estimates in Panel B of Table 6). We present the results for a continuous *Loan versus bond choice*. Due to the exclusion of fossil fuel firms' home information when calculating *Climate policy exposure*, we lack observations and do not obtain consistent estimates for the more restrictive binary *Loan versus bond choice* definition.

Instrumental variable robustness. A setting where heterogeneity of the location of reserves is difficult to justify *a priori* is where unobserved country-specific shocks are likely to affect fossil fuel firm outcomes through the same mixture of exposure, such as, for example, economic policy uncertainty shocks. To insulate our analysis from the possibility of such endogeneity bias in the *Climate policy exposure* measure, we use country-specific temperature variability as an instrumental variable (IV) for firms' exposure to climate policies.

Global anthropogenic greenhouse gas emissions lead to more frequent and intense temperature

extremes, not only due to the mean warming itself, but also due to changes in temperature variability. Temperature variability is closely linked to how strict climate policies are, affecting public opinion and the creation of laws regarding global climate change (Weber, 2016). This index is, however, exogenous to fossil fuel firms' debt financing, assuming that the current and future extraction and processing of proved fossil fuel reserves is not impacted by current temperature variability in the country where the reserves are located. While temperature variability in the countries where fossil fuels are consumed may have an effect on long-run economic development due to larger uncertainty about future temperature realizations (e.g., Linsenmeier, 2023) and high abnormal temperatures may slow concurrent firm productivity, particularly in manufacturing and heat-sensitive industries (e.g., Custódio et al., 2024), there is currently no evidence as far as we know that temperature variability in the countries where the proved reserves are located have affected their rate of extraction. This lack of evidence should not come as a surprise given that these activities are typically extreme weather proofed (hurricanes or winter storms, typically originating elsewhere, have in the past only very temporarily halted fossil fuel extraction in the Gulf of Mexico or the Norwegian Sea for example).

We obtain data on country-level surface temperature anomalies from HadCRUT5, a global temperature dataset that provides gridded temperature anomalies worldwide (Morice et al., 2021).²⁵ We retrieve averages as annual values of the HadCRUT5, then square the values before calculating the moving average of the last 5 years. This variance is then weighted by the share of reserves abroad of a fossil fuel firm in a given country. Thus, we employ a "leave-one-out" type to calculate a firm's weighted temperature variability by excluding the firm's exposure to temperature variability in its headquarters country, that is if the firm has fossil fuel reserves where it is also headquartered. Since the total relative reserves may not equal one due to this exclusion, we normalize the result by dividing by the sum of the relative reserves. This adjustment ensures that the calculated impact value accurately reflects the proportionate contribution of temperature variability. Excluding headquarters, exposure addresses potential bias from firm financing outcomes being influenced by home countries' characteristics or local shocks that run in parallel.

We present the results in Table 12 and find that they confirm the main findings of Table 6.

²⁵HadCRUT is published by the Climatic Research Unit (University of East Anglia and NCAS) in conjunction with the Hadley Centre (UK Met Office). The HadCRUT5 presents monthly average near-surface temperature anomalies, relative to the 1961–1990 period, on a regular 5° latitude by 5° longitude grid from 1850 to 2018.

$$Temperature\ variability_{j,t} = \left(\frac{1}{5} \sum_{i=t-4}^t (HadCRUT5_{j,t})^2 \right)$$

$$IV_{f,t,c} = \frac{\sum_{j \neq c} Relative\ reserves_{f,j,t} \times Temperature\ variability_{j,t}}{\sum_{j \neq c} Relative\ reserves_{f,j,t}}$$

4.2 Alternative Empirical Context: US Wells and a News-based Measure of Policy Stringency

To test the external validity of our results, we focus on firms with oil and gas wells in the United States, as well as an alternative measure for climate policy stringency. US fossil fuel reserves make up a large part of the total sample, warranting an analysis to delve into variations within the US and how much the results might be driven by this. In Appendix E, we replicate the results for the US subsample by exploiting the following information: 1) Information on the firms' location of oil and gas wells in different states, 2) a news-based stringency measure for environmental policy in the US, and 3) information on state-level variation of oil and gas revenue dependency, used as a proxy for the likelihood of regulations affecting fossil fuel reserves to take effect. The results are consistent with our earlier findings: 1) stranded-asset risk is more heavily priced into corporate bonds, and 2) an increase in stranded-asset risk among U.S. firms raises the proportion of financing from loans relative to bonds.

5 Summary Discussion and Conclusion

5.1 Summary Discussion

Our analysis shows that fossil fuel firms' exposure to climate policy risk is priced in corporate bonds but not in syndicated bank loans. This differential pricing induces firms to substitute away from bond financing toward bank financing when their exposure to stranded-asset risk increases. We interpret this within-firm bond-to-loan substitution as evidence of credit misallocation: banks continue to finance fossil fuel projects that public debt markets would not. In the context of the climate transition, our findings imply that banks—more than bond markets—are facilitating continued capital flows to carbon-intensive

activities.²⁶

Several mechanisms could explain why banks impose lower risk premia on fossil fuel firms compared to bond markets. First, we rule out that differences in debt contract characteristics drive the results (Section 3.1.3). Second, we consider that banks' informational advantage through relationship lending may explain differential pricing. However, we find no evidence that banks differentiate between fossil fuel firms based on their riskiness: Our results hold when matching lead managers of bonds and loans and controlling for bank and firm fixed effects (Section 3.2.3).

Moreover, we explore alternative explanations and find no evidence that the bond-to-loan substitution is driven by banks' environmental preferences or by firms' green innovation activities (Appendix B). Finally, in Section 3.3, we document that large banks—those most likely to benefit from implicit government support—are particularly active in lending to fossil fuel firms facing stranded-asset risk. This "too-big-to-strand" behavior suggests that large banks may continue to allocate credit to fossil fuel firms despite rising climate policy risks. This result has important policy implications, especially in light of growing regulatory expectations that banks account for climate-related financial risks.²⁷

5.2 Conclusion

This paper has investigated and contrasted how market- versus bank-based financing contributes to climate change through its impact on the real economy. We draw two conclusions. First, market discipline, on its own, is more effective in driving bondholders, rather than banks, to price the negative effect associated with the risk of stranded assets. Second, it is important to recognize debt heterogeneity when looking at how to reduce the financing of carbon-intensive activities. A substitution mechanism between bond and bank financing, or even within the banking industry between financing by large versus smaller banks, could potentially mitigate the capital constraints on fossil fuel firms imposed by the bond market and/or by some more environmentally friendly banks.

²⁶Figure B.1 illustrates this mechanism, with the red area indicating the share of fossil fuel financing that banks provide but bond markets would not.

²⁷For instance, the European Central Bank's 2020 supervisory expectations require banks to integrate climate-related risks into their risk management frameworks and disclosures. A recent review by the ECB shows that banks still fall short of meeting these expectations (European Central Bank, 2022).

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Table 1: Descriptive statistics

This table presents summary statistics on key variables. Panel A shows the summary statistics for the corporate bond sample. Panel B presents summary statistics for the syndicated bank loan subsample. Panel C presents summary statistics for the *Loan versus bond choice* measures. Column (1) presents data for the respective whole sample, and Column (2) for the fossil fuel sector subsample. Column (3) reports t-tests of the differences between fossil fuel and non-fossil fuel firms. In Panels A and B, firm characteristics variables have been winsorized. Firm size and bond and loan amounts are in USD and logarithmized. The summary statistics represent all observations for which all debt-level information presented in the table is available (bond spread, bond amount, maturity, exchange-listed status, secured status, and all-in-drawn spread, loan amount, maturity, collateral, number of lenders, and number of general covenants, respectively). In Panel C, the loan and bond observations are aggregated at the firm-year level. Total debt amount is in USD and has been logarithmized.

	Whole sample		Fossil fuel sector		Difference	
	mean	sd	mean	sd	b	t
Panel A: Corporate bonds						
Bond spread (in bps)	195.83	195.87	377.44	246.47	-195.88***	(-20.24)
Bond amount	19.81	0.87	20.11	0.66	-0.32***	(-12.04)
Maturity (in years)	10.43	8.00	10.24	7.20	0.21	(0.71)
Secured	0.10	0.29	0.05	0.23	0.04***	(4.79)
Exchange-listed	0.66	0.47	0.72	0.45	-0.07***	(-3.71)
Firm size	10.83	2.51	9.20	1.76	1.76***	(23.76)
Market-to-book value (in %)	1.59	0.92	1.46	0.73	0.14***	(4.56)
Asset tangibility	83.31	58.96	139.42	50.25	-60.41***	(-28.27)
Leverage	33.43	16.24	28.89	17.39	4.90***	(6.98)
Observations	9298		677		9298	
Panel B: Syndicated bank loans						
All-in-drawn spread (in bps)	229.81	157.74	250.20	160.44	-22.46***	(-4.12)
Loan amount	19.49	1.71	19.88	1.27	-0.43***	(-9.57)
Maturity (in years)	5.02	2.35	4.44	1.52	0.63***	(11.46)
Collateral	0.45	0.50	0.52	0.50	-0.07***	(-4.11)
Number of lenders	10.05	7.76	10.92	8.14	-0.96***	(-3.48)
Performance provisions	0.26	0.44	0.25	0.43	0.01	(0.72)
Number of general covenants	2.21	1.99	2.12	1.65	0.10	(1.73)
Firm size	9.17	2.11	8.78	2.30	0.43***	(5.41)
Market-to-book value (in %)	1.58	0.90	1.48	0.91	0.11***	(3.42)
Leverage (in %)	35.26	19.12	32.03	18.06	3.57***	(5.63)
Asset tangibility (in %)	68.89	47.97	130.27	53.48	-67.66***	(-34.54)
Observations	10316		950		10316	
Panel C: Loan versus bond choice						
Loan versus bond choice	0.63	0.48	0.64	0.48	-0.01	(-0.85)
Loan versus bond choice (non-binary)	0.61	0.45	0.59	0.44	0.01	(1.04)
Average maturity weighted	6.33	4.74	5.83	3.15	0.53***	(5.38)
Total amount	19.35	2.43	20.35	1.42	-1.09***	(-24.32)
Observations	16977		1252		16919	

Table 2: Syndicated bank loan spreads and Climate policy exposure

This table reports regressions at the individual syndicated bank loans level for the period 2007-2017. The dependent variable is the all-in spread drawn in bps of syndicated bank loans and the *Climate policy exposure* is measured by the CCPI. All variables are as defined in Table B.3. There can be several loan observations per loan facility for each lead manager in the loan syndicate. To account for this while still including lead bank fixed effects, we weigh each observation by 1 over the total number of lead banks per loan. The lower part of the table denotes the type of fixed effects and clustering used in each specification. For readability, omitted variables due to collinearity are left out. Firm-level controls include firm size, leverage, market-to-book ratio, and asset tangibility. Debt-level controls include loan amount and maturity, collateral, number of lenders, performance provisions, and number of general covenants.

