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JEL Classification: N/A

Keywords: Climate policy risk, Financial Intermediation, Stranded assets, Credit misallocation

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Too-big-to-strand? Bond versus bank financing in the transition to a low-carbon economy.

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Abstract

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1 Introduction

The transformation of the present global economy to one which can be sustained over the long-term, given the physical limits to the use of natural resources, requires that productive factors are directed away from the fossil fuel industry. Capital investment decisions are critical in shaping the nature and pace of the climate transition and the role of the financial sector is central to this process. Where firms lack the internally generated funds needed to attain the desired level of investment, debt financing becomes relevant for allocating investment funds. Firms cite financial constraints as some of the most important impediments to their investment and growth (Manole & Spatareanu, 2009). Fossil fuel resource extraction is particularly capital-intensive and firms in the energy industry traditionally run highly leveraged balance sheets. For this reason, bond markets and banks can either play an important role in facilitating continuing fossil fuel investments or, contrarily, play a decisive role in channeling funds away from the fossil fuel sector. This paper examines the role played by market- and bank-based debt in the climate transition process.

The transition to a low-carbon economy creates credit risks for the financial sector because it limits the extraction and use of fossil fuel resources by companies to which banks and bondholders may have credit exposures. To meet the Paris Agreement goal to limit global warming to 2 degrees Celsius or less, a major fraction of existing world fossil fuel reserves must go unburned (McGlade & Ekins, 2015). This would make obsolete billions of dollars of existing and planned investments in oil, gas, and coal as these resources become stranded (Addison, 2018; Carbon Tracker Initiative, 2017). There is a growing consensus that these risks may materialize (Krueger et al., 2019). As governments move to more strictly control

Challenges FEM-2021 (e-Paris), the UZH Young Researcher Workshop on Climate Finance 2020 (Zurich), the 2021 Workshop on Sustainable Banking (Zurich), and the Swiss Finance Institute Research Days 2020 (e-Gerzensee) for helpful comments and suggestions. Corresponding author: Winta Beyene, Department of Banking and Finance, Plattenstrasse 14, 8032 Zurich, Switzerland. winta.beyene@bf.uzh.ch.

carbon emissions, the future cash flow prospects of fossil fuel firms become poor and there is a push to a reorientation of capital allocation. With increasing risk of stranded assets, lenders' response should be to first, require a higher interest rate – to compensate for the increased risk of default – and eventually to limit credit to risky fossil fuel sector borrower. Our paper empirically examines, at the firm-level, the potentially different roles of market- versus bank-based credit in the (mis-)allocation of resources to fossil fuel. We do so by investigating fossil fuel firms' cost of corporate bond versus syndicated bank loan financing, and consequent composition of these two debt types along these fossil fuel firms' risk of seeing part of their assets stranding. Moreover, we explore whether bank characteristics related to bank size may influence banks' reaction in terms of lending and risk-taking to stranded asset risk. Since a fossil fuel firm's set of stranding assets cannot be easily observed, we follow Delis et al. (2018) and substitute the risk of stranded assets through a firm-level risk measure – climate policy exposure. This measure is based on the quantity of fossil fuels a firm holds within a specific country and this country's potential willingness to implement stricter climate policies. To measure a country's climate policy stringency, we mainly use the Climate Change Policy Index (CCPI) by Germanwatch (Burck et al., 2016). We use firm-level data that includes fossil fuel firms raising new corporate bond and syndicated bank loan financing from 2007 to 2017. We examine syndicated bank loans to estimate bank exposures to fossil fuel firms because large fossil fuel companies would rely somewhat less on bilateral bank loans owing to their much smaller size (Weyzig et al., 2014). Similarly, a look at the sectoral distribution of corporate bond markets, reveals that a significant portion of debt funding for fossil fuel firms likely comes from corporate bonds. Furthermore, the substitutability of corporate bonds and syndicated bank loans is evidenced by a body of literature (Badoer et al., 2019; Delis et al., 2018; Fabozzi et al., 2019).

We start by comparing the corporate bond spreads with the syndicated bank loan spreads charged to fossil fuel firms along the risk of their assets stranding. We find that newly issued

corporate bonds in the fossil fuel industry have higher yields than syndicated bank loans, and that with increasing climate policy exposure bond markets earn a higher premium relative to the syndicated bank loan-implied credit spread. Hence, bonds of fossil fuel firms are issued at a higher yield relative to their non-fossil fuel counterparts while no such relative discount can be detected for syndicated bank loans of the same fossil fuel firms.

To investigate fossil fuel firms' composition of external financing, we study the factors that determine the outcome of the bank loan versus bond issuance decision. Firm-year observations, when neither bonds nor syndicated bank loans were issued, are excluded to rule out a lack of demand for either type of credit (Becker & Ivashina, 2014; Ruggiero, 2018). Conditional on the issuance of new debt, firm-level controls, and aggregate loan supply indicators, we find that fossil fuel firms substitute from corporate bonds to syndicated bank loans in response to changing climate policy exposure. Indeed, firms' switching from bonds to loans with increasing risk of stranded assets indicates a contraction in bond supply relative to syndicated bank loan supply for fossil fuel firms. These changes in the bond financing supply to fossil fuel firms are reinforced by the pricing of climate policy exposure in bonds. The differential in the pricing of climate policy exposure and the consequential larger allocation of bank credit towards fossil fuel implies that banks have been less amenable to account for the likelihood that environmental policies will lead to assets being stranded.

We investigate avenues in which banks' incentives to finance fossil fuel firms are distorted and suggest that climate policy exposure may affect the characteristics of the pool of lenders of fossil fuel firms and, in particular, that large banks with diversified portfolios and too-big-to-strand incentives are more willing to finance fossil fuel firms with stranded assets risk because it leads to greater lending ex-ante and prevents further losses from divestment. We test this implication by investigating whether there is a migration towards the very largest banks in the syndicated bank loan market along fossil fuel firm's climate policy exposure. Our findings show that there is a heterogeneity among banks and that an increase in firms'

climate policy exposure, increases the fraction of large bank financing.

Our contribution to the literature therefore lies in enhancing the understanding of the role of the two primary sources of debt – public bonds and private bank loans – in the climate transition. The relevance of debt financing for the fossil fuel sector and the imminent risk of assets stranding suggests that bond and bank financing both could be directing investments away from fossil fuel. However, market-based finance might be better placed than bank-based finance to facilitate this climate transition. Recent research, which covers the period 2007 to 2016, suggests that fossil fuel firms that are more exposed to climate policy risk are on average not charged higher syndicated bank loan spreads than otherwise similar non-fossil fuel firms or comparable fossil fuel firms (Delis et al., 2018). Furthermore, a recent analysis from the World Resources Institute indicates that from 2016-2018, the average annual level of fossil fuel finance from banks with active sustainable finance commitments is still nearly twice the annualized amount of such commitments (Banking on Climate Change, 2019; Pinchot & Christianson, 2019). On the other hand, in markets, it appears that green bonds and fossil fuel divestment have emerged as a bottom-up approach to climate action within the business community. Bolton & Kacperczyk (2022) for example find that investors in the stock market are already demanding compensation for their exposure to carbon emission risk. On the other hand, Brown et al. (2017) for example show that bank sector development does not necessarily spur growth in innovative-intensive industries, but it has a significant effect on growth in industries with high external financing dependence. This suggests that the prevalence of private bank-based credit might privilege the fossil fuel over the renewable energy sector. And clearly investments in fossil fuel continue to dwarf investments in renewable energies. The finance literature has long debated the superiority of the relative merits of market- versus bank-based financing in promoting efficient allocation of risk and funding. Banks' comparative advantage, generally, lies in their ability to collect private information about their borrowers through repeated interaction. However,

the pro-cyclicality of the bank credit supply is a source of inefficient allocation of external funding. During asset price booms banks tend to finance riskier projects, distorting efficient capital allocation, but when asset prices fall they deleverage (Langfield & Pagano, 2016). And while there is evidence that due to their green preferences banks re-allocate syndicate loan credit towards firms with lower carbon emissions (Kacperczyk & Peydró, September 1, 2021), it may still be the case that – compared to bond markets – banks less likely cut fossil fuel financing as long as the value of carbon assets does not sharply slump. In addition, financial markets and banks may differ in the way they reallocate credit across and within different industries. Banks' existing knowledge in fossil fuel technology along with their exposure to carbon assets are important variables that could explain the relative inefficiency of bank-based versus bond-market based financing in the climate transition (Degryse et al., 2020). It is also possible that for all these reasons especially the largest banks continue to lend to fossil fuel firms, given these are "big-ticket items", while concurrently turning the rest of their credit portfolios towards lower carbon firms.

The rest of this paper is organized as follows. Section 2 provides details on the data while in Section 3 the research methodology and results are presented. 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 fossil fuel firms' substitution between syndicated bank loans and corporate bonds as a response to changing climate policy exposure. In section 3.3 we examine bond-to-bank substitution from the lead manager bank's perspective. In section 3.4 we examine bank heterogeneity in the pricing of firms' risk of stranded assets. Ultimately, in Section 4 we summarize and further discuss our findings.