	Dependent variable: All-in spread drawn			
	(1)	(2)	(3)	(4)
Fossil fuel	36.501*** (3.451)	55.012*** (3.632)	43.008*** (3.320)	43.008*** (4.336)
Fossil fuel*Climate policy exposure	0.053 (0.172)	-0.227 (-0.550)	-0.052 (-0.141)	-0.052 (-0.172)
Controls				
Firm-level controls	No	Yes	Yes	Yes
Debt-level controls	Yes	No	Yes	Yes
Crude oil price	No	Yes	Yes	Yes
Fixed effects				
Bank*Year	Yes	Yes	Yes	Yes
Loan purpose	Yes	Yes	Yes	Yes
Loan type	Yes	Yes	Yes	Yes
Clustered standard errors	Firm & Bank	Firm & Bank	Firm & Bank	Loan & Bank
Lead banks \times loan observations	30218	22295	22119	22119
Observations	5683	4113	4075	4075
R^2	0.612	0.576	0.614	0.614
R^2_{adj}	0.582	0.540	0.581	0.581

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Corporate bond spreads and Climate policy exposure

This table reports regressions at the corporate bond issue level for the period 2007-2017. The dependent variable is the spread of corporate bonds in bps, and the *Climate policy exposure* is measured by the CCPI. Column (4) contains the subsample of bonds that are exchange-listed. All variables are as defined in Table B.3. The lower part of the table denotes controls, the type of fixed effects, and clustering used in each specification. For readability, omitted variables due to collinearity are left. Firm-level controls include firm size, leverage, market-to-book ratio, and asset tangibility. Debt-level controls include bond amount and maturity.

	Dependent variable: Bond spread			
	(1)	(2)	(3)	(4)
Fossil fuel	134.427*** (3.588)	101.345*** (3.461)	89.120*** (2.930)	43.164* (1.651)
Fossil fuel*Climate Policy Exposure (CCPI)	0.447 (0.461)	1.278* (1.739)	1.252* (1.653)	1.694** (2.325)
Controls				
Firm-level controls	No	Yes	Yes	Yes
Debt-level controls	Yes	No	Yes	Yes
Crude oil price	No	Yes	Yes	Yes
Fixed effects				
Firm country*Year	Yes	Yes	Yes	Yes
Use of proceeds	Yes	Yes	Yes	Yes
Instrument type	Yes	Yes	Yes	Yes
Seniority	Yes	Yes	Yes	Yes
Clustered standard errors	Firm	Firm	Firm	Firm
Observations	3172	2524	2520	2233
R^2	0.438	0.595	0.604	0.502
R^2_{adj}	0.420	0.580	0.589	0.481

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Pooling and matching of loan and bond pricing

This table presents pooled syndicated bank loan and corporate bond regression results. The dependent variable is the corporate bond LIBOR swap spread at issue, and the all-in spread drawn respectively. In Column (2) loan and bond observations are matched using the coarsened exact matching method on debt maturity, amount, issuance year, and a secured-dummy. In Column (3) the matching method additionally includes debt purpose. In Column (4) the matching method additionally includes debt purpose and borrower rating. All regressions cluster the standard errors at borrower country level. Firm-level controls include firm size, leverage, market-to-book ratio, and asset tangibility. Debt-level controls include debt amount and maturity, secured dummy.

Dependent Variable: Interest rate spreads (All-in spread drawn and corporate bond LIBOR swap spread)				
	(1)	(2)	(3)	(4)
Fossil fuel	93.054** (2.722)	26.537 (0.657)	75.033** (2.372)	83.508*** (3.104)
Loan	-36.151*** (-2.864)	-169.646*** (-5.642)	-123.296*** (-5.336)	-101.907*** (-4.806)
Fossil fuel*Loan	-86.740*** (-2.744)	-20.967 (-0.539)	-66.511* (-1.800)	-87.454** (-2.412)
Fossil fuel*Climate policy exposure	1.018 (1.520)	2.864*** (4.739)	3.375*** (7.573)	2.259*** (3.706)
Fossil fuel*Loan*Climate policy exposure	-1.372** (-2.269)	-3.186*** (-5.159)	-3.228*** (-5.322)	-2.023*** (-2.771)
Controls				
Firm-level controls	Yes	Yes	Yes	Yes
Debt-level controls	Yes	Yes	Yes	Yes
Fixed effects				
Year	Yes	Yes	Yes	Yes
Year x Maturity	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Purpose	No	No	Yes	Yes
Borrower rating category	No	No	No	Yes
Clustered standard errors	Firm country	Firm country	Firm country	Firm country
Observations	6056	5923	5210	4639
R^2	0.369	0.546	0.548	0.537
$R^2_{adj.}$	0.363	0.541	0.542	0.531

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Climate policy exposure and firm value

This table reports estimates from high-dimensional fixed effects regressions of the market-to-book ratio (Column 2) and Tobin's Q (Column 1) on climate policy exposure, interacted with fossil fuel dummy. The regressions control for firm characteristics. Standard errors are clustered at the country level. The negative and significant interaction term suggests that climate policy exposure reduces firm valuation, consistent with the interpretation of stranded-asset risk.

	Tobin's Q (1)	Market-to-Book (2)	Market Equity (3)	Book Equity (4)
Fossil Fuel	0.191** (0.079)	0.191** (0.079)	0.338** (0.128)	0.088 (0.197)
Fossil Fuel \times Climate Policy Exposure (CCPI)	-0.003*** (0.001)	-0.003*** (0.001)	-0.015*** (0.003)	-0.002 (0.002)
Firm Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Country \times Year FE	Yes	Yes	Yes	Yes
Observations	12,615	12,615	13,029	13,004
Adjusted R-squared	0.8065	0.8065	0.9597	0.9769

Table 6: Loan versus bond choice and Climate policy exposure

This table provides within-firm evidence on corporate bond-to-syndicated bank loan substitution. The table reports the results of the linear regression for the period 2007-2017. The main coefficient of interest is that of the fossil fuel dummy and *Climate policy exposure* interaction term. In Panel A, the outcome variable is the non-binary *Loan versus bond choice*, which equals 1 if only syndicated bank loans are issued, 0 if only bonds are issued, and any number between 0 and 1 indicates a mix of syndicated loan and bond financing. Panel B, the outcome variable *Loan versus bond choice* is binary and equals 1 if the firm receives a new loan in the year and 0 if the firm receives a new bond; hence, it provides a stricter definition of debt choice in which we do not allow for partial substitution. The lower parts of the tables denote the controls, the type of fixed effects, and the clustering used in each specification. For readability, omitted variables due to collinearity are excluded. All variables are defined as in Table B.3.

Panel A	Dependent variable: Loan versus bond choice		
	(1)	(2)	(3)
Fossil fuel	0.051 (0.159)	0.194 (0.486)	0.189 (0.480)
Fossil fuel*Climate policy exposure (CCPI)	0.006*** (14.585)	0.006*** (13.069)	0.006*** (13.653)
Controls			
Total amount	Yes	Yes	Yes
Loan supply indicators	Yes	Yes	Yes
Firm-level controls	No	Yes	Yes
Crude oil price	Yes	Yes	No
Fixed effects			
Firm	No	Yes	Yes
Year	No	No	Yes
Clustered standard errors	Firm country	Firm country	Firm country
Observations	9291	7941	7941
R^2	0.398	0.408	0.417
$R^2_{adj.}$	0.248	0.249	0.260

Panel B	Dependent variable: Loan versus bond choice (binary)		
	(1)	(2)	(3)
Fossil fuel	0.034 (0.098)	0.171 (0.407)	0.163 (0.395)
Fossil fuel*Climate policy exposure	0.007*** (9.827)	0.007*** (7.411)	0.007*** (6.337)
Controls			
Total amount	Yes	Yes	Yes
Loan supply indicators	Yes	Yes	Yes
Firm-level controls	No	Yes	Yes
Crude oil price	Yes	Yes	No
Fixed effects			
Firm	No	Yes	Yes
Year	No	No	Yes
Clustered standard errors	Firm country	Firm country	Firm country
Observations	6948	5901	5901
R^2	0.500	0.512	0.523
$R^2_{adj.}$	0.332	0.336	0.350

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Within Bank Loan versus bond choice and Climate policy exposure

The dependent variable equals one if a lead manager bank underwrites a syndicated bank loan and zero if the lead manager bank underwrites a corporate bond. The coefficient of interest is the fossil fuel dummy and *Climate policy exposure* interaction term. We weigh each observation by one over the total number of lead manager banks per loan or bond. All firm- and loan-level variables are as defined in Table B.3. The lower part of the table denotes the type of fixed effects and clustering used in each specification. For readability, omitted variables due to collinearity are left out. Crude oil price annualized and asset tangibility coefficients have been scaled by ten for better readability.

	Dependent variable: Loan versus bond choice			
	(1)	(2)	(3)	(4)
Fossil fuel	-0.051 (-0.423)	-0.113 (-0.966)	-0.108 (-0.899)	-0.229 (-1.481)
Fossil fuel*Climate policy exposure	0.007*** (2.691)	0.007** (2.639)	0.007** (2.487)	0.006*** (2.741)
Controls				
Total amount	Yes	Yes	Yes	Yes
Loan supply indicators	Yes	Yes	Yes	Yes
Firm-level controls	Yes	Yes	Yes	Yes
Bank-level controls	No	Yes	Yes	Yes
Crude oil price	Yes	Yes	No	No
Fixed effects				
Lead manager bank	Yes	Yes	Yes	No
Firm	Yes	Yes	Yes	No
Year	No	No	Yes	Yes
Lead manager bank*Firm	No	No	No	Yes
Clustered standard errors	Bank	Bank	Bank	Bank
Observations	58808	50995	50995	48903
R^2	0.510	0.499	0.502	0.623
$R^2_{adj.}$	0.496	0.483	0.486	0.555

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Loan versus bond choice, Carbon emissions, and Climate policy exposure

This table provides within-firm evidence on corporate bond-to-syndicated bank loan substitution. The table reports the results of the linear regression for the period 2007-2017. The main coefficient of interest is that of the fossil fuel dummy and *Climate policy exposure* interaction term. The outcome variable *Loan versus bond choice* is equal to 1 if the firm receives a new loan in the year and 0 otherwise, which is a more stringent definition than a continuous interpretation of this variable. The lower parts of the tables denote the controls, the type of fixed effects, and the clustering used in each specification. For readability, omitted variables due to collinearity are excluded. All variables are defined as in Table B.3.

	Dependent variable: Loan versus bond choice		
	(1)	(2)	(3)
Fossil fuel	0.165 (1.086)	0.489 (1.405)	0.444 (1.411)
Fossil fuel*Climate policy exposure	0.006 (1.225)	0.010** (2.418)	0.009** (2.175)
Weighted Disclosure: Carbon	0.000 (0.754)	-0.000 (-0.638)	-0.000 (-0.875)
Controls			
Total amount	Yes	Yes	Yes
Loan supply indicators	Yes	Yes	Yes
Firm-level controls	No	Yes	Yes
Crude oil price	Yes	Yes	No
Fixed effects			
Firm	No	Yes	Yes
Year	No	No	Yes
Clustered standard errors	Firm country	Firm country	Firm country
Observations	1747	1536	1536
R^2	0.556	0.539	0.549
$R^2_{adj.}$	0.362	0.326	0.335

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Large versus small bank choice and Climate policy exposure

This table provides within-firm evidence on the substitution of small-to-large bank loans based on firms' *Climate policy exposure*. The table reports the results of the linear probability model for the period 2007-2017. The coefficient of interest is the interaction term between the fossil fuel dummy and *Climate policy exposure* (CCPI). In Panel A, the dependent variable equals one if a firm receives a loan from a syndication group with at least one large lead manager bank; it equals zero otherwise. In Panel B, the dependent variable equals one if a firm receives a loan from a syndication group with at least one large lead manager bank, equals zero if the syndication group consists only of small lead banks, and any value between 0 and 1 indicates a mix of loan financing from syndication groups with at least one large lead bank and none. All variables are defined in Table B.3. The lower part of the table specifies the types of fixed effects and clustering used in each specification. For readability, omitted variables due to collinearity are not included. The crude oil price (annualized), asset tangibility, and leverage coefficients have been scaled by ten for better readability.

Panel A	Dependent variable: Large versus small bank choice		
	Large bank= top 1/3	Large bank= top 1/4	Large bank= top 1/5
	(1)	(2)	(3)
Fossil fuel	-0.384*	-0.396	-0.246
	(-1.788)	(-1.564)	(-1.438)
Fossil fuel*Climate policy exposure (CCPI)	-0.002	0.003	0.005*
	(-0.711)	(1.185)	(1.824)
Controls			
Total amount	Yes	Yes	Yes
Loan supply indicators	Yes	Yes	Yes
Firm-level controls	Yes	Yes	Yes
Crude oil price	Yes	Yes	Yes
Fixed effects			
Firm	Yes	Yes	Yes
Clustered standard errors	Firm country	Firm country	Firm country
Observations	6386	6385	6415
R^2	0.642	0.561	0.555
$R^2_{adj.}$	0.524	0.417	0.410

Panel B	Dependent variable: Large versus small bank choice (non-binary)		
	Large bank= top 1/3	Large bank= top 1/4	Large bank= top 1/5
	(1)	(2)	(3)
Fossil fuel	-0.391**	-0.402**	-0.292**
	(-2.291)	(-2.228)	(-2.126)
Fossil fuel*Climate policy exposure	-0.003	0.002	0.005*
	(-0.919)	(0.959)	(1.879)
Controls			
Total amount	Yes	Yes	Yes
Loan supply indicators	Yes	Yes	Yes
Firm-level controls	Yes	Yes	Yes
Crude oil price	Yes	Yes	Yes
Fixed effects			
Firm	Yes	Yes	Yes
Clustered standard errors	Firm country	Firm country	Firm country
Observations	6976	6976	6976
R^2	0.616	0.539	0.534
$R^2_{adj.}$	0.500	0.401	0.395

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Bank weighted Climate policy exposure and fossil fuel loan share

The outcome variable in Columns (1)-(3) is the weighted *Climate policy exposure* of fossil fuel firms to which a bank has provided a syndicated loan as the lead manager in a given year. The dependent variable in Columns (4)-(6) is the share of fossil fuel loans in banks' total syndicated loan portfolio. The sample period is from 2007 to 2017. The lower part of the table denotes the type of fixed effects and clustering in each specification. Bank size is equivalent to $\ln(1 + \text{Total assets})$. Bank controls include EBIT over total assets, the market value of equity over the book value of equity, cash over total assets, and deposits over total assets. Macro controls include the GDP growth rate of the bank's country.

Dependent variable:	Bank weighted Climate policy exposure			Bank fossil fuel share		
	(1)	(2)	(3)	(4)	(5)	(6)
Bank size	2.720*** (5.391)	1.871*** (2.716)	2.359 (1.360)	-0.006 (-0.853)	-0.022** (-2.241)	-0.008 (-0.547)
Support Rating Floor			1.242*** (4.020)			0.006*** (3.917)
Controls:						
Bank-level controls	No	Yes	Yes	No	Yes	Yes
Bank country controls	No	Yes	Yes	No	Yes	Yes
Fixed effects:						
Year	Yes	Yes	Yes	Yes	Yes	Yes
Clustered standard errors	Bank	Bank	Bank	Bank	Bank	Bank
Observations	2270	1632	347	2255	1451	344
R^2	0.064	0.089	0.272	0.012	0.030	0.147
$R^2_{adj.}$	0.060	0.080	0.234	0.008	0.019	0.102

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Loan versus bond choice and abroad Climate policy exposure

This table provides within-firm evidence on corporate bond-to-syndicated bank loan substitution. The table reports the results of the linear regression for the period 2007-2017. The main coefficient of interest is that of the fossil fuel dummy and *Climate policy exposure* interaction term. In both Panels, the outcome variable is the non-binary *Loan versus bond choice*, which equals 1 if only syndicated bank loans are issued, 0 if only bonds are issued, and any number between 0 and 1 indicates a mix of syndicated loan and bond financing. In Panel B we include "Inland" Climate Policy interaction term in the regression. "The lower parts of the tables denote the controls, the type of fixed effects, and the clustering used in each specification. For readability, omitted variables due to collinearity are excluded. All variables are defined as in Table B.3.

Panel A	Dependent variable: Loan versus bond choice		
	(1)	(2)	(3)
Fossil fuel	0.052 (0.164)	0.196 (0.501)	0.191 (0.491)
Fossil fuel* Abroad Climate policy exposure	0.011*** (7.098)	0.011*** (4.609)	0.011*** (4.728)
Controls			
Total amount	Yes	Yes	Yes
Loan supply indicators	Yes	Yes	Yes
Firm-level controls	No	Yes	Yes
Crude oil price	Yes	Yes	No
Fixed effects			
Firm	No	Yes	Yes
Year	No	No	Yes
Clustered standard errors	Firm country	Firm country	Firm country
Observations	8940	7614	7614
R^2	0.403	0.413	0.422
$R^2_{adj.}$	0.254	0.256	0.267

Panel B	Dependent variable: Loan versus bond choice		
	(1)	(2)	(3)
Fossil fuel	0.042 (0.127)	0.182 (0.440)	0.178 (0.432)
Fossil fuel*Abroad Climate policy exposure	0.007*** (3.232)	0.006*** (3.586)	0.006*** (3.373)
Fossil fuel*Inland Climate policy exposure	0.009*** (3.649)	0.008*** (3.840)	0.008*** (3.804)
Controls			
Total amount	Yes	Yes	Yes
Loan supply indicators	Yes	Yes	Yes
Firm-level controls	No	Yes	Yes
Crude oil price	Yes	Yes	
Fixed effects			
Firm	No	Yes	Yes
Year	No	No	Yes
Clustered standard errors	Firm country	Firm country	Firm country
Observations	8916	7591	7591
R^2	0.403	0.412	0.422
$R^2_{adj.}$	0.254	0.255	0.266

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Loan versus bond choice (non-binary) and Climate policy exposure (CCPI). IV with temperature variability.

Column (1) contains the first stage regression. In Columns (2)-(4), the dependent variable loan versus bond choice equals one if only syndicated bank loans are issued, zero if only bonds are issued, and any number between 0 and 1 indicates a mix of syndicated loan and bond financing. The table reports the results of the linear regression for the period 2007-2017. The lower part of the table denotes the type of fixed effects and clustering used in each specification. For readability, omitted variables due to collinearity are left out.

Dependent variable:	CPE(CCPI)	Loan versus bond choice non-binary		
	(1)	(2)	(3)	(4)
IV-Weighted temperature variability	34.263*** (6.572)			
Fossil fuel		0.045 (0.137)	0.178 (0.443)	0.181 (0.454)
Fossil fuel*Climate Policy Exposure (CCPI)		0.007** (2.317)	0.008*** (3.414)	0.007*** (3.691)
Controls				
Firm-level controls	Yes	No	Yes	Yes
Loan supply indicators	Yes	Yes	Yes	Yes
Debt-level controls	No	Yes	No	Yes
Crude oil price	No	Yes	Yes	No
Fixed effects				
Firm	Yes	Yes	Yes	Yes
Year	Yes			Yes
Clustered standard errors	Firm country	Firm country	Firm country	Firm country
Observations	242	8920	7598	7598
R^2	0.977	0.007	0.010	0.006
$R^2_{adj.}$	0.967	0.006	0.008	0.003

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 1: The Climate Change Performance Index (CCPI) development and composition

The Climate Change Performance Index (CCPI) by Germanwatch (Burck et al., 2016) analyzes countries' climate protection performance. The graph on the left side plots the evolution of the CCPI over time for eight countries. The CCPI is based on the categories listed on the right side.

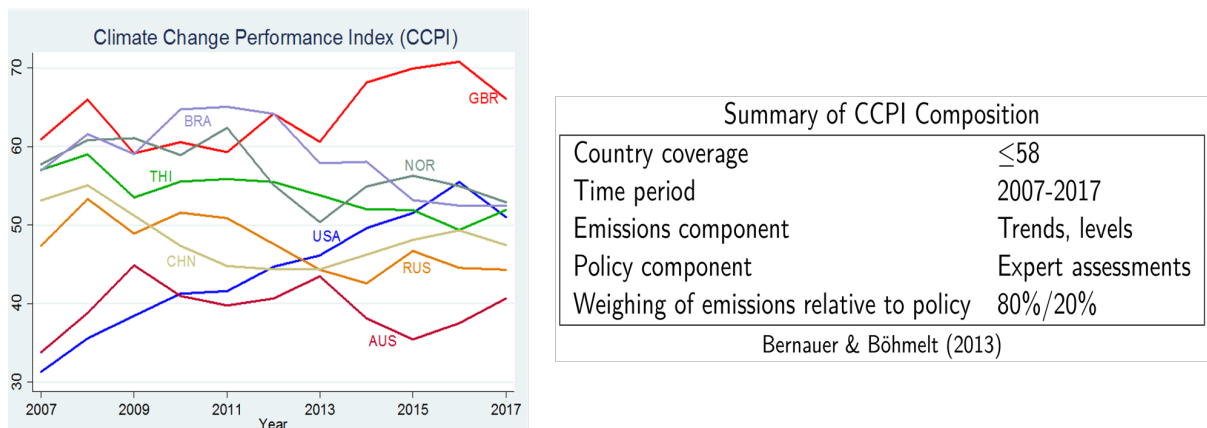
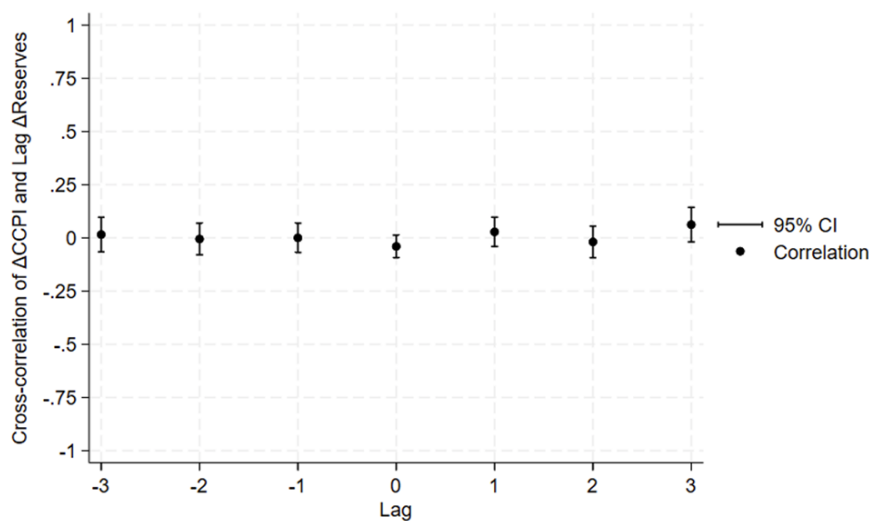


Figure 2: Cross-correlation between ΔCCPI and $\Delta\text{Reserves}$

This figure displays the cross-correlation coefficients and corresponding 95% confidence intervals between ΔCCPI —the annual absolute change in the CCPI of country c at time t —and $\Delta\text{Reserves}$, which represents the change in the relative location of firm f 's reserves in country c at time t —over multiple time lags. Only firms with non-zero reserves in country c at time $t - 1$ are included in the calculation of the correlation coefficients. The figure indicates that changes in countries' CCPIs do not correlate with changes in the location of firms' fossil fuel reserves in the country, both three years prior and three years subsequent.