2 Data

2.1 Corporate Bond and Syndicated Bank Loan Data

Our sample consists of corporate bond and syndicated bank loan data for fossil fuel and non-fossil fuel firms. To retrieve corporate bond data, security identifiers (ISIN or CUSIP) are collected from Thomson Reuters Eikon and subsequently bond characteristics are requested via an Excel add-in. We exclude instrument types such as strip bonds, convertible bonds and capital securities.[1] The main characteristics of the same firms' syndicated bank loans, i.e., spread at issue, maturity, issue amount are retrieved from DealScan.[2] We only keep the loan observations of firms that have issued at least once a corporate bond and syndicated bank loan during 2007-2017. We restrict the analysis to the sample of loans originated between 2007 and 2017 due to availability of climate policy data. We further exclude the financial sector from the sample of control firms, as well as debt with a maturity of less than a year. Firm-level accounting data of firms are collected from Compustat, in order to control for firms' specific time-varying characteristics in the regression specifications.[3] Table 1 presents the frequency of retrieved syndicated bank loan and bond issues in the period 2007-2017. In total we retrieve 23,699 individual loan observations from Dealscan. The sample of loan observations originally retrieved from DealScan shrinks henceforth as not for all observations loan-level information on the debt pricing is available. The final syndicated bank loan sample for the pricing regression consists of 13,579 loan observations whereby 1,106

[1] Thomson Reuters Eikon provides international deal-level data on new issues of corporate bonds, which are 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; the type, interest rate structure, maturity date and rating category of the bond, the amount of and use of proceeds obtained from the issue.

[2] The Loan Pricing Corporation DealScan is the leading source for 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-1980's.

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

of these are issued by fossil fuel firms. A syndicated loan is jointly extended by a group of banks, including one (or a few) lead banks and many participant banks. Ordinarily, the lead manager bank negotiates the key terms of the loan while other loan participant banks are invited to buy a stake of the loan. Our focus is on the borrower–lender (lead bank) relation, when we explore potential heterogeneity among banks in the pricing of climate policy exposure in section 3.4. We 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).

The same set of firms has issued 20,623 corporate bonds and 1,338 fossil fuel corporate bonds, respectively, in the same sample period. Similarly, the sample size shrinks due to the availability of pricing information to 9,313 corporate bond observations of which 682 are issued by fossil fuel firms. When a firm issues a bond, a lead underwriting bank, for a fee, seeks to buy the bonds from the issuer and sell the bonds to investors, thereby providing insurance for unsold securities and facilitating the sale of the bond. Underwriter can seek out partnerships with other banks to share the underwriting responsibilities (Yasuda, 2005). We retrieve lead manager information from Thomson Reuters. As opposed to the syndicated bank loans, the number of bond issues for which this information is available is limited to only 11,820 and 687 for the fossil fuel subsection. The original spread at issue is available for 8,188 and 508 of these bond observations.

[Table 1 about here.]

2.2 Climate Policy Exposure

Our main analyses examine whether the use of fossil fuel reserves and the respective risk that these reserves will become stranding is reflected in bond and syndicated bank loan financing patterns. Therefore, ideally, our main explanatory variable would be the amount of

stranded assets of a fossil fuel firm, but since this is unobserved, we strictly follow Delis et al. (2018) and proxy the risk of stranded assets with climate policy stringency. Decarbonization policies involve direct environmental regulations and stimulate technological improvements. Therefore, we assume that the probability of stranded fossil fuel reserves is higher in countries with higher climate policy stringency. We construct a climate policy exposure variable as the product of a country's climate policy stringency and the relative amount of reserves a firm has in this country. Data on firms' amount and location (by country) of fossil fuel reserves are retrieved from annual reports. Table 2 presents an overview of the countries where the fossil fuel reserves of the fossil fuel firms in our syndicated bank loan and corporate bond sample are located while Table 3 shows the countries of headquarters of these fossil fuel firms.

$$\textit{Climate Policy Exposure (CCPI)}_{t,i} = \sum\nolimits_{c} \textit{Relative Reserves}_{t,i,c} \times CCPI_{t,c} \tag{1}$$

To measure a country's climate policy stringency we use mainly the Climate Change Policy Index (CCPI) by Germanwatch (Burck et al., 2016). The CCPI Index compares countries by their emissions development, emissions levels, renewable energy, efficiency and climate policies, thus offering a comprehensive view of the current efforts of the countries analyzed. Figure 1 illustrates the evolution of the climate policy index, CCPI, over time for eight countries. There is a large variation across country and time.[4] For robustness checks, we additionally generate a firm-year measure of climate policy exposure from the product of relative reserves and of the Climate Change Cooperation Index (C3I) by Bernauer &

[4]The publicly available CCPI scores includes changes in the methodology of calculation applied by Germanwatch e.V. from 2013 onward. From the Germanwatch team we received a CCPI data set based on a uniform weightings for each index component, for which we are most grateful. However, the CCPI Index with the old methodology is only available up to 2017.

Boehmelt (2013).[5]

We focus on the fossil fuel industry because much of the global stock of carbon emissions can be traced to the fossil fuel sector. Previous work using firm-level emissions has mostly focused on scope 1 and 2 emissions, and therefore neglects the role of the fossil fuel sector (Ilhan et al., 2020; Reghezza et al., 2018). Different Environmental, Social, and Governance (ESG) measures lack consistency and moreover, Elmalt et al. (2021) show that ESG scores do not appear to capture differences in emissions growth across large fossil fuel producers, making a cross-firm comparison futile. In order to proxy firms risk of stranded assets, we therefore focus on a firm-level indicator that is based on fossil fuel reserves rather than on greenhouse gas (GHG) emissions.

[Figure 1 about here.]

[Table 2 about here.]

[Table 3 about here.]

3 Results

3.1 Climate Policy Exposure and the Pricing of Syndicated Bank Loans and Corporate Bonds

3.1.1 Climate Policy Exposure Pricing and Fossil Fuel Credit Allocation

Corporate debt is priced by charging a premium over the corresponding risk-free-yield, which is determined by the expected default loss. The climate transition is a credit risk concern

[5]The Climate Change Cooperation Index by Bernauer and Böhmelt (2013) evaluates countries' overall climate policy performance, as well as performance in terms of political behavior (output) and emissions (outcome). As the index is constructed backwards, it is composed of objective indicators only. The index is defined on the interval [0,100], with higher values indicating stricter climate policy (or climate-friendly countries). This index only covers the period 1996-2014 (for up to 172 countries).

as climate change exposure increases the possibility of financial losses due to changes in the credit quality of firms in carbon-intensive industries. Therefore, we expect price reactions to reflect changes in a companies climate change exposure. To formalize this intuition, we can look at the elements of expected loss to discuss climate transition-induced changes. Expected Loss (EL) is an essential metric for understanding credit risk and simplified is equal to $EL = PD \times LGD$. PD is the probability of default and LGD is the loss given default. We presume that the loss given default is positively correlated with the possibility that fossil fuel reserves will be stranded. When the value of the firm's assets decreases relative to the book value of the assets, the percentage of exposure, which will be not recovered after the counter-party's default also increases. Likely the probability of default is as well positively correlated with the possibility that fossil fuel reserves will be stranded. When more climate change-related risk is connected to lower and less stable cashflows, that translate into lower asset values, then fossil fuel firms exhibit higher probabilities of default. Following from this, the implication is that an increase in climate policy exposure, via the net effect of both $dLGD$ and dPD, will determine a positive sign of dEL.

[Figure 2 about here.]

Figure 2 illustrates some parameters of credit allocation towards fossil fuel firms. A lender can invest in a safe asset and obtain a certain future risk-free return, or lend to a fossil fuel firm. Let r be the interest rate the lender charges a fossil fuel firm. If the firm defaults, the lender receives no payment. The interest rate compensates for EL and is positively correlated with the expected loss. We assume that the expected loss and return vary across firms and their respective climate policy exposure. A price-setting lender should set the price of a debt in such a way that it covers the actual risk of the loan. To cover the expected loss on a loan, the bank needs to apply an interest rate, equal to the risk-free rate plus a spread that makes the expected return, given its probability of default PD and the loss given default

LDG, equal to that of a risk-free investment of the same amount. In Figure 2, a debt is granted and thereby a fossil fuel investments made possible in the area space under the lines that express the relationship between expected loss and interest rate. Market allocation is already inefficient if credit is granted on the left side of the risk-free return vertical line. If a bank sets the interest rate in a manner that does not account for the dEL attributed to climate policy exposure, then for a given actual expected loss, EL_0, interest rate r_1 instead of r_0 is required from fossil fuel firms. In this case, the area in which firms borrow, thus the number of loans and fossil fuel investments, would be larger by the red area in Figure 2.

3.1.2 Empirical Identification

In this paper, we investigate whether a pricing differential in the pricing of the risk of stranded assets between corporate bonds and syndicated bank loans implies that banks continue to finance fossil fuel projects, as illustrated by the red area space in Figure 2, that the bond market would not. To this goal, we first examine whether corporate bonds and syndicated bank loans of fossil fuel firms with climate policy exposure sell for a discount. We regress yield spreads at issue on the interaction between the fossil fuel dummy and climate policy exposure. If corporate bond and/or syndicated bank loan pricing is affected by the risk of fossil fuel reserves to become unburnable, then we should observe the coefficient of the interaction term to be positive and significant. The basic regression we estimate is

$$\begin{aligned} \textit{Cost of debt}_{f,t,i} =& a + \beta_1 \textit{Fossil fuel}_{f,t} + \beta_2(\textit{Fossil fuel}_{f,t} \times \textit{Climate Policy Exposure}_{f,t}) + \\ & \lambda I_{i,t} + \gamma F_{f,t} + \epsilon_{f,t,i} \end{aligned} \tag{2}$$

To examine syndicated bank loan credit spreads, our main outcome variable is the so-called 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 the All-in Spread Drawn of a loan facility i received by the borrower f in year t. To examine corporate bond credit spreads, we define as *Cost of Debt* the corporate bond benchmark spread at issue, which is calculated as the yield differential between the bond redemption yield and the Treasury curve, with maturity and compounding frequency taken into account. *Fossil fuel* is a dummy variable that equals one if firm f has a Standard Industrial Classification (SIC) code that indicates a relation to the fossil fuel industry and zero otherwise.[6] Firms with non-zero Climate Policy Exposure are as a rule fossil fuel firms, hence due to collinearity, we can and do not include Climate Policy exposure in the regression model outside of the interaction term. I is a vector of debt issue-specific characteristics. In the corporate bond regressions, I is a vector 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 has performance pricing provisions, and the number of general covenants. Further, a is a vector of fixed effects. In the corporate bond regression we use the variables use of proceeds, instrument type, seniority type as well as firms' country*year fixed effects. For the syndicated bank loan regression, we similarly use loan purpose, loan type, bank*year fixed effects. F is a vector of the firm-level controls firm size, leverage, market-to-book ratio, and asset tangibility. ϵ is the error term. All components of the yield spread analysis are described in Table 4.

[Table 4 about here.]

[6]The fossil fuel dummy equals to 1 if the SIC code of the firms as provided by Dealscan or TR Eikon is between 1200-1400.

3.1.3 Descriptive Statistics

We provide basic summary statistics of key variables used in our analysis in Tables 5 and 6. Column 3 in both tables reports t-tests of the difference between fossil fuel and non-fossil fuel firms. The mean All-in Spread Drawn in our loan sample is 231 basis points (bps), while the mean spread for fossil fuel firms is 247 and statistically different from non-fossil fuel firms. Fossil fuel loans are larger but their average maturity is lower by half a year.

In Table 5 we observe that newly issued corporate bonds in the fossil fuel industry have on average significantly higher yields relative to non-fossil fuel firms. The overall average mean credit spread at issue is 195 bps, while for the fossil fuel subsample the mean spread is 377. Notably, a much bigger difference than what we observe in syndicated loans. The indicator whether or not a bond is secured relies on the variable "Seniority" from Thomson Reuters Eikon that represents the order in which the asset is repaid, in relation to other assets services by the same entity, in the case of liquidation or a significant change to the ownership of servicing entity. While the share of loans secured by collateral is larger in the fossil fuel subsample, the reverse is true for bonds. The maturity of bonds is on average twice as long as the maturity of syndicated bank loans. Table 5 indicates that a large fraction of our bond sample is exchange listed.

Differences in firm characteristics highlight the structural peculiarities of fossil fuel firms. In either sample the average market-to-book ratio and leverage of fossil fuel firms are lower relative to non fossil fuel firms, while fossil fuel firms' asset tangibility is much larger.

[Table 5 about here.]

[Table 6 about here.]

3.1.4 Estimation Results

Table 7 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 the state of the economy and that might affect spreads. Instrument type, seniority, and use of proceed fixed effects are included to saturate for bond-specific credit risk. Because the latter variables are only sporadically available for bonds, our sample size is further reduced relative to Table 5. Given that, in addition, the number of bond issues for which lead bank information is available is limited, especially for fossil fuel firms, we are not able to include bank or bank*year fixed effects in the specifications. While the sample for Columns (1)-(3) consists of all retrieved bond observations, in Column (4) we look at the subsample consisting of bonds that are exchange-listed. This is to better account for different bondholder characteristics in a public issue of corporate bonds. Additionally, we include the crude oil price as a control as reduced energy use and prices might magnify the risk of stranded assets.

The regression results in Table 7 show that more climate policy risk exposure has resulted in increased credit spreads in the period 2007-2014. One standard deviation of climate policy exposure results in an increase on average in the cost of credit by approximately 10 bps,[7] which is equivalent to approximately 4.8% change of cost of credit relative to the mean in the period 2007-2014. An example to further illustrate this: Canada and Norway both possess substantial quantities of fossil fuels, but as Norway has a higher climate policy exposure (CCPI), the probability of seeing the Norway government 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 have been lower by

[7]The standard deviation for Climate Policy Exposure in the bond sample is 6.09(6.63) when debt pricing is available for the period 2007-2014 (2007-2017).

over 20 bps in 2014 relative to the cost of bonds for companies with reserves in Norway. In Column (4) we look at the subsample of bonds that are listed on exchange markets and that make 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 of climate policy exposure leads to an on average increase in the cost of credit by approximately 13 bps. This increase per standard deviation climate policy exposure is equivalent to an approximately 6% change of cost of credit 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 decisions 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).

Table 8 reports our findings with respect to the pricing of climate policy exposure measured with the CCPI in syndicated bank loans. To exclude a potential effect of bad controls, specification (1) includes only loan-level controls, specification (2) firm-level controls and the crude oil price, and specification (3) and (4) the full set of controls. The results are robust with different fixed effects and clustered standard error combinations. Because the lead bank information is largely available, we are able to include bank*year fixed effects. To do so, we only look at loans with at least one leader for the syndicated bank loan pricing regression. Every loan facility is repeated in the dataset depending on the number of lead banks. On average a loan has 4 lead banks. To account for this multiplicity, we cluster the standard errors at the borrower firm-level along with at the bank-level and adjust the point estimates by weighting each observation by the inversion of their multiplicity, hence one over the total number of lead banks per loan. In Column (4), we additionaly report loan-level clustered standard errors. We do not find any evidence that climate policy exposure measured by the

CCPI has been priced by the syndicated loan market throughout the period from 2007 to 2014.

[Table 7 about here.]

[Table 8 about here.]

3.1.5 Robustness Checks

Maturity

Time-inconsistency between climate risk materialization and short maturity of debt might incentive banks and bondholders to externalize the long-term costs associated with climate change by reducing the debt term. This in turn allows them to assume short-term benefits while ignoring the long-term risks associated with climate change risk. In Tables 9 and 10 we regress a dummy indicating whether corporate bonds respectively syndicated bank loans have a short maturity (<5years) or long maturity(>10years) on the climate policy exposure and fossil fuel interaction. We find no increase in the share of short term debt along firms' Climate Policy Exposure in either case.

The observation that bond market pricing is more sensitive to firms' stranded assets risk than bank loan pricing, could be due to the relative shorter maturity of bank loans. The reason for this being that debt with relatively longer maturity will bear higher environmental policy risk, because of the underlying uncertainty on relevant policy innovations in the more distant future. We examine the bond-pricing equation, where we interact maturity with firms' climate policy exposure and fossil fuel dummy. The results are presented in Table 11.

[Table 9 about here.]

[Table 10 about here.]

[Table 11 about here.]

Alternative climate policy index: C-3I

We conduct robustness tests related to our measure of climate policy risk exposure, by using C-3I instead of CCPI as the measure of the stringency of climate policies when calculating the Climate Policy Exposure. The C-3 Index evaluates countries overall climate policy performance, as well as performance in terms of political behavior (output) and emissions (outcome) (Bernauer & Boehmelt, 2013). The Index is only available for the time period 2006-2014. However, it includes more countries than the CCPI which we used in the main empirical part. The results are reported in Tables 12 and 13 and confirm our previous result that climate policy risk is priced.

[Table 12 about here.]

[Table 13 about here.]

Bond LIBOR swap spread as dependent variable

Typically bonds pay a fixed coupon rate, while loans have a fixed spread over LIBOR. To account for this and in order to 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 14 we examine the bond LIBOR swap spread instead of the simple credit spread as dependent variable. We retrieve the bond LIBOR swap spread by subtracting from the bond-yield-to maturity at issuance the LIBOR swap rate matched by closest maturity. The findings in Table 14 reflect the above.

[Table 14 about here.]

Policies of importing countries

In Tables 15 and 16 we use a climate policy exposure variable that is based on the CCPI of

the headquarter of the fossil fuel firms, in order to investigate the relevancy of the climate policies of the countries where firms sell their fossil fuel reserves. We do not find an impact on neither corporate bond nor syndicated bank loan spreads, and hence, conclude that the climate policies of the countries where the reserves are located are indeed more relevant to evaluate firms' risk of stranded assets.

[Table 15 about here.]

[Table 16 about here.]

3.1.6 Comparing Pre- and Post-2015 Paris Climate Change Agreement

The ratification of the 2015 Paris Climate Agreement is regarded as milestone in international climate politics. The agreement aims to increase the ability of countries to deal with the impacts of climate change and includes as a long-term goal, a commitment to "making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development." Climate change risks and the notion of a "carbon bubble" have gained more prominence after the Paris Agreement in December 2015, implying that the commitment of governments to fight climate change has gained some credibility with banks because of the Paris accord. For these reasons, the 2015 Paris Climate Agreement offers the opportunity to assess the impact of climate policy on the financial market (Monasterolo & De Angelis, 2018; Pham et al., 2019).

Delis et al. (2018) find first evidence for the pricing of climate policy risk in syndicated bank loans only post the 2015 Paris Climate Agreement: a one standard deviation increase in our measure of climate policy exposure implies that fossil fuel firms from 2015 onward are on average given a 15.4 bps higher All-in Spread Drawn compared to other firms.

In the following, we introduce an identification approach in which we distinguish the periods after 2015 in our bond and syndicated bank loan pricing estimation models. We enter

the interaction between the dummy variable $Post2015$ and our variable of interest *Climate Policy Exposure* as follows:

$$\begin{aligned} \textit{Cost of Debt}_{f,t,i} = & a + \beta_1 \textit{Fossil fuel}_{f,t} + \beta_2(\textit{Fossil fuel}_{f,t} \times \textit{Post2015}_t) + \\ & \beta_3(\textit{Fossil Fuel}_{f,t} \times \textit{Climate Policy Exposure}_{f,t}) + \\ & \beta_4(\textit{Fossil fuel}_{f,t} \times \textit{Post2015}_t \times \textit{Climate Policy Exposure}_{f,t}) + \\ & \lambda I_{i,t} + \gamma F_{f,t} + \epsilon_{f,t,i} \end{aligned} \tag{3}$$

Since the topic of climate policy risk has gained more prominence, we could observe that investors factor the risk of fossil fuel reserves to become unburnable more into the bond pricing of fossil fuel firms. That is $\beta_4 > 0$. However, this would depend on how much more new information the Paris Agreement introduced respectively how much more credible or likely are stringed climate policies.