A Appendix: Notes on Fossil Fuel Data Collection

Fossil fuel firms' reserve data is retrieved from annual reports, 10-Ks, or other regulatory required annual information forms. To collect information on fossil fuel firms' oil, gas and coal reserves, we rely on reserve definitions and reporting standards required by the US Securities and Exchange Commission (SEC). The general term "reserves" typically refers to oil and gas and mineral resources that are commercially viable and are further broken down into the sub-categories of proved, probable and possible. We collect:

- **“Proved”** oil and gas reserves (SEC, 2009)

According to the SEC's oil and gas disclosure rules proved reserves must be reported, probable reserves may be reported, no other reserves or resources may be reported in required filings.

- **“Proven and probable”** coal reserves (SEC, 2018)

According to SEC guidance coal mineral reserves are to be identified as probable or proven based on the mineralization's level of certainty. The determination and disclosure of mineral reserves is required to be supported with a final feasibility study. A probable mineral reserve is the economically mineable part of an indicated and, in some cases, a measured mineral resource. A proven mineral reserve is the economically mineable part of a measured mineral resource.

To make different fossil fuels comparable, we use a conversion table.²⁸ To merge the collected data with loan observations, we use a Dealscan-Compustat link file to merge Thomson-Reuter's (Refinitiv) LPC Dealscan and Standard and Poor's Computstat databases (Chava & Roberts, 2008).

We classify a firm as being in the fossil fuel sector if it has a Standard Industrial Classification (SIC) code between 1200-1400 (1221, 1222, 1231, 1311, or 1321). Therefore, not all fossil fuel firms possess oil, gas, or coal reserves. Within the fossil fuel sector, we identify firms that are expected to have non-zero reserves; consequently, if reserves cannot be retrieved, it is treated as a missing value.

²⁸BP. (2018). Retrieved from <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2018-approximate-conversion-factors.pdf>

B Appendix: Additional Figures and Tables

Table B.1: The location of fossil fuel reserves

This table presents an overview of the countries housing fossil fuel reserves of the firms in our syndicated bank loan and corporate bond sample.

Country	Freq.	Country	Freq.	Country	Freq.
Algeria	4	France	10	Norway	34
Argentina	14	Gabon	6	Oman	1
Australia	45	Germany	3	Pakistan	3
Azerbaijan	1	India	27	Papua New Guinea	6
Bangladesh	3	Indonesia	30	Peru	12
Brazil	4	Iraq	1	Poland	6
Brunei	1	Ireland	8	Romania	1
Bulgaria	2	Israel	6	Russia	26
Canada	393	Italy	5	South Africa	3
China	19	Kazakhstan	3	Sudan	2
Colombia	40	Libya	2	Syria	2
Congo	1	Malaysia	13	Thailand	4
Czech Republic	5	Mauritania	3	Trinidad and Tobago	3
Denmark	5	Mexico	9	Tunisia	7
Ecuador	9	Mongolia	4	Turkey	2
Egypt	23	Morocco	1	United Kingdom	49
Equatorial Guinea	4	Myanmar	1	United States of America	767

Table B.2: Frequency of new debt financing

This table reports the frequency of syndicated bank loans and corporate bond issues in our sample for 2007-2017. Row 1 presents the starting number of syndicated bank loans and corporate bonds. The issuing firms are not in the financial sector and have access to the syndicated bank loan as well as the corporate bond market at least once in 2007-2017. Row 2 presents the subsample of syndicated loans and corporate bonds for which pricing data is available.

		Syndicated bank loans	Corporate bonds
1	All observations	18044	20667
	↳ Fossil fuel subsample	1385	1341
2	All observations with pricing data	10428	9323
	↳ Fossil fuel subsample	963	684

Table B.3: Overview of variables

This table presents variable definitions and their sources.

Variable	Description	Source
A. Dependent variables		
All-in spread drawn	Sum of the spread over LIBOR plus the facility fee.	Dealscan
Bond spread	Yield differential between the bond redemption yield and the Treasury curve.	Thomson Reuters (TR)
Bond LIBOR swap spread	Difference between the bond-yield-to-maturity at issuance and the LIBOR swap rate matched by closest maturity.	TR
Loan versus bond choice	Equal 1 if new loan is received, zero if new bond is issued per firm-year.	Dealscan and TR
Loan versus bond choice (non-binary)	Equal 1 if new loan is received, zero if new bond is issued per firm-year, and any number between 0 and 1 if a mix of loan and bond financing is received.	Dealscan and TR
Bank's loan versus bond choice	Equal 1 if a lead manager underwrites a syndicated bank loan and zero if a lead manager underwrites a corporate bond.	Dealscan and TR
Large versus small bank choice	Equal 1 if a firm receives a loan from a syndication group with at least one large lead manager bank in the syndication group, zero otherwise.	Dealscan
B. Explanatory variables: Firm characteristics		
Leverage	Ratio of total debt to total assets (times 100).	Compustat
Firm size	Log of total assets in USD.	idem
Market-to-book	Ratio of total assets (book equity value + market equity value) to total assets.	idem
Asset tangibility	Ratio of tangible assets to total assets (times 100).	idem
C. Explanatory variables: Bond characteristics		
Maturity	Bond duration in years.	Dealscan/ TR
Bond amount	Log of nominal amount issued in USD.	idem
Secured	Dummy equal to 1 if the loan is secured.	idem
Exchange-listed	Dummy equal to 1 if the bond is exchange-listed.	idem
Use of proceeds	A series of dummy variables indicating bond use of proceeds (e.g., general purpose, capital expenditure, etc.).	idem
Instrument type	A series of dummy variables indicating instrument type (e.g. note, debenture, etc.).	idem
Seniority	A series of dummy variables indicating seniority group (e.g. junior secured, senior unsecured, etc.).	idem
D. Explanatory variables: Loan characteristics		
Maturity	Loan duration in years.	Dealscan/ TR
Loan amount	Log of nominal amount issued in USD.	idem
Collateral	Dummy equal to 1 if the loan is secured with collateral.	idem
Number of lenders	The number of banks involved in the syndicated loan.	idem
Performance provisions	Dummy equal to 1 if the loan has performance pricing provisions.	idem
Number of general covenants	The number of covenants in the loan contract.	idem
Loan purpose	A series of dummy variables indicating loan purpose (e.g. corporate purpose, debt repay, etc.).	idem
Loan type	A series of dummy variables indicating loan type (e.g. term loan, revolver/line, etc.).	idem
E. Explanatory variables: Bank characteristics		
Bank size	Log of total assets in USD.	FitchID
Bank EBIT-over total assets	Basic Earning Power (BEP) ratio which equals the earnings before interest and taxes (EBIT) divided by total assets.	FitchID
Bank cash over total assets	Cash over total assets.	FitchID
Bank deposits over total assets	Deposits (total customers and banks) over total assets.	FitchID
Bank non-performing assets	Non-performing assets (total) over total asset.	FitchID
Support Rating Floor (SRF)	A rating on the 21-point scale that reflects the probability of extraordinary sovereign support.	FitchID
F. Carbon risk related data		
Climate policy exposure	Determined by weighting countries' climate policy index by the relative amount of a firm's fossil fuel reserves in each year in that country. (see Equation 1).	Annual reports and climate policy indices
G. Macro Controls		
Crude oil price	Simple average of three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh.	IMF
NPL	Country bank non-performing loans to total gross loans.	WDI
Lending growth	Growth rate of loans granted to non-financial corporations in a country.	WDI
GDP growth	Annual GDP growth rate.	WDI

Table B.4: Overview of lead manager in the corporate bond and syndicated bank loan market

This table presents an overview of the lead managers that have both underwritten corporate bonds and participated as a lead bank in bank loan syndicates for fossil fuel firms in our sample during the period 2007-2017.

Lead manager	Bond	Loan	Total
ANZ Banking Group	3	89	92
Axis Bank Ltd	4	5	9
BBVA	26	42	68
BMO Capital Markets	51	117	168
BNP Paribas SA	72	265	337
Bangkok Bank	5	8	13
Bank of China Ltd	4	38	42
Bank of Shanghai	1	2	3
Barclays	232	183	415
BofA Securities Inc	326	365	691
CIBC World Markets Inc	15	83	98
CITIC	9	2	11
Capital One Financial Corp	13	18	31
China Construction Bank	2	9	11
Citi	255	348	603
Commerzbank AG	2	55	57
Commonwealth Bank of Australia	2	60	62
Credit Agricole CIB	32	170	202
Credit Suisse	129	88	217
DBS Group Holdings	6	85	91
DNB ASA	18	149	167
Danske Bank	2	17	19
Deutsche Bank	146	112	258
Fifth Third Bancorp	1	1	2
Gazprombank	18	2	20
Goldman Sachs & Co	113	60	173
HDFC Bank Ltd	1	2	3
HSBC Holdings PLC	77	119	196
ICICI Bank Ltd	1	12	13
IMI - Intesa Sanpaolo	12	51	63
ING	6	145	151
Itau Unibanco	2	1	3
JP Morgan	332	437	769
Jefferies LLC	8	9	17
Landesbank Baden-Wuerttemberg	2	25	27
Lloyds Bank	1	48	49
Macquarie Group	3	10	13
Mediobanca	6	10	16
Mitsubishi UFJ Financial Group	72	237	309
Mizuho Financial Group	35	8	43
Morgan Stanley	160	62	222
National Australia Bank	1	45	46
Natixis	10	84	94
Nordea	2	61	63
PNC Financial Services Group	14	41	55
RBC Capital Markets	125	25	150
SEB	3	36	39
Santander Corp & Invest Bkg	12	13	25
Sberbank CIB	14	9	23
Scotiabank	46	16	62
Societe Generale	48	97	145
State Bank of India	3	29	32
Sumitomo Mitsui Finl Grp Inc	17	191	208
Swedbank	2	18	20
TD Securities Inc	35	102	137
UBS	61	40	101
UniCredit	20	78	98
United Overseas Bank Ltd	1	30	31
VTB Capital	20	1	21
Wells Fargo & Co	244	283	527

Table B.5: Overview of most frequent fossil fuel lenders

This table presents the 20 banks that have participated the most frequently in syndicated bank loans to a fossil fuel firms with *Climate policy exposure* >0. The sample covers the period 2007-2018.

Bank	Freq.	Percent	Cum.
JP Morgan	153	6.43	6.43
BNP Paribas SA	105	4.41	10.84
Bank of America Merrill Lynch	99	4.16	4.99
BMO Capital Markets Financing Inc	84	3.53	18.52
Wells Fargo & Co	72	3.02	21.55
Royal Bank of Canada	70	2.94	24.49
Wells Fargo Bank NA	69	2.90	27.38
Citibank	62	2.60	29.99
JP Morgan Chase Bank NA	57	2.39	32.38
Bank of America	55	2.31	34.69
Bank of Tokyo-Mitsubishi UFJ Ltd [BTMU]	53	2.23	36.92
Citigroup	53	2.23	39.14
Toronto Dominion Bank	52	2.18	41.33
Bank of Nova Scotia	48	2.02	43.34
Royal Bank of Scotland Plc [RBS]	45	1.89	45.23
Barclays Bank Plc	42	1.76	47.00
HSBC	39	1.64	48.64
Bank of Montreal	35	1.47	50.10
Morgan Stanley	33	1.39	51.49
Sumitomo Mitsui Banking Corp	32	1.34	52.83

Table B.6: Pre- and post-2015 Paris Climate Change Agreement

This table examines whether the pricing of *Climate policy exposure* differs before and after the 2015 Paris Climate Change Agreement. The dependent variable is the corporate bond spread at issuance (Panel A) and the all-in-drawn spread for syndicated bank loans (Panels B and C). *Climate policy exposure* is measured by the CCPI. Columns (1) to (4) report results under different sets of controls and fixed effects, as in Tables 3 and 2.

Panel A shows no evidence of a change in the bond market's pricing of *Climate policy exposure* post-2015. Similarly, Panel B shows no significant pricing effect in syndicated bank loans. Panel C restricts the sample to firms that issued debt both before and after the Paris Agreement to address concerns that loan spreads may understate climate risk pricing due to renegotiation flexibility. If renegotiation dynamics explained the absence of loan pricing effects, we would expect increased sensitivity to *Climate policy exposure* in loans issued after 2015. The results in Panel C do not support this hypothesis.

For syndicated loans, multiple observations per loan facility correspond to individual lead banks. To account for this, we weight each observation by the inverse of the number of lead banks per facility. Standard errors are clustered at the borrower and lead bank level. All variables are defined in Table

Panel A: Corporate bonds	Dependent variable: Bond spread			
	(1)	(2)	(3)	(4)
Fossil fuel	127.906*** (2.880)	105.357*** (2.999)	93.616** (2.562)	39.200 (1.078)
Fossil fuel*Climate policy exposure (CCPI)	0.629 (0.529)	1.255 (1.396)	1.200 (1.300)	1.707* (1.764)
Fossil fuel*Post 2015	43.957 (0.576)	-27.614 (-0.306)	-28.573 (-0.309)	28.170 (0.285)
Fossil fuel*Post 2015*Climate policy exposure (CCPI)	-1.051 (-0.549)	0.226 (0.113)	0.337 (0.164)	-0.072 (-0.031)
Observations	5048	4209	4202	3684
R^2	0.416	0.579	0.591	0.513
$R^2_{adj.}$	0.399	0.565	0.577	0.495

Panel B: Syndicated bank loans	Dependent variable: All-in-drawn spread			
	(1)	(2)	(3)	(4)
Fossil fuel	31.146*** (3.338)	47.997*** (3.436)	38.332*** (3.282)	38.332*** (3.955)
Fossil fuel*Post 2015	73.343*** (3.843)	62.679*** (2.764)	51.832** (2.534)	51.832** (2.273)
Fossil fuel*Climate policy exposure (CCPI)	-0.063 (-0.231)	-0.287 (-0.758)	-0.196 (-0.579)	-0.196 (-0.662)
Fossil fuel*Post 2015*Climate policy exposure (CCPI)	0.078 (0.098)	0.028 (0.038)	0.382 (0.526)	0.382 (0.601)
Lead banks x loan observations	42748	32625	32404	32404
Observations	7788	5857	5813	5813
R^2	0.608	0.583	0.621	0.621
$R^2_{adj.}$	0.579	0.549	0.590	0.590

Panel C: syndicated bank loans – Continuous Issuers	Dependent variable: All-in-drawn spread			
	(1)	(2)	(3)	(4)
Fossil fuel	36.943*** (3.202)	60.871*** (4.310)	42.948*** (3.577)	42.948*** (4.176)
FossilFuel*Post2015	72.069*** (3.753)	50.006** (2.232)	46.787** (2.300)	46.787** (1.989)
Fossil fuel*Climate Policy Exposure (CCPI)	-0.274 (-0.820)	-0.626* (-1.681)	-0.402 (-1.197)	-0.402 (-1.401)
FossilFuel*Post2015*Climate Policy Exposure (CCPI)	0.218 (0.273)	0.360 (0.485)	0.564 (0.773)	0.564 (0.891)
Lead banks x loan observations	31512	24302	24132	24132
R^2	0.633	0.605	0.644	0.644
$R^2_{adj.}$	0.603	0.569	0.611	0.611

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.7: Corporate bond LIBOR swap spreads and Climate policy exposure.

The dependent variable is the corporate bond LIBOR swap spread in basis points (bps), and the *Climate policy exposure* is measured by the CCPI. Column (4) contains the subsample consisting of exchange-listed bonds. The lower part of the table indicates the type of fixed effects and clustering used in each specification. For readability, omitted variables due to collinearity are excluded.

	Dependent variable: Bond LIBOR swap spread (in bps)			
	(1)	(2)	(3)	(4)
Fossil fuel	136.018*** (3.653)	96.912*** (3.808)	98.823*** (3.690)	63.819** (2.503)
Fossil fuel*Climate policy exposure	0.576 (0.622)	1.206* (1.936)	1.292** (1.966)	1.824*** (2.713)
Controls				
Firm-level controls	No	Yes	Yes	Yes
Debt-level controls	Yes	No	Yes	Yes
Crude oil price	No	Yes	Yes	Yes
Fixed effects				
Firm country*Year	Yes	Yes	Yes	Yes
Use of proceeds	Yes	Yes	Yes	Yes
Instrument type	Yes	Yes	Yes	Yes
Seniority	Yes	Yes	Yes	Yes
Clustered standard errors	Firm	Firm	Firm	Firm
Observations	3433	2740	2738	2417
R^2	0.448	0.611	0.615	0.495
$R^2_{adj.}$	0.430	0.597	0.601	0.475

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.8: Bank size and Climate policy exposure (CCPI)

The dependent variable is the all-in spread drawn, and the *Climate policy exposure* is measured by the CCPI. The sample period is from 2007 to 2017. The coefficient of interest is that of the interaction term *Fossil fuel* \times *Climate policy exposure* \times *Bank size*. Bank size is represented by $\text{LN}(++\text{Total assets})$. We weigh each observation by the inverse of the total number of lead manager banks per loan. The lower part of the table denotes the type of fixed effects and clustering used in each specification. Loan-level controls include maturity, loan amount, collateral, number of lenders, performance provisions, and the number of general covenants. Firm controls include firm size, leverage, market-to-book ratio, and asset tangibility. Bank controls include EBIT over total assets, market value of equity over book value of equity, cash over total assets, and deposits over total assets. Macro controls include the GDP growth rate, lending growth rate, and nonperforming loans. For readability, omitted variables due to collinearity are excluded.

Dependent variable: All-in spread drawn				
	(1)	(2)	(3)	(4)
Fossil fuel	59.744 (0.460)	-34.238 (-0.394)	-0.554 (-0.007)	90.043 (0.902)
Bank size	-3.468 (-1.083)	-5.947** (-2.368)	-5.493** (-1.980)	27.634 (1.034)
Fossil fuel*Climate policy exposure (CCPI)	9.325** (2.027)	13.915*** (2.980)	15.466*** (3.043)	13.670** (2.259)
Fossil fuel*Bank size	-0.671 (-0.075)	5.824 (0.938)	3.429 (0.652)	-3.123 (-0.431)
Fossil fuel*Climate policy exposure (CCPI)*Bank size	-0.676** (-2.130)	-0.999*** (-3.090)	-1.104*** (-3.126)	-0.973** (-2.311)
Controls				
Loan-level	Yes	Yes	Yes	Yes
Firm-level			Yes	Yes
Bank-level		Yes	Yes	Yes
Macro-level	Yes	Yes	Yes	Yes
Fixed effects				
Year	Yes	Yes	Yes	Yes
Bank country	Yes	Yes	Yes	
Firm country	Yes	Yes	Yes	Yes
Bank				Yes
Loan purpose	Yes	Yes	Yes	Yes
Loan type	Yes	Yes	Yes	Yes
Clustered SE	Firm & Bank	Firm & Bank	Firm & Bank	Firm & Bank
Observations	18936	13902	11886	11861
R^2	0.564	0.558	0.557	0.583
$R^2_{adj.}$	0.561	0.554	0.551	0.572

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.9: Loan versus bond choice, Climate policy exposure, and green patents

This table provides within-firm evidence on corporate bond-to-syndicated bank loan substitution. The table reports the results of the linear regression for the period 2007-2017. In Panel A, the dependent variable is equal 1 if the firm receives a new loan in the year, zero otherwise. In Panel B, the dependent variable non-binary *Loan versus bond choice* equals one if only syndicated bank loans are issued, zero if only bonds are issued, and any number between 0 and 1 is indicating a mix of syndicated loan and bond financing. The lower part of the table denotes the type of fixed effects and clustering used in each specification. For readability, omitted variables due to collinearity are left out. The coefficients of the variables crude oil price annualized and tangible assets have been scaled by ten for better readability.