For the bond market, when using the CCPI-based measure of climate policy exposure, we do not find evidence for a pricing change of climate policy exposure post-2015 period.

Furthermore, in contrast to Delis et al. (2018) we do not find convincing evidence that banks start to price the CCPI-based climate policy exposure post the 2015 Paris Agreement. We suggest that the reason for this difference of findings is the fact that our sample consists of firms that have access to both the syndicated bank loan as well as the corporate bond market. By design, our analysis relies on the least financially constrained firms, who are less likely to be affected by a contraction in either debt supply due to climate policy exposure.

Having established that there is on average no change in the pricing of neither corporate bonds nor syndicated bank loan post the 2015 Paris-Climate Agreement; in the following sections we look at the sample period 2007 to 2017.

[Table 17 about here.]

[Table 18 about here.]

3.2 Climate Policy Exposure and Bond-to-Loan Substitution

3.2.1 Borrower's Loan versus Bond Choice

The observation that in corporate bonds climate policy exposure is priced, indicates that the bond market is less willing to lend to fossil fuel firms with climate policy exposure than banks are. Therefore, bond financing provided to fossil fuel firms decreases with increasing climate policy exposure. To establish this empirically, we investigate fossil fuel firms' composition of external financing. We study whether the relative amount of bond financing compared to syndicated bank loan financing provided to fossil fuel firms is influenced by firms' risk of stranded assets. We assume that changing credit conditions modify the relative costs between different forms of financing thus requiring a rebalancing of the firm's debt structure. If the bond market prices climate policy risk higher than the loan market, ceteris paribus, some firms which would issue bonds otherwise instead might receive bank loans.

Altunbaş et al. (2010) investigate the financial factors behind the issuance of syndicated loans compared to those of the corporate bond market. Their main findings are that firms with greater financial leverage, more profits, and higher liquidation values tend to prefer syndicated bank loans. In contrast, firms with larger levels of short-term debt and those perceived by markets as having more growth opportunities favour financing through corporate bonds. Furthermore, financing through bonds is a more risky choice for firms. Once a negative signal about a risky firm's fundamental occurs, bondholders of the firm may want to liquidate their assets which would lead to a loss of the firm's initial net worth. For this

reason, risky firms appreciate bank credit because banks are efficient at liquidating assets for troubled firms (Becker & Ivashina, 2014; Bharath, 2002; Bolton & Freixas, 2000). There is also a body of literature providing evidence for the substitutability of corporate bonds and syndicated loans. However, this literature is mostly from the perspective that a bond is a substitute for a loan when the loan supply is tightening. Further evidence for close substitutability of corporate bonds and syndicated bank loans can be found in Becker & Ivashina (2014); Crouzet (2018); Faulkender & Petersen (2006); Kashyap et al. (1994).

3.2.2 Estimation Identifcation

To study firms' substitution between corporate bonds and syndicated bank loans along their Climate Policy Exposure, we again use firm-level data which includes firms who have access to syndicated bank loans as well as to the bond market, raising new debt financing from 2007 to 2017 with a maturity of at least one year. The sample period for this substitution analysis is from 2007 to 2017, having established that throughout this period there is a consistent differential pricing of climate policy exposure in the bond and syndicated bank loan markets.

The main dependent variable is the dummy "loan versus bond choice". When the dependent variable equals 0, only corporate bonds are issued, and when it equals one, firms issue only syndicated bank loans. Additionally, to capture partial substitution, we introduce a non-binary "loan versus bond choice" variable, that also equals one if the issue is a loan and zero if the issue is a bond. However, in the case where syndicated bank loans and corporate bonds have been issued in the same year, the variable compares the total amount raised through syndicated bank loans in a given year to the total amount of syndicated bank loan and bond funds borrowed in that year. When the non-binary loan versus bond choice variable equals zero, only syndicated loans are issued, and when it equals one, firms issue only bonds, while any number between zero and one is indicating a mix of syndicated loan and bond financing.

The measures are organized as a panel of firm-year observations and capture firms' (partial) substitution from syndicated bank loans to bonds and vice versa.

Firm-year observations, where neither syndicated bank loans nor bonds were issued, are excluded 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 bond-over-total debt ratio is due to lack of credit demand rather than a shrinkage in bond or syndicated bank loan supply. The empirical specification with this bond-over-total debt ratio as the dependent variable is the following:

$$\begin{aligned} \textit{Loan versus bond choice}_{f,t} = a + \beta_1 \textit{Fossil fuel}_{f,t} + \beta_2 \textit{Climate Policy Exposure}_{f,t} + \\ \beta_3(\textit{Fossil fuel}_{f,t} \times \textit{Climate Policy Exposure}_{f,t}) + \\ \lambda I_t + \gamma F_{f,t} + \delta Z_t + \epsilon_{f,t} \end{aligned} \tag{4}$$

a is a vector of fixed effects and ϵ the remainder disturbance. I represents a the variable *debt amount*, the total loan and/or bond amount issued in a year. Firm-level variable, F, includes firm size, leverage, market-to-book ratio, and asset tangibility. Z represents all wider economy control variables. To attribute a change in the "loan versus bond choice" variable to climate policy exposure variation, we need to address the alternative explanation of a change in the syndicated loan supply. Theoretical literature and policies that aim to stimulate lending by providing financial support to the banks, suggests that the bank-loan supply is high in good times and low during bad times. For this reason, it is important to control for syndicated bank credit availability with loan supply indicators; 1) "non-performing loan" which indicates banks non-performing loans to total gross loans in countries, and 2) "lending growth" which is the growth rate of loans granted to non-financial corporations. Fixed effects at the firm-level are included in most specifications to capture compositional effects in firms' financing decisions. The literature suggests that being in a certain class of firms with

some specific characteristics (e.g., high level of log-assets) is relevant for receiving additional credit. Including firm fixed effects implies that only (partial) switchers are considered in the regression.

3.2.3 Estimation Resutls

Table 19 contains the summary statistics of the dependent variables. Table 20 presents within-firm evidence on corporate bond-to-syndicated bank loan substitution. To account for potential differences in the nature of bond and syndicated loan issues, we control for the total amount of the corporate bonds and/or syndicated bank loans issued in a year. We note, however, that realized outcomes are potentially not optimal controls for borrower's desired debt amount. We introduce firm fixed effects to eliminate endogeneity due to unobserved firm characteristics. Hence, in these specifications, we estimate the within-firm effects of Climate Policy Exposure. Because we include firm-fixed effects the fossil fuel treatment dummy is collinear with the fixed effects, however the variable does not drop out of the regression model since few firms change their primary SIC code in the observation period. The estimations with respect to our explanatory variable of interest, the Climate Policy Exposure (CCPI) interaction, show a positive and significant impact in all specifications. The coefficient point estimate in the main specification Column (3), zero.007 implies that a one standard deviation increase in climate policy exposure reduced the fraction of external debt financing that is made up of bonds by approximately 5%. In other words, firms appear to substitute bonds with syndicated bank loans when climate policy exposure is high. Based on this finding, we can for example, ceteris paribus, infer that a fossil fuel firm that has fossil fuel reserves in the Canada is more likely to issue bonds over receiving syndicated loans than a fossil fuel firm with reserves in Norway. In Table 22 we investigate of firms' bond-to-loan substitution while allowing for a partial substitution between the two forms of debt and observe a coefficient of 0.006.

Overall, we find that, when banks are underpricing climate policy exposure related credit risks relative to the bond market, there is a substitution from bond to bank financing. We interpret the bond-to-loan substitution as a measure of the relative misallocation of bank credit relative to bond credit which can be visualized by the red area in Figure 2. The comparison with bond financing reveals that banks allocate too much credit to fossil fuel firms with climate policy exposure, thereby they enable inefficient fossil fuel capital investments. From fossil fuel firms' perspectives, the differential in the pricing of climate policy exposure attracts fossil fuel firms with climate policy exposure to pursue syndicated bank loans rather than bonds.

[Table 19 about here.]

[Table 20 about here.]

[Table 21 about here.]

[Table 22 about here.]

3.3 Lead Manager of Syndicated Bank Loans and Corporate Bonds

3.3.1 Bank's Loan versus Bond Choice

We have documented a positive relation between the use of bank debt financing and climate policy exposure. We extend this analysis to examine the debt choice from the lead manager banks perspective. Is a bank with increasing climate policy exposure more likely to underwrite a corporate bond or a syndicated bank loan?

The differential pricing of climate policy exposure in the bond and loan market might be impacted by differences in the underwriters' opinion over a given firm's riskiness. If a bank that functions as a lead manager has loans outstanding to a new corporate bond issuer

or syndicated bank loan borrower, the private information this bank has obtained through the previous loan transactions may enable it to form more precise expectations towards a fossil fuel firms' ability to mitigate its stranded assets risk (Takaoka & McKenzie, 2006). Therefore, the endogeneity of underwriter choice potentially could lead to a sorting of better quality fossil fuel firms to the syndicated bank loan market. In order to show that our results on the bond-to-bank substitution are unlikely to arise from differences in banks that underwrite corporate bonds from banks that underwrite syndicated bank loans and ultimately from a difference in quality of borrower, we undertake the following analysis.