Panel A	Dependent variable: Loan versus bond choice		
	(1)	(2)	(3)
Fossil fuel	-0.034 (-0.101)	0.117 (0.296)	0.114 (0.297)
Green patents	-0.036** (-2.500)	-0.037*** (-3.847)	-0.029*** (-3.269)
Fossil fuel*Green patent	0.074*** (3.834)	0.061** (2.250)	0.055 (1.548)
Fossil fuel*Climate policy exposure (CCPI)	0.007*** (4.825)	0.008*** (5.182)	0.008*** (4.433)
Fossil fuel*Climate policy exposure (CCPI)*Green patent	-0.000 (-0.189)	-0.001 (-0.669)	-0.001 (-0.712)
Controls			
Total amount	Yes	Yes	Yes
Loan supply indicators	Yes	Yes	Yes
Firm-level controls		Yes	Yes
Crude oil price	Yes	Yes	
Fixed effects			
Firm	Yes	Yes	Yes
Year			Yes
Clustered standard errors	Firm country	Firm country	Firm country
Observations	6948	5901	5901
R^2	0.500	0.512	0.523
$R^2_{adj.}$	0.332	0.336	0.349

Panel B	Dependent variable: Loan versus bond choice non-binary		
	(1)	(2)	(3)
Fossil fuel	-0.047 (-0.152)	0.110 (0.283)	0.110 (0.288)
Green patent	-0.023* (-1.890)	-0.030*** (-3.386)	-0.022*** (-2.861)
Fossil fuel*Green patent	0.104*** (4.536)	0.091*** (5.790)	0.085*** (4.976)
Fossil fuel*Climate policy exposure (CCPI)	0.008*** (6.650)	0.008*** (7.961)	0.008*** (6.589)
Fossil fuel*Climate policy exposure (CCPI)*Green patent	-0.002 (-1.437)	-0.002* (-1.704)	-0.003* (-1.781)
Controls			
Total amount	Yes	Yes	Yes
Loan supply indicators	Yes	Yes	Yes
Firm-level controls		Yes	Yes
Crude oil price	Yes	Yes	
Fixed effects			
Firm	Yes	Yes	Yes
Year			Yes
Clustered standard errors	Firm country	Firm country	Firm country
Observations	9291	7941	7941
R^2	0.399	0.408	0.417
$R^2_{adj.}$	0.248	0.250	0.260

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.10: Green banks and Climate policy exposure

The dependent variable is the all-in spread drawn in bps of syndicated bank loans and the *Climate policy exposure* is measured by the CCPI. We weight each observation by one over the total number of lead banks per loan. The lower part of the table denotes the type of fixed effects and clustering used in each specification. For readability, omitted variables due to collinearity are left out.

Dependent variable: All-in spread drawn				
	(1)	(2)	(3)	(4)
Fossil fuel	64.741** (2.555)	52.732*** (2.737)	50.556*** (2.667)	47.333** (2.577)
UNEP	9.339* (1.938)	1.977 (0.294)	2.431 (0.296)	-5.473 (-0.495)
Fossil fuel*Climate policy exposure (CCPI)	-0.633 (-1.052)	-0.325 (-0.643)	-0.218 (-0.422)	-0.198 (-0.381)
Fossil fuel*UNEP	-24.941 (-0.843)	-19.523 (-0.608)	-10.213 (-0.329)	0.508 (0.017)
Fossil fuel*UNEP*Climate policy exposure (CCPI)	1.444	1.108	1.047	0.956
Loan-level controls	Yes	Yes	Yes	Yes
Firm-level controls			Yes	Yes
Bank-level controls		Yes	Yes	Yes
Macro-level controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	
Bank country FE	Yes	Yes	Yes	
Firm country FE	Yes	Yes	Yes	Yes
Bank country*Year FE				Yes
Loan purpose FE	Yes	Yes	Yes	Yes
Loan type FE	Yes	Yes	Yes	Yes
Clustered SE	Firm & Bank	Firm & Bank	Firm & Bank	Firm & Bank
Observations	22160	13902	11886	11861
R^2_{adj}	0.552	0.551	0.549	0.570

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.11: Green banks and bank's weighted Climate policy exposure (CCPI) and fossil fuel share.

The dependent variable in Columns (1)-(3) is the weighted *Climate policy exposure* of fossil fuel firms to which a bank has provided a syndicated bank loan as lead manager in a given year. The dependent variable in Columns (4)-(6) is the share of fossil fuel loans of a banks' total syndicated bank loan portfolio. The sample period is 2007-2017. The lower part of the table denotes the type of fixed effects and clustering used in each specification. Bank size is equivalent to $\ln(1 + \text{total assets})$ in USD. Bank controls include EBIT-over total assets, market value of equity over book value of equity, cash over total assets, deposits over total asset. Macro controls include GDP growth rate of bank country.

Dependent variable:	Bank weighted <i>Climate policy exposure</i>			Bank fossil fuel share		
	(1)	(2)	(3)	(4)	(5)	(6)
Bank size	1.871*** (2.716)	1.603** (2.283)	2.183 (1.215)	-0.022** (-2.241)	-0.022** (-2.281)	-0.008 (-0.546)
UNEP		12.125*** (3.661)	9.135* (1.760)		0.020 (0.735)	0.002 (0.074)
SRF			1.164*** (3.596)			0.006*** (3.846)
Bank-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank-level country controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank clustered SE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1632	1632	347	1451	1451	344
R^2	0.089	0.117	0.292	0.030	0.030	0.147
R^2_{adj}	0.080	0.107	0.253	0.019	0.019	0.100

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure B.1: Credit allocation towards fossil fuel

This figure illustrates the parameters of credit allocation towards fossil fuel firms. An increase in a firms' *Climate policy exposure* implies an increase in the expected loss (EL). If a lender does not account for a firms' *Climate policy exposure*, r_1 instead of r_0 is required from the fossil fuel firm.

$$\text{Climate policy exposure} \Rightarrow \Delta \text{ Expected Loss} > 0$$

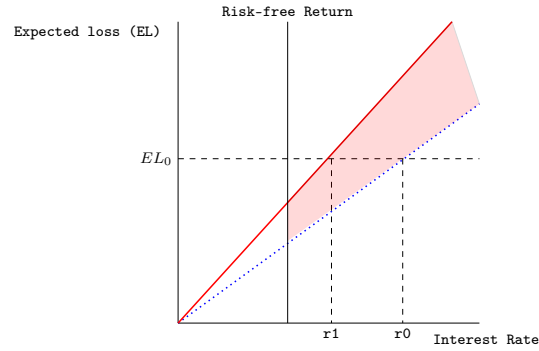


Figure B.2: Outstanding volume of syndicated bank loans for *Climate policy exposure* > 0

This figure illustrates the dollar volume of outstanding syndicated bank loans for fossil fuel firms with a *Climate Policy Exposure* (abbreviated as CPE in this figure) greater than 0, from 2007 to 2018. The graph displays the outstanding syndicated bank loans separately for firm subgroups categorized as above and below the median CPE for each month-year. Additionally, the graph presents the average Firm CPE on the right y-axis.

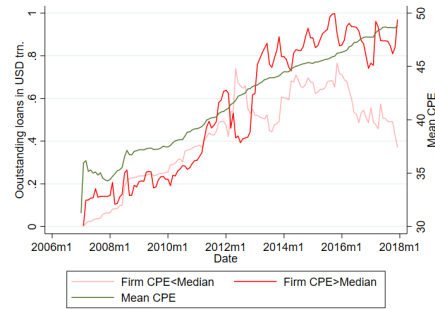
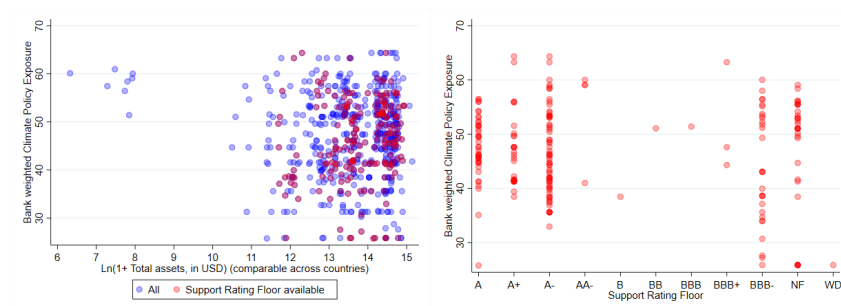


Figure B.3: Banks' weighted climate policy exposure, Fitch Support Rating Floors, and size

The figure on the left side plots banks' weighted climate policy exposure along their size. The figure distinguishes bank-year observations for which SRFs are available. The figure on the right side plots banks' weighted *Climate policy exposure* corresponding to their SRFs.



C Appendix: Corporate Bond and Syndicated Bank Loan Matching

We conduct our analysis using the coarsened exact matching (CEM) approach (Blackwell et al., 2010) to address differences in debt characteristics between syndicated bank loans and corporate bonds. For example, the average maturity is much shorter for bank loans (5 years) than corporate bonds (10 years). For this reason, we match loan observations to similar bond observations in order to make the groups comparable and exclude heterogeneity between the two debt types with regards to several debt characteristics that could potentially explain a difference in pricing.

To begin the coarsened exact matching analysis, we select matching variables and define appropriate coarsening levels. The more coarsening we allow, the more observations we will have, but the larger the bound on model dependence and estimation error. For **maturity**, we classify loans and bonds into short-term (1–3 years), medium-term (4–10 years), and long-term (>10 years). Loan and bond **amounts** are grouped into small (<\$100 million), medium (\$100–\$500 million), and large (>\$500 million). We also match on the variable **secured**, classifying loans as secured if they are collateralized. Bonds are considered secured if the 'seniority' variable in Thomson Reuters Eikon, which represents the order of repayment, contains the word 'secured'. Additionally, we match on the **issuance year** to control for time-varying factors affecting debt markets. We further categorize the **purpose of debt** issuance, differentiating between working capital, capital expenditure, M&A, dividend & stock buyback, debt repayments, bankruptcy-related debt, commercial paper backup, restructuring, recapitalization, refinance, collateralized Debt Obligation (CDO), general purpose, undisclosed, other, energy efficiency/green projects, spinoff, and aircraft/ship finance. Finally, we include **long-term borrower credit ratings** as a matching variable.

Appendix Table C.1 presents the sample means for loan and bond groups before and after applying coarsened exact matching. Column (1) shows the original unmatched data. Column (2) reports results after matching on maturity, amount, issuance year, and secured status. Column (3) incorporates debt purpose in the matching process, and Column (4) further includes borrower ratings. Using the matched data, we estimate Equation (3) to compare pricing differences between bonds and loans. The difference-in-differences results in Table 4 confirm that fossil fuel firms' climate policy exposure is priced less in syndicated bank loans than in corporate bonds.

Table C.1: Coarsened exact matching imbalances

This table provides sample means for the credit spread for the loan and bond observations in the original data: Columns 1) without matching; 2) after coarsened matching on maturity, loan amount, secured status, and country of issue; and 3) after additionally matching on debt purpose, as well as on the borrower's long-term rating. Coarsened exact matching was performed using the `-cem-` command in Stata, followed by weighted descriptive statistics with $iweight = cem - weights$ under the condition of $cem - matched = 1$, in which weights and matching analyses reflect the matching ratio of the number of controls to the number of cases.

	No Matching	Matching 1	Matching 2	Matching 3
Bond spread (in bps)	227.3 (3.717)	337.0 (6.050)	293.8 (6.389)	292.0 (6.717)
Loan All-in-drawn spread (in bps)	255.3 (2.296)	244.5 (2.434)	222.8 (2.720)	213.4 (3.033)
Observations	8,100	6,633	4,893	3,964

D Appendix: Alternative Definitions Climate Policy Exposure

This section presents additional robustness tests for the measure of *Climate policy exposure*. Our findings remain consistent across different specifications of both the measure and the regression models.

D.1 The Climate Change Cooperation Index (C3I)

We test the robustness of our *Climate policy exposure* variable constructed with the CCPI against an alternative climate policy stringency measure. The Climate Change Cooperation Index (C3I) Bernauer & Boehmelt (2013) evaluates countries' overall climate policy performance, as well as their performance in terms of political behavior and emissions. The index is only available for the period 2006–2014 and includes fewer countries and exhibits less variation across countries and time than the CCPI used in the main empirical analysis. The results reported in Appendix Table D.1 confirm our previous finding that climate policy risk is priced only in corporate bonds.