3.3.2 Estimation Identification

In a first step, we combine the corporate bond and the syndicated bank loan subsets for which the lead manager information is available. Lead managers are matched at the parent company-level. Following this matching, in our dataset the same banks are observed to engage in corporate bonds and in syndicated bank loans as lead managers. Table 23 presents an overview of the lead manager that have underwritten corporate bonds as well as syndicated bank loans in our sample during the period 2007-2017.

[Table 23 about here.]

$$\begin{aligned} \textit{Bank's loan versus bond choice}_{f,b,t,i} = a + \beta_1 \textit{Fossil fuel}_{f,t} + \beta_2 \textit{Climate Policy Exposure}_{f,t} + \\ \beta_3(\textit{Fossil fuel}_{f,t} \times \textit{Climate Policy Exposure}_{f,t}) + \\ \lambda I_{i,t} + \gamma F_{f,t} + \delta B_{b,t} + \zeta Z_t + \epsilon_{f,b,t,i} \end{aligned} \tag{5}$$

The dependent variable *Bank's loan versus bond choice* is a dummy variable that equals one if a lead manager bank has underwritten a loan and zero if the lead manager bank has

underwritten a bond. a is a vector of fixed effects, most importantly firm fixed effects and lead manager bank fixed effects. ϵ is the remainder disturbance. I represents the bond or loan-specific controls *debt amount* and the *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: Basic Earning Power (BEP) ratio which equals the Earnings Before Interest and Taxes (EBIT) divided by total assets, cash over total assets, and bank deposits over total assets. Macro controls, Z, include: GDP growth, non-performing loans over total loans and the lending growth rate.

3.3.3 Estimation Results

[Table 24 about here.]

The estimations in Table 24 show that the coefficient for Climate Policy Exposure interaction is positive and significant with a point estimate of 0.008. For a standard deviation increase in the CCPI, the probability that a bank underwrites a syndicated bank loan over a corporate bond changes by over 5 percentage points. Table 24 therefore indicates that, controlling for bank and firm fixed effects, with firm's increasing climate policy exposure, banks are more likely to underwrite syndicated bank loans than corporate bonds. Hence, we show that our results from Table 20 are unlikely to arise from differences in banks' opinion over a given firm's risk.

3.4 Climate Policy Exposure Pricing and Small-to-Large Banks Substitution

3.4.1 Climate Policy Exposure and Big Banks

The results presented indicate that corporate bonds earn a premium in excess of the syndicated bank loan-implied credit spread along firms' climate policy exposure. Whether or not the risk premiums charged by the bond market are sufficient to cover the potential losses related to the climate policy risk, the differential in the pricing of climate policy exposure implies that banks have been disregarding the actual likelihood that environmental policies will lead to assets being stranded to a larger extent. What are the reasons underpinning the banks' underpricing of firms' climate policy exposure? The tendencies of banks to lend to fossil fuel firms may be correlated with bank characteristics, which we want to uncover. If a bank correctly perceives the risk of stranded assets, it will incorporate this risk in its optimal decisions. If that bank nevertheless decides to lend in the same or larger volumes to fossil fuel, one can assume that the expected gains from an increased investment today may in some ways compensate for the expected costs of financial distress in the future.

This might be the case for big banks for several reasons. The recent Financial Stability Review of the European Central Bank suggests that exposures to climate-related risks tend to be more concentrated than overall exposures. Banks that hold the largest exposure to physical transition risks are generally "large and well diversified across asset classes and regions and have additional capital buffers given their status as global or other systemically important banks" (European Central Bank, 2021). The same seems to be the case for banks that hold the largest exposures to firms with stranded asset risks. According to the European Systemic Risk Board (ESRB), exposures of euro area banks to high-emitting firms appear limited on average, but "are concentrated in a few large exposures for some

banks" (European Systemic Risk Board, 2020).[8] A key benefit of large banks is their ability to diversify risks and avoid "putting all of their eggs in one basket", thus making them less vulnerable to carbon-intensive counterparties in their loan portfolios. Big banks, especially those that are deemed to be global systemically important, are additionally subject to higher capital requirements, and therefore better protected in the event of transition risk related losses. Finally, too big to fail banks (TBTF) benefit from large explicit and implicit public subsidies, including the expectation that such institutions will receive public support during future emergencies. If banks expect government bailouts, then the price of bank loans issued by TBTF banks will not fully reflect their risk. For the reasons above, big banks might be encouraged to continuously lend to the fossil fuel sector and consequently collect stranded assets risk on their balance sheets. Because banks invest in financial assets that in turn pay for real projects by non-financial companies, banks ma be interfering with the process of destruction and innovation of the fossil fuel sector that is needed for a successful climate transition. [9]

To summarize, continued lending to fossil fuel may be the better strategy for a bank in some cases as it leads to greater lending ex-ante and prevents further losses from divestment. We suggest that climate policy exposure may affect the characteristics of the pool of lenders of fossil fuel firms. To test the implication whether large banks are more willing to finance fossil fuel firms with stranded asset risk, we examine whether there is a within-firm substitution from small to large banks along fossil fuel firm's Climate Policy Exposure.

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[8] Table 28 contains an overview of the 20 banks that have participated the most frequently in syndicated bank loans to a fossil fuel firms with Climate Policy Exposure >0 in our dataset. Our table is consistent with the Banking on Climate Change (2019) annual listing of the top banks that provide financing to companies active across the fossil fuel life cycle.

[9] The trend that transition risks are increasingly concentrated in certain sectors and companies that are better able to mitigate their transition risks can also be observed in the fossil fuel sector itself. As fossil fuel firms face mounting pressure to divest fossil fuel assets, production may be shifting to commodity traders, private or state-owned companies which face much less scrutiny over their activities, and are also better protected from transition risks due to their diversified portfolios or political connectedness (Rval, 2021).

3.4.2 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 regression is based on Equation 2. The outcome variable is again the All-in Spread Drawn, which equals the spread of the loan facility over LIBOR plus any facility fee, received by the fossil fuel borrower f and granted by bank b in year t. We define as the main variable of interest the interaction of the continuous variables Climate Policy Exposure and bank size.

In Table 25 we assess the pricing of syndicated bank loans along bank size, and find that across all syndicated loans, large banks acting as lead managers charge a lower all-in spread drawn than small banks do. For a fossil fuel firm that borrows from a bank with the largest bank size, a one standard deviation increase in Climate Policy Exposure will imply a loan rate that is lower by over 30 bps compared to a fossil fuel firm borrowing from a bank with the smallest bank size.[10] 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. These spread findings are therefore consistent with the exposure estimates discussed above.

3.4.3 Empirical Identification Small-to-Large Banks Substitution

We separate lead manager banks into two size categories using a dummy variable for size named Large, which takes value 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, and top 1/3 percentile of the distribution of total assets of all the lead manager banks in that particular year. Applying Equation 4

[10] [15.20- 6.15]*7.9*[coefficient of the triple interaction]

to our data, we obtain the following basic specification:

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

The main dependent variable is the dummy *Large versus small bank choice*. When the dependent variable equals one a firm receives a loan from a syndication group with at least 1 Large lead manager bank. The variable is 0 when a firm receives a loan from a syndication group without any Large lead manager banks. a is a vector of firm fixed effects and ϵ the remainder disturbance. I represents a the variable *debt amount*, 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 represents GDP growth and crude oil price annualized.

3.4.4 Empirical Results Small-to-Large Banks Substitution

[Table 25 about here.]

[Table 26 about here.]

[Table 27 about here.]

Table 26 contains the results of the estimation 6. In Column (1), we define lead bank managers as Large if their total assets are in the top 1/5 percentile of the distribution of total assets of all the lead manager banks in that particular year. In Columns (2) and (3) banks are Large if they are in the top 1/4 percentile, and in top 1/3 percentile, respectively. In Column (1) the coefficient of the fossil fuel and Climate Policy Exposure interaction is positive, as expected. This result implies that a one standard deviation increase in climate policy exposure increases the fraction of large bank financing by approximately 3 percentage points. In Column (2) the coefficient is still positive, however, the effect is smaller and

the coefficient is not significant. In Column (3) the Climate Policy Exposure interaction coefficient is negative, smaller, and has no significant impact on *large versus small bank choice*. We conclude that there is substitution towards the very largest lead manager banks along fossil fuel firm's Climate Policy Exposure. The results highlight the importance of considering bank size as it modifies the effect of climate policy exposure on fossil fuel firms debt financing. Table 27 contains the results when the dependent variable *Large versus small bank choice* is non-binary.

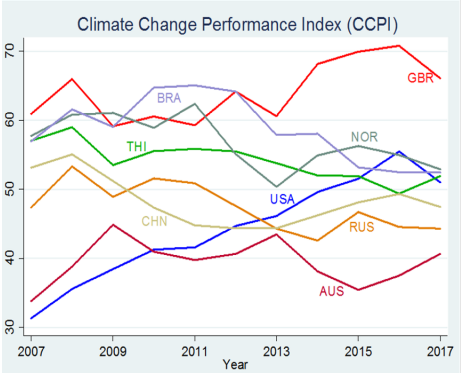
4 Conclusion

The most direct channel through which climate risk may impact the cost of debt is through the risk of an ambitious decarbonization policy. In this paper, we investigate and contrast how market- versus bank-based financing contributes to climate change through its impact on the real economy. We find that the within-firm bond-to-loan substitution, relative to firm-specific credit risk, is an indicator of misallocated bank credit. In the context of the climate transition and fossil fuel firms' risk of stranded assets, our results imply that banks – more so than bond markets – have been facilitating the continuation of fossil fuel investments. The monitoring role of banks, generally, should be rewarded with more precise expectations embedded in loan prices. Despite this informational advantage, the differential in the pricing of climate policy exposure and the consequential allocation of credit towards fossil fuel implies that banks have been disregarding the likelihood that environmental policies will lead to assets being stranded to a larger extent. We suggest that incentives and expectation related to bank size might play a role and lead to further allocation of financing towards the fossil fuel sector.