D.2 Climate Policy at Headquarter and Importing Countries

Firms may not be incorporated or selling fossil fuels in the country where their reserves are located; hence, they may be exposed to climate policy elsewhere. In Table D.2, we use a *Climate policy exposure* variable based on the CCPI of the headquarters of the fossil fuel firms to investigate the relevance of the climate policies of the countries where firms are incorporated. We do not find an impact on either corporate bond or syndicated bank loan spreads and, therefore, conclude that the climate policies of the countries where the reserves are located are indeed more relevant for evaluating firms' risk of stranding assets.

To similarly examine the impact of climate policies in fossil fuel-exporting countries, ideally, we would construct the *Climate policy exposure* variable by weighting fossil fuel firms' downstream sales. However, sufficient microdata on where the fossil fuels are sold is not available. Arguably, such a measure may be more prone to endogeneity, as firms may be nimble enough to circumvent such policy constraints by selling fossil fuels elsewhere, in contrast to reserves that are stuck in the ground.

D.3 National and International Climate Policy

Twenty percent of the CCPI is based on a climate policy section, capturing the latest developments in national and international frameworks. These qualitative components are assessed by country-level climate and energy experts and supplement the quantitative emissions and energy indicators that dominate

the rest of the index.²⁹ Figure D.1 illustrates the evolution of policy ratings for eight countries across time. Notably, the national and international policy sub-indices show relatively limited variation across countries and years compared to the full CCPI index, which aggregates additional dimensions such as emissions trends and renewable energy use.

To isolate the role of policy frameworks from the broader CCPI index, we construct a firm-level measure of *Climate policy exposure* using only the national and international policy components. Table D.3 presents the regression results for bond and syndicated loan spreads. In the bond market specification (Panel A), the coefficients on both national and international policy exposure are positive, suggesting that fossil fuel firms operating in countries with more ambitious climate policies tend to face higher bond spreads. In contrast, the estimated effects in the loan market specification (Panel B) are smaller in magnitude and more mixed in direction, indicating a more muted or heterogeneous pricing response to sovereign climate policy in the syndicated loan market. Columns (2) and (4) report specifications without firm-level clustering, while clustering is applied in Columns (1) and (3) to account for the firm-level construction of the exposure variables. The combination of narrow cross-country variation in the policy indices and firm-level clustering likely explains the lack of statistical significance, though the direction and magnitude of the coefficients remain consistent—and in some cases, the results are only marginally below conventional significance thresholds. Overall, we find these estimates to be consistent with the more comprehensive (and therefore more relevant) CCPI that encompasses all categories.

²⁹See Burck et al. (2016) for methodological details on expert evaluations and delayed policy impacts.

Table D.1: Climate policy exposure (C3I). Regression results for the period 2007-2014.

In Panel A, the dependent variable in this analysis is the spread of corporate bonds, and *Climate policy exposure* is measured by the C3I. Column (4) specifically focuses on the subset of bonds that are exchange-listed. The lower section of the table indicates the type of fixed effects and clustering applied in each specification. For readability, omitted variables resulting from collinearity are not included. In Panel B, the dependent variable is the all-in spread, measured in basis points (bps), of syndicated bank loans, and *Climate policy exposure* is also measured by the C3I. There can be several loan observations per loan facility for each lead manager in the loan syndicate. To account for this, while still including lead bank fixed effects, each observation is weighted by 1 divided by the total number of lead banks per loan. The lower part of the table denotes the type of fixed effects and clustering used in each specification. For readability, omitted variables due to collinearity are excluded.

Panel A	Dependent variable: Bond spread (in bps)			
	(1)	(2)	(3)	(4)
Fossil fuel	141.219*** (3.189)	96.899*** (2.846)	82.871** (2.379)	34.432 (0.981)
Fossil fuel*Climate Policy Exposure (C3I)	0.064 (0.067)	1.088 (1.531)	1.043 (1.466)	1.407* (1.820)
Controls				
Firm-level controls	No	Yes	Yes	Yes
Debt-level controls	Yes	No	Yes	Yes
Crude oil price	No	Yes	Yes	Yes
Fixed effects				
Firm country*Year	Yes	Yes	Yes	Yes
Use of proceeds	Yes	Yes	Yes	Yes
Instrument type	Yes	Yes	Yes	Yes
Seniority	Yes	Yes	Yes	Yes
Clustered standard errors	Firm	Firm	Firm	Firm
Observations	3176	2527	2523	2236
R^2	0.437	0.595	0.603	0.501
$R^2_{adj.}$	0.420	0.580	0.588	0.481

Panel A	Dependent variable: All-in spread drawn			
	(1)	(2)	(3)	(4)
Fossil fuel	22.329** (2.156)	44.161*** (2.989)	33.957*** (2.660)	33.957*** (3.726)
Fossil fuel*Climate policy exposure (C3I)	0.116 (0.518)	-0.141 (-0.447)	-0.055 (-0.185)	-0.055 (-0.234)
Controls				
Firm-level controls	No	Yes	Yes	Yes
Debt-level controls	Yes	No	Yes	Yes
Crude oil price	No	Yes	Yes	Yes
Fixed effects				
Bank*Year	Yes	Yes	Yes	Yes
Loan purpose	Yes	Yes	Yes	Yes
Loan type	Yes	Yes	Yes	Yes
Clustered standard errors	Firm & Bank	Firm & Bank	Firm & Bank	Loan & Bank
Observations	30258	22324	22148	22148
R^2	0.612	0.577	0.614	0.614
$R^2_{adj.}$	0.583	0.540	0.581	0.581

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D.2: Headquarter Climate policy exposure (CCPI). Regression results for the period 2007-2014.

In Panel A the dependent variable is the spread of corporate bonds, and the headquarter *Climate policy exposure* is measured by the CCPI. Column (4) contains the subsample of bonds that are exchange-listed. The lower part of the table denotes the type of fixed effects and clustering used in each specification. For readability, omitted variables due to collinearity are excluded. In Panel B, the dependent variable is the all-in spread, measured in basis points, of syndicated bank loans, and the headquarter *Climate policy exposure* is also measured by the CCPI. There can be several loan observations per loan facility for each lead manager in the loan syndicate. To account for this while still including lead bank fixed effects, we weigh each observation by 1 divided by the total number of lead banks per loan. The lower part of the table denotes the type of fixed effects and clustering used in each specification. For readability, omitted variables due to collinearity are excluded.

Panel A	Dependent variable: Bond spread			
	(1)	(2)	(3)	(4)
Fossil fuel	122.342*** (2.969)	90.960*** (2.758)	78.647** (2.332)	31.301 (0.908)
Fossil fuel*Headquarter climate policy exposure (CCPI)	-0.450 (-0.408)	0.839 (0.986)	0.773 (0.899)	1.173 (1.311)
Controls				
Firm-level controls	No	Yes	Yes	Yes
Debt-level controls	Yes	No	Yes	Yes
Crude oil price	No	Yes	Yes	Yes
Fixed effects				
Firm country*Year	Yes	Yes	Yes	Yes
Use of proceeds	Yes	Yes	Yes	Yes
Instrument type	Yes	Yes	Yes	Yes
Seniority	Yes	Yes	Yes	Yes
Clustered standard errors	Firm	Firm	Firm	Firm
Observations	30845	22727	22551	22551
R^2	0.430	0.592	0.601	0.500
$R^2_{adj.}$	0.412	0.577	0.586	0.480

Panel B	Dependent variable: All-in spread drawn			
	(1)	(2)	(3)	(4)
Fossil fuel	24.633** (2.484)	40.422*** (2.825)	31.338** (2.493)	31.338*** (3.209)
Fossil fuel*Climate policy exposure (CCPI hq)	0.027 (0.093)	-0.104 (-0.261)	-0.048 (-0.131)	-0.048 (-0.157)
Controls				
Firm-level controls	No	Yes	Yes	Yes
Debt-level controls	Yes	No	Yes	Yes
Crude oil price	No	Yes	Yes	Yes
Fixed effects				
Bank*Year	Yes	Yes	Yes	Yes
Loan purpose	Yes	Yes	Yes	Yes
Loan type	Yes	Yes	Yes	Yes
Clustered standard errors	Firm & Bank	Firm & Bank	Firm & Bank	Loan & Bank
Observations	30207	22284	22108	22108
R^2	0.612	0.576	0.614	0.614
$R^2_{adj.}$	0.582	0.540	0.581	0.581

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure D.1: National and international climate policy over time

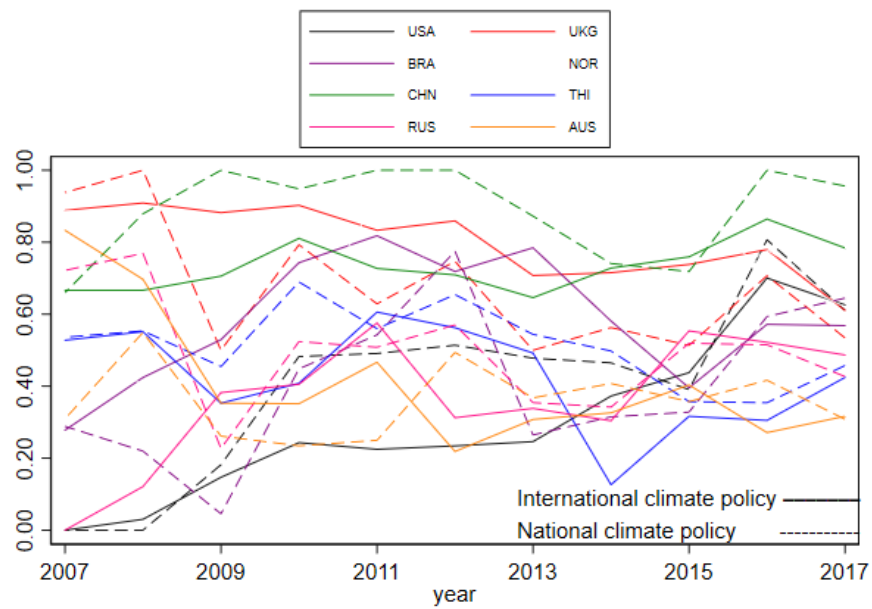


Table D.3: National and international Climate policy exposure (CCPI). Regression results for the period 2007-2014.

The dependent variable is the corporate bond spread at issue, and the all-in spread drawn, respectively. The *Climate policy exposure* is measured by the national policy and the international policy elements of the CCPI. The upper part of the table denotes the results for the syndicated bank loan specifications. There can be several loan observations per loan facility for each lead manager in the loan syndicate. To account for this while including lead bank fixed effects, we weight each observation by 1 over the total number of lead banks per loan. For readability, omitted variables due to collinearity are excluded. The maximum score of the international and national policy elements is 1 (the CCPI as a whole is represented in absolute numbers; the maximum score is 100).