We draw two conclusions. First, market discipline, on its own, seems to be 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 banks with different stances towards the climate transition, could potentially mitigate the capital constraints on fossil fuel firms imposed by the bond market and/or by some more environmentally-friendly banks.

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

The Climate Change Policy Index (CCPI) by Germanwatch (Burck et al., 2016) provides an analysis of 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.



Summary of CCPI Composition	
Country coverage	≤58
Time period	2007-2017
Emissions component	Trends, levels
Policy component	Expert assessments
Weighing of emissions relative to policy	80%/20%

Bernauer & Böhmelt (2013)

Figure 2: 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.

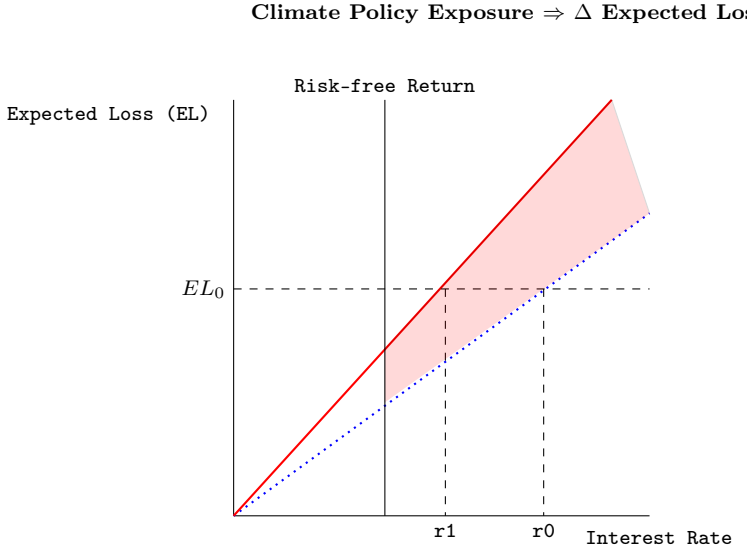


Table 1: Frequency of new debt finance

This table reports the frequency of syndicated bank loan and corporate bond issues in our sample for the period 2007-2017. Row 1 presents the starting total number of syndicated bank loans and corporate bonds. The issuing firms are not in the financial sector and have had access to the syndicated bank loan as well as the corporate bond market at least once in the period 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	23,699	20,623
	↳ Fossil fuel subsample	1,611	1,338
2	All observations with pricing data	13,579	9,313
	↳ Fossil fuel subsample	1,106	682

Table 2: The location of fossil fuel reserves

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

Country	Freq.	Country	Freq.
Algeria	4	Mauritania	3
Argentina	14	Malaysia	13
Australia	44	Mexico	9
Azerbaijan	1	Mongolia	4
Bangladesh	3	Morocco	1
Brazil	4	Myanmar	1
Bulgaria	2	New Zealand	2
Canada	381	Nigeria	4
China	18	Norway	33
Colombia	39	Netherlands	11
Congo	1	Oman	1
Czech Republic	5	Pakistan	3
Denmark	4	Peru	12
Vietnam	10	Papua New Guinea	6
Ecuador	8	Poland	6
Egypt	22	Romania	1
Equatorial Guinea	4	Russia	25
France	10	South Africa	3
Gabon	6	Sudan	2
Germany	3	Syria	2
India	26	Thailand	4
Indonesia	29	Trinidad and Tobago	3
Ireland	8	Tunisia	7
Iraq	1	Turkey	2
Israel	6	United Kingdom	47
Italy	5	United States of America	748
Kazakhstan	3	Venezuela	1
Libya	2	Yemen	4
		Observations	1222

Table 3: Headquarter countries of fossil fuel firms

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

Headquarters	Freq.	Percent
Argentina	2	0.23
Australia	7	0.81
Canada	211	24.53
China	2	0.23
France	1	0.12
United Kingdom	6	0.7
Indonesia	3	0.35
India	23	2.67
Israel	1	0.12
Mongolia	3	0.35
Norway	13	1.51
Romania	1	0.12
Russia	19	2.21
Sweden	1	0.12
United States of America	567	65.93

Table 4: 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 other-wise.	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 FE	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 purpose	A series of dummy variables indicating loan type (e.g., term loans, revolvers, etc.).	idem
E. Carbon risk related data		
Climate Policy Exposure (CCPI)	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
Bank Outstanding Fossil Fuel Exposure	Fraction of outstanding loans to the fossil fuel industry over the total number of its outstanding loans	Dealscan
Bank Outstanding Exposure to firm f	Fraction of outstanding loans to firm f over the total number of its outstanding loans	Dealscan
F. 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 5: Summary statistics – Corporate bonds 2007-2017.

This table presents summary statistics on key variables: Column 1 for the whole corporate bond sample, and Column 2 for the fossil fuel sector subsample. Column 3 reports t-tests of the difference between fossil fuel and non-fossil fuel firms. Firm characteristics variables have been winsorized. Firm size and bond amount are in USD and logarithmized. The summary statistics represents all observations for which all bond-level information presented in the table is available (bond spread, bond amount, maturity, exchange-listed, secured).

	Whole sample		Fossil fuel sector		Difference	
	mean	sd	mean	sd	b	t
Bond spread (in bps)	195.31	195.27	377.38	246.07	-196.34***	(-20.29)
Bond amount	19.81	0.87	20.11	0.66	-0.32***	(-11.97)
Maturity (in years)	10.44	8.01	10.25	7.21	0.21	(0.71)
Secured	0.10	0.29	0.05	0.22	0.05***	(4.96)
Exchange-listed	0.66	0.47	0.72	0.45	-0.07***	(-3.71)
Size	10.83	2.51	9.20	1.75	1.76***	(23.78)
Market-to-book value	1.59	0.92	1.46	0.73	0.15***	(4.66)
Asset tangibility	83.31	58.94	139.22	50.02	-60.19***	(-28.26)
Leverage	33.41	16.23	28.80	17.22	4.98***	(7.14)
Observations	9288		675		9288	

Table 6: Summary statistics – Syndicated bank loans 2007-2017.

This table presents summary statistics on key variables: Column 1 for the whole syndicated bank loan sample, and Column 2 for the fossil fuel sector subsample. Column 3 reports t-tests of the difference between fossil fuel and non-fossil fuel firms. Firm characteristics variables have been winsorized. Firm size and loan amount are in USD and logarithmized. The summary statistics represents all observations for which all loan-level information presented in the table is available (all-in-drawn spread, loan amount, maturity, collateral, number of lenders, number of general covenants).

	Whole sample		Fossil fuel sector		Difference	
	mean	sd	mean	sd	b	t
All-in-drawn spread (in bps)	231.36	160.70	247.40	160.02	-17.49***	(-3.39)
Loan amount	19.33	1.81	19.86	1.29	-0.58***	(-13.30)
Maturity (in years)	5.03	2.34	4.49	1.67	0.59***	(10.43)
Collateral	0.47	0.50	0.51	0.50	-0.04*	(-2.29)
Number of lenders	9.70	7.58	10.78	8.09	-1.18***	(-4.55)
Performance provisions	0.25	0.43	0.26	0.44	-0.01	(-0.54)
Number of general covenants	2.20	2.02	2.11	1.63	0.10	(1.86)
Firm size	9.04	2.10	8.79	2.29	0.27***	(3.62)
Market-to-book value	1.57	0.90	1.47	0.89	0.12***	(3.80)
Leverage	35.11	19.70	31.14	18.31	4.33***	(7.08)
Asset tangibility	68.26	46.58	127.56	52.88	-64.68***	(-34.82)
Observations	12707		1048		12707	

Table 7: Corporate bond spreads and Climate Policy Exposure (CCPI). Regression results for the period 2007-2014.

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 consisting of bonds that are exchange-listed. All variables are as defined in Table 4. 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: Bond spread			
	(1)	(2)	(3)	(4)
Fossil fuel	131.228***	95.465***	82.390**	32.102
	(3.162)	(2.859)	(2.414)	(0.908)
Fossil fuel*Climate Policy Exposure (CCPI)	0.505	1.554*	1.462*	1.990**
	(0.438)	(1.765)	(1.650)	(2.034)
Bond amount	-43.676***		40.412***	43.647***
	(-6.420)		(5.014)	(6.252)
Maturity	-1.331***		-0.350	0.168
	(-4.043)		(-1.149)	(0.619)
Firm size		-50.152***	-62.409***	-50.434***
		(-13.256)	(-15.710)	(-14.826)
Market-to-book value		-46.373***	-49.322***	-40.972***
		(-7.906)	(-8.416)	(-8.024)
Asset tangibility		-0.365***	-0.309***	-0.209*
		(-3.076)	(-2.650)	(-1.872)
Leverage		2.394***	2.297***	1.937***
		(8.206)	(8.071)	(6.876)
Crude oil price		0.038	-0.003	-0.022
		(0.294)	(-0.020)	(-0.182)
Constant	1127.580***	744.544***	67.026	-149.219
	(8.263)	(16.992)	(0.463)	(-1.175)
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	Borrower	Borrower	Borrower	Borrower
Observations	3177	2526	2522	2236
R^2	0.440	0.595	0.604	0.502
R^2_{adj}	0.422	0.580	0.589	0.482

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Syndicated bank loan spreads and Climate Policy Exposure (CCPI). Regression results for the period 2007-2014.