Panel A	Dependent variable: Corporate bond spreads			
	(1)	(2)	(3)	(4)
Fossil fuel	101.800*** (3.126)	101.800*** (5.604)	111.706*** (3.406)	111.706*** (5.631)
Fossil fuel*International policy exposure	161.769 (1.070)	161.769** (1.980)		
Fossil fuel*National policy exposure			85.184 (1.055)	85.184* (1.762)
Bond-level controls	Yes	Yes	Yes	Yes
Firm-level controls	Yes	Yes	Yes	Yes
Crude oil price	Yes	Yes	Yes	Yes
Firm country*Year FE	Yes	Yes	Yes	Yes
Use of proceeds FE	Yes	Yes	Yes	Yes
Instrument type FE	Yes	Yes	Yes	Yes
Seniority FE	Yes	Yes	Yes	Yes
Clustered SE	Firm	Firm	Firm	Firm
Observations	2520	2520	2512	2512
R^2	0.604	0.604	0.606	0.606
R^2_{adj}	0.589	0.589	0.591	0.591

Panel B	Dependent variable: All-in spread drawn			
	(1)	(2)	(3)	(4)
Fossil fuel	24.478** (2.252)	24.478*** (2.876)	35.311*** (3.196)	35.311*** (5.023)
Fossil fuel*International policy exposure	29.470 (0.706)	29.470 (0.876)		
Fossil fuel*National policy exposure			-18.425 (-0.666)	-18.425 (-0.963)
Loan-level controls	Yes	Yes	Yes	Yes
Firm-level controls	Yes	Yes	Yes	Yes
Crude oil price	Yes	Yes	Yes	Yes
Bank*Year FE	Yes	Yes	Yes	Yes
Loan purpose FE	Yes	Yes	Yes	Yes
Loan type FE	Yes	Yes	Yes	Yes
Clustered SE	Firm & Bank	Bank	Firm & Bank	Bank
Observations	22118	22118	22066	22066
R^2	0.614	0.614	0.615	0.615
R^2_{adj}	0.581	0.581	0.582	0.582

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

E Appendix: US Oil and Gas Wells and a News-based Environmental Policy Index

To further confirm the internal validity of our results we focus on firms with fossil fuel reserves in the United States as well as a news-based index to proxy climate policy stringency. US fossil fuel reserves make up a large part of the total sample, warranting an analysis to delve into variations within the US and how much the results might be driven by this. The components of this analysis are 1) information on the firms' location of oil and gas wells in different US states, 2) a news-based stringency measure for environmental policy in the US, and 3) information on state-level variation of oil and gas revenue dependency, used as a proxy for the likelihood of the regulations affecting fossil fuel reserves to take effect.

US oil and gas wells. The United States is one of the world's top producer of oil and natural gas. In 2018 there were 982,000 active oil and gas wells in the United States (EIA, 2019). The fossil fuel firms in our sample own a significant share of these wells, because we find that they own approximately 908,431 wells, as counted in 2018. To identify the oil and gas wells in different U.S. States owned by fossil fuel firms in our syndicated bank loans and corporate bond data set, we used the commercial Shalexp database. After collecting information on all past and present wells, the status of a well is determined by the indicated well end date or plugging date. Where such information is not available, the prospective end date has been extrapolated based on the well's start date and an average of 25 productive years. Figure E.1 illustrates the number and location of oil and gas wells by U.S. States owned by fossil fuel firms in our sample. The sample comprises very large US-based firms as well as international companies with significant presence in the United States.

News-based environmental policy index. We employ a novel news-based measure to assess the stringency of environmental policies in the United States by Noailly et al. (2022). To construct this index, the authors extract text from ten prominent US newspapers spanning the past four decades and utilize machine learning techniques. An increase in the volume of environmental policy news enhances the awareness of economic agents regarding existing regulations and the growing risk of new restrictions. Consequently, agents are not only incentivized to invest in clean technology but also divest from polluting industries, such as fossil fuels.³⁰ Appendix figure E.2 illustrates the movement of the index over time.

³⁰Noailly et al. (2022) demonstrate a correlation between the index and policy stringency. Earlier research indicates that investor attention plays a significant role regarding whether climate change risk is priced in markets (Chava, 2014; Waisman et al., 2015). Additionally, non-environment-related news-based political risk is linked to higher corporate debt

US States' dependence on oil and gas extraction. Next, we collect data to proxy state-dependence on oil and gas extraction. We calculate the share of GDP from oil and gas extraction relative to the state's GDP from all industries combined. The data was retrieved from FRED[®], Federal Reserve Bank of St. Louis. The higher the share of oil and gas extraction for a state's economy, the more entrenched the industry is in a states' economy, implying that barriers to transition away from the industry are higher (Morris, 2016; U.S. Energy Information Administration, 2021).

Empirical specification. In a first step, we construct a state-level measure for stranding asset risk.

$$State\ stranding\ asset\ risk_{s,t} = \frac{GDP\ oil\ \&\ gas\ extraction_{s,t}}{GDP\ all\ industries_{s,t}} \times EnvP_t \quad (8)$$

To construct a measure of risk on firm-level, we follow the approach to calculate the *Climate policy exposure* in the main analysis. We weight the state stranding asset risk with firm's share of wells in the respective state. Thus, when the news-based measure for climate policy stringency in the US is high, the risk for firms with wells is also higher, depending on the state.

$$Firm\ stranding\ asset\ risk_{i,s,t} = \sum_s \frac{\#Wells_{i,s,t}}{\#Wells_{s,t}} \times State\ stranding\ asset\ risk_{s,t} \quad (9)$$

In Table E.1, we present the results. In Column 1, the dependent variable is the corporate bond spread, and in Column 2, the dependent variable is the syndicated bank loan all-in drawn spread. The specifications in columns 1 and 2 follow equation (2) in the main paper. However, we do not include year fixed effects, as the analysis is within country, and the main variation for policy stringency comes from the same country-level EnvP Index. Hence, the state-level stranding asset risk measures are correlated since the state-level variation stems from a weighting of the EnvP index. The results are aligned with our earlier findings that firm stranding asset risk is priced more in corporate bonds. Column 2 shows that one standard deviation increase in firm standing asset risk results in an increase of corporate bond spread at origination by approximately 7 basis points. On the other hand, in the syndicated bank loan specification the coefficient of the stranding asset risk measure implies a negative but not significant correlation.³¹

In Columns (3) and (4), we look at the bond versus bank substitution along US firms' stranding asset risk. While the choice of financing is driven by *Climate policy exposure*, the overall risk of stranded

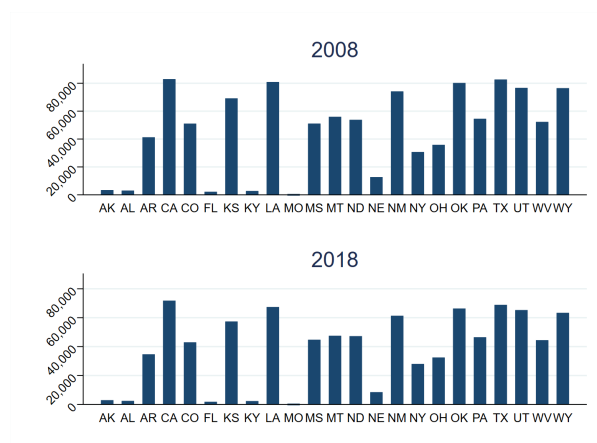
financing costs, as evidenced by studies using news-based risk indices (Caldara & Iacoviello, 2022).

³¹The mean for US firms' stranding asset risk is 143.80 with a standard deviation of 15.66

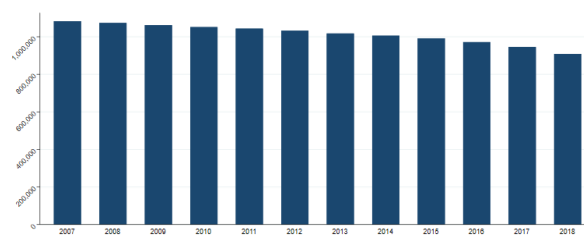
assets of a diversified fossil fuel firm with reserves in many countries is not necessarily correlated with the within-US variation in risk. Hence, in Column (4), we conduct an additional horse-race with with the *Climate policy exposure* that accounts for fossil fuel firms' riskiness of the whole portfolio in the cross-country setting. Column (4) implies that a one standard deviation increase in firms stranding asset risk, increases the fraction that is financed by loans by 9 percentage points.³²

Figure E.1: Distribution of US oil and gas wells by state and year

(a) US oil and gas wells by state



(b) US oil and gas wells by year



³²The mean of the *Loan versus bond choice* for US firms is 0.66 with a standard deviation of 0.47.

Figure E.2: News-based Environmental Policy Index (Noailly et al., 2022)

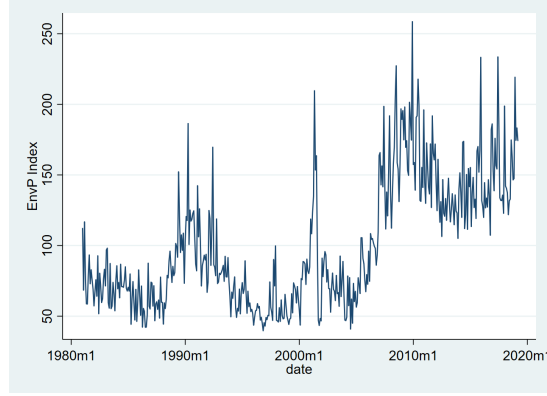


Table E.1: US well stranding asset risk

This table shows the results from regressions of corporate bond spreads (Column 1), syndicated bank loan all-in spreads (Column 2), and binary *Loan versus bond choice* on US well stranding asset risk. The sample includes firms headquartered in the US. The date range covered is 2007-2018. Firm-level control variables are (winsorized) size, leverage, market-to-book, and asset tangibility. Debt-level controls are for Column 1: loan amount, maturity, collateral, number of lenders, performance dummy, number of covenants; for column 2: bond amount, maturity, secured dummy; and for Column 3: total debt level and average maturity. Crude oil price is included in all specifications. In Column 3, the dependent variable is equal 1 if the firm receives a new loan in the year, zero otherwise further. Included loan supply indicators are as specified in section 3 of this paper. All fixed effects are displayed in the lower part of the table.

Dependent variable:	Loan All-in spread drawn	Bond credit spread	Loan versus bond choice	
	(1)	(2)	(3)	(4)
Fossil fuel	38.79*** (13.31)	59.19* (32.74)	-0.00404 (0.171)	-0.419 (0.311)
Fossil fuel* US Firm stranding asset risk	-0.111 (0.113)	0.433* (0.251)	0.00149 (0.00206)	0.00578** (0.00280)
Fossil fuel*Climate Policy Exposure (CCPI)				0.0137** (0.00542)
Firm-level controls	Yes	Yes	Yes	Yes
Debt-level controls	Yes	Yes	Yes	Yes
Bank FE	Yes			
Purpose FE	Yes	Yes		
Debt type FE	Yes	Yes		
Firm FE			Yes	Yes
Clustered SE	Firm & Bank	Firm	Firm	Firm
Adj. R^2	0.568	0.500	0.272	0.271
Number of loan observations	17514			
Observations	3916	3606	3097	3010

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