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 4. 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	24.173***	34.135**	31.244***	31.244***
	(2.719)	(2.487)	(2.655)	(3.704)
Fossil fuel*Climate Policy Exposure (CCPI)	0.049	-0.074	-0.092	-0.092
	(0.178)	(-0.188)	(-0.257)	(-0.316)
Loan amount	-14.712***		-11.234***	-11.234***
	(-6.660)		(-4.546)	(-4.793)
Maturity	1.336		1.671	1.671
	(1.303)		(1.226)	(1.279)
Collateral	65.756***		50.201***	50.201***
	(13.798)		(8.936)	(10.356)
Number of lenders	-1.711***		-1.170**	-1.170***
	(-4.312)		(-2.535)	(-2.805)
Performance provisions	-25.495***		-21.040***	-21.040***
	(-7.430)		(-5.673)	(-6.150)
Number of general covenants	1.914*		1.395	1.395
	(1.878)		(1.370)	(1.482)
Firm size		-14.451***	-7.230***	-7.230***
		(-8.464)	(-3.397)	(-3.598)
Market-to-book value		-13.379***	-8.938***	-8.938***
		(-5.202)	(-4.427)	(-5.401)
Asset tangibility		-0.047	-0.007	-0.007
		(-0.817)	(-0.127)	(-0.144)
Leverage		0.747***	0.530***	0.530***
		(5.114)	(3.906)	(4.460)
Crude oil price		0.010	0.019	0.019
		(0.137)	(0.286)	(0.288)
Constant	496.016***	363.353***	491.545***	491.545***
	(12.308)	(18.483)	(11.841)	(12.527)
Bank*Year FE	Yes	Yes	Yes	Yes
Loan purpose FE	Yes	Yes	Yes	Yes
Loan type FE	Yes	Yes	Yes	Yes
Clustered SE	Borrower & Bank	Borrower & Bank	Borrower & Bank	Loan & Bank
Observations	37464	27485	27237	27237
R^2	0.602	0.575	0.607	0.607
R^2_{adj}	0.575	0.542	0.577	0.577

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Share of syndicated bank loans with short/long maturity category and Climate Policy Exposure.

The dependent variable in Column (1) is a dummy indicating a loan maturity of <5years, and in Column (2) a dummy indicating a loan maturity of >10 years. The Climate Policy Exposure is measured by the CCPI.The sample covers the period 2007-2017. All variables are as defined in Table 4. 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.

	Short maturity	Long maturity
	(1)	(2)
Fossil fuel	0.094**	-0.012
	(2.283)	(-0.809)
Fossil fuel*Climate Policy Exposure (CCPI)	0.002	0.001
	(1.319)	(1.195)
Collateral	-0.038***	-0.005
	(-2.717)	(-0.657)
Loan amount	-0.013***	-0.002
	(-4.050)	(-0.596)
Number of lenders	-0.003***	-0.003***
	(-3.201)	(-5.891)
Performance provisions	-0.046**	0.003
	(-2.556)	(0.620)
Number of general covenants	-0.012***	0.001
	(-2.952)	(0.886)
Firm size	0.002	0.016***
	(0.496)	(5.090)
Market-to-book value	-0.018***	0.005
	(-2.912)	(1.470)
Asset tangibility	-0.001***	0.000***
	(-4.308)	(2.718)
Borrower Leverage	0.000	0.000
	(0.257)	(1.618)
Crude oil price	-0.000	0.000
	(-1.365)	(1.424)
Constant	0.712***	-0.083
	(7.969)	(-1.388)
Bank*Year FE	Yes	Yes
Loan purpose FE	Yes	Yes
Loan type FE	Yes	Yes
Clustered SE	Borrower & Bank	Borrower & Bank
Observations	0.295	0.455
R^2	0.295	0.455
$R^2_{adj.}$	0.248	0.419

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Share of corporate bonds with short/long maturity category and Climate Policy Exposure.

The dependent variable in Column (1) is a dummy indicating a bond maturity of <5years, and in Column (2) a dummy indicating a loan maturity of >10 years. The Climate Policy Exposure is measured by the CCPI. The sample covers the period 2007-2014. All variables are as defined in Table 4. 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.

	Short maturity	Long maturity
	(1)	(2)
Fossil fuel	-0.006	-0.054
	(-0.171)	(-0.808)
Fossil fuel*Climate Policy Exposure (CCPI)	-0.001	-0.002
	(-0.845)	(-1.390)
Bond amount	0.022***	-0.024***
	(10.642)	(-3.970)
Size	0.016***	0.045***
	(15.669)	(12.944)
Market-to-book value	0.011***	0.030***
	(3.536)	(17.583)
Tangibility assets	-0.000**	0.001***
	(-2.211)	(8.967)
Leverage	-0.001***	-0.002***
	(-7.862)	(-14.074)
Crude oil price	-0.000	-0.000***
	(-0.789)	(-5.324)
Constant	-0.489***	0.573***
	(-12.198)	(3.777)
Firm country*Year FE	Yes	Yes
Use of proceeds FE	Yes	Yes
Instrument type FE	Yes	Yes
Seniority FE	Yes	Yes
Clustered SE	Borrower	Borrower
Observations	3542	3542
R^2	0.071	0.126
$R^2_{adj.}$	0.040	0.097

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Corporate bond spreads, Climate Policy Exposure and maturity.

The dependent variable is the spread of corporate bonds in bps and the climate policy exposure is measured by the CCPI. The sample covers the period 2007-2017. Column (4) contains the subsample consisting of bonds that are exchange-listed. All variables are as defined in Table 4. 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: Bond spread			
	(1)	(2)	(3)	(4)
Fossil fuel	387.781***	428.858***	434.060***	134.336
	(2.642)	(3.665)	(3.707)	(0.985)
Maturity	3.951***	3.743***	2.975***	3.830***
	(5.532)	(5.681)	(4.675)	(7.228)
Fossil fuel*Maturity	-28.751**	-38.995***	-40.919***	-8.738
	(-1.983)	(-3.274)	(-3.474)	(-0.651)
Fossil fuel*Climate Policy Exposure (CCPI)	-0.722	-2.206	-2.268	3.340
	(-0.193)	(-0.768)	(-0.778)	(0.942)
Fossil fuel*Climate Policy Exposure (CCPI)*Maturity	0.125	0.428	0.426	-0.212
	(0.330)	(1.427)	(1.409)	(-0.572)
Bond amount	-40.947***		43.250***	39.190***
	(-6.670)		(6.674)	(7.239)
Firm size		-47.659***	-59.741***	-46.615***
		(-13.443)	(-15.702)	(-13.948)
Market-to-book value		-40.371***	-43.237***	-35.733***
		(-9.262)	(-10.218)	(-9.630)
Asset tangibility		-0.280***	-0.226**	-0.168*
		(-2.772)	(-2.321)	(-1.893)
Leverage		2.054***	2.007***	1.715***
		(8.280)	(8.401)	(7.443)
Crude oil price		-0.007	-0.041	-0.033
		(-0.054)	(-0.339)	(-0.283)
Constant	1011.307***	679.830***	-58.961	-143.411
	(8.212)	(15.808)	(-0.502)	(-1.421)
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	Borrower	Borrower	Borrower	Borrower
Observations	4249	3594	3594	3104
R^2	0.445	0.608	0.619	0.545
$R^2_{adj.}$	0.426	0.593	0.604	0.525

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Syndicated bank loan spreads and Climate Policy Exposure (C3I). Regression results for the period 2007-2014.

The dependent variable is the All-in Spread Drawn in bps of syndicated bank loans and the climate policy exposure is measured by the C3I. All variables are as defined in Table 4. 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	21.831**	37.994***	33.726***	33.726***
	(2.299)	(2.695)	(2.841)	(4.443)
Fossil fuel*Climate Policy Exposure (C3I)	0.138	-0.112	-0.086	-0.086
	(0.647)	(-0.368)	(-0.308)	(-0.409)
Loan amount	-14.733***		-11.156***	-11.156***
	(-6.676)		(-4.544)	(-4.795)
Maturity	1.301		1.615	1.615
	(1.270)		(1.181)	(1.231)
Collateral	65.573***		50.026***	50.026***
	(13.811)		(8.906)	(10.334)
Number of lenders	-1.724***		-1.175**	-1.175***
	(-4.358)		(-2.551)	(-2.825)
Performance provisions	-25.478***		-20.976***	-20.976***
	(-7.425)		(-5.659)	(-6.128)
Number of general covenants	1.942*		1.395	1.395
	(1.908)		(1.375)	(1.490)
Firm size		-14.652***	-7.404***	-7.404***
		(-8.727)	(-3.515)	(-3.726)
Market-to-book value		-13.405***	-9.004***	-9.004***
		(-5.239)	(-4.462)	(-5.448)
Asset tangibility		-0.047	-0.007	-0.007
		(-0.838)	(-0.144)	(-0.163)
Leverage		0.752***	0.533***	0.533***
		(5.066)	(3.871)	(4.398)
Crude oil price		0.011	0.019	0.019
		(0.143)	(0.285)	(0.287)
Constant	496.720***	364.984***	492.102***	492.102***
	(12.330)	(18.715)	(11.884)	(12.590)
Bank*Year FE	Yes	Yes	Yes	Yes
Loan Purpose FE	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes
Clustered SE	Borrower & Bank	Borrower & Bank	Borrower & Bank	Loan & Bank
Observations	37500	27509	27261	27261
R^2	0.603	0.576	0.608	0.608
$R^2_{adj.}$	0.575	0.543	0.577	0.577

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Corporate bond spreads and Climate Policy Exposure (C3I). Regression results for the period 2007-2014.

The dependent variable is the spread of corporate bonds and the Climate Policy Exposure is measured by the C3I. Column (4) contains the subsample consisting of bonds that are exchange-listed. All variables are as defined in Table 4. 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: Bond spread			
	(1)	(2)	(3)	(4)
Fossil fuel	141.496***	96.854***	82.648***	34.016
	(8.036)	(3.676)	(3.080)	(1.076)
Fossil fuel*Climate Policy Exposure (C3I)	0.060	1.082**	1.038**	1.420***
	(0.213)	(2.670)	(2.367)	(3.392)
Bond amount	-43.719***		40.559***	43.886***
	(-26.352)		(19.407)	(18.710)
Maturity	-1.330***		-0.351***	0.168***
	(-16.526)		(-5.102)	(3.180)
Firm size		-50.236***	-62.545***	-50.550***
		(-73.624)	(-66.333)	(-39.734)
Market-to-book value		-46.323***	-49.296***	-41.003***
		(-95.150)	(-111.263)	(-37.039)
Asset tangibility		-0.358***	-0.303***	-0.203***
		(-15.264)	(-17.742)	(-8.165)
Leverage		2.389***	2.292***	1.934***
		(68.668)	(68.155)	(24.960)
Crude oil price		0.034	-0.007	-0.026
		(0.731)	(-0.171)	(-0.665)
Constant	1128.488***	745.812***	65.943*	-152.416***
	(34.252)	(59.245)	(2.044)	(-3.764)
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	Borrower	Borrower	Borrower	Borrower
Observations	3181	2529	2525	2239
R^2	0.439	0.594	0.603	0.502
$R^2_{adj.}$	0.421	0.579	0.588	0.481

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14: Corporate bond LIBOR swap spreads and Climate Policy Exposure (CCPI). Regression results for the period 2007-2014.

The dependent variable is the corporate bond LIBOR swap spread in bps and the climate policy exposure is measured by the CCPI. Column (4) contains the subsample consisting of bonds that are exchange-listed. All variables are as defined in Table 4. The lower part of the table denotes the type of fixed effects and clustering used in each specification. Columns(3) and (4) contain only corporate bonds that are listed on an exchange. For readability, omitted variables due to collinearity are left out

	Dependent variable: Bond LIBOR swap spread			
	(1)	(2)	(3)	(4)
Fossil fuel	135.223***	90.410***	93.111***	53.356*
	(3.205)	(4.981)	(3.135)	(1.749)
Fossil fuel*Climate Policy Exposure (CCPI)	0.262	1.508***	1.553**	2.006**
	(0.230)	(4.049)	(2.022)	(2.345)
Bond amount	-0.204		8.705**	10.735***
	(-0.023)		(2.241)	(2.806)
Maturity	-0.258		1.171***	1.720***
	(-0.674)		(3.298)	(5.562)
Firm size		-53.592***	-54.028***	-40.965***
		(-101.994)	(-18.240)	(-14.453)
Market-to-book value		-48.516***	-50.728***	-42.795***
		(-49.558)	(-8.232)	(-7.581)
Asset tangibility		-0.353***	-0.416***	-0.343***
		(-10.191)	(-3.754)	(-3.284)
Leverage		2.442***	2.703***	2.398***
		(48.929)	(9.798)	(8.468)
Crude oil price		0.032	0.021	0.021
		(0.808)	(0.164)	(0.167)
Constant	229.918	771.180***	591.790***	382.462***
	(1.310)	(70.512)	(6.574)	(4.401)
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	Borrower	Borrower	Borrower	Borrower
Observations	3422	2736	2736	2415
R^2	0.447	0.609	0.612	0.493
$R^2_{adj.}$	0.429	0.595	0.598	0.473

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15: Syndicated bank loan spreads and Headquarter Climate Policy Exposure (CCPI). Regression results for the period 2007-2014.

The dependent variable is the All-in Spread Drawn in bps of syndicated bank loans and the Headquarter Climate Policy Exposure is measured by the CCPI. All variables are as defined in Table 4. 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	25.427***	35.631***	33.102***	33.102***
	(2.840)	(2.635)	(2.884)	(4.083)
FossilFuel*Climate Policy Exposure (CCPI hq)	-0.071	-0.225	-0.203	-0.203
	(-0.277)	(-0.610)	(-0.626)	(-0.802)
Loan amount	-14.804***		-11.193***	-11.193***
	(-6.739)		(-4.588)	(-4.841)
Maturity	1.266		1.603	1.603
	(1.233)		(1.171)	(1.221)
Collateral	66.336***		50.692***	50.692***
	(13.986)		(9.031)	(10.479)
Number of lenders	-1.723***		-1.178**	-1.178***
	(-4.367)		(-2.577)	(-2.854)
Performance provisions	-25.084***		-20.569***	-20.569***
	(-7.324)		(-5.607)	(-6.081)
Number of general covenants	1.912*		1.344	1.344
	(1.879)		(1.327)	(1.437)
Firm size		-14.875***	-7.518***	-7.518***
		(-8.875)	(-3.598)	(-3.814)
Market-to-book value		-13.203***	-8.828***	-8.828***
		(-5.044)	(-4.291)	(-5.222)
Asset tangibility		-0.047	-0.007	-0.007
		(-0.848)	(-0.145)	(-0.165)
Leverage		0.763***	0.541***	0.541***
		(5.175)	(3.943)	(4.488)
Crude oil price		0.014	0.022	0.022
		(0.186)	(0.329)	(0.331)
Constant	497.626***	365.371***	492.306***	492.306***
	(12.396)	(18.670)	(11.967)	(12.675)
Bank*Year FE	Yes	Yes	Yes	Yes
Loan purpose FE	Yes	Yes	Yes	Yes
Loan type FE	Yes	Yes	Yes	Yes
Clustered SE	Borrower & Bank	Borrower & Bank	Borrowern & Bank	Loan & Bank
Observations	37753	27705	27457	27457
R^2	0.603	0.575	0.608	0.608
$R^2_{adj.}$	0.576	0.543	0.578	0.578

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 16: Corporate bond spreads and Headquarter Climate Policy Exposure (CCPI). Regression results for the period 2007-2014.

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 consisting of bonds that are exchange-listed. All variables are as defined in Table 4. 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: Bond spread			
	(1)	(2)	(3)	(4)
Fossil fuel	122.732***	91.277***	78.765**	30.869
	(3.024)	(2.765)	(2.331)	(0.896)
Fossil fuel*Headquarter Climate Policy Exposure (CCPI)	-0.464	0.824	0.760	1.191
	(-0.429)	(0.967)	(0.882)	(1.332)
Bond amount	-44.782***		41.625***	44.761***
	(-6.549)		(5.229)	(6.509)
Maturity	-1.318***		-0.385	0.155
	(-4.046)		(-1.268)	(0.571)
Firm size		-51.354***	-63.826***	-51.509***
		(-13.590)	(-16.340)	(-15.413)
Market-to-book value		-46.103***	-49.180***	-41.255***
		(-7.888)	(-8.416)	(-8.055)
Asset tangibility		-0.366***	-0.310***	-0.216*
		(-3.107)	(-2.678)	(-1.963)
Leverage		2.463***	2.362***	2.006***
		(8.448)	(8.302)	(7.145)
Crude oil price		0.024	-0.017	-0.029
		(0.182)	(-0.133)	(-0.240)
Constant	1149.441***	756.362***	57.230	-160.451
	(8.384)	(17.189)	(0.398)	(-1.274)
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	Borrower	Borrower	Borrower	Borrower
Observations	3245	2586	2582	2294
R^2	0.432	0.591	0.601	0.501
$R^2_{adj.}$	0.413	0.577	0.586	0.481

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 17: Syndicated bank loan spreads and Climate Policy Exposure Post 2015

The dependent variable is the All-in Spread Drawn and the Climate Policy Exposure is measured by the CCPI. This table compares pre- and post-2015 periods. The sample covers the period 2007-2017. All variables are as defined in Table 4. 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	29.009***	40.898***	37.422***	37.422***
	(3.499)	(3.082)	(3.377)	(4.386)
FossilFuel*Post2015	72.098***	64.500***	50.226***	50.226**
	(4.252)	(3.454)	(2.880)	(2.507)
Fossil fuel*Climate Policy Exposure (CCPI)	-0.035	-0.272	-0.259	-0.259
	(-0.132)	(-0.736)	(-0.799)	(-0.956)
FossilFuel*Post2015*Climate Policy Exposure (CCPI)	0.194	0.105	0.545	0.545
	(0.263)	(0.163)	(0.838)	(0.921)
Loan amount	-13.897***		-10.413***	-10.413***
	(-7.399)		(-5.190)	(-5.558)
Maturity	1.265		1.480	1.480
	(1.602)		(1.498)	(1.576)
Collateral	64.881***		49.819***	49.819***
	(15.721)		(10.710)	(12.497)
Number of lenders	-1.727***		-1.102***	-1.102***
	(-4.895)		(-2.944)	(-3.369)
Performance provisions	-24.733***		-20.683***	-20.683***
	(-8.357)		(-6.418)	(-7.061)
Number of general covenants	1.676*		0.728	0.728
	(1.801)		(0.833)	(0.911)
Firm size		-15.497***	-8.525***	-8.525***
		(-9.759)	(-4.412)	(-4.795)
Market-to-book value		-13.732***	-9.393***	-9.393***
		(-6.358)	(-5.404)	(-6.426)
Asset tangibility		-0.016	0.009	0.009
		(-0.353)	(0.221)	(0.266)
Leverage		0.772***	0.562***	0.562***
		(6.281)	(4.905)	(5.749)
Crude oil price		0.023	0.047	0.047
		(0.357)	(0.827)	(0.859)
Constant	478.236***	359.666***	476.271***	476.271***
	(14.022)	(20.248)	(14.064)	(15.164)
Bank*Year FE	Yes	Yes	Yes	Yes
Loan purpose FE	Yes	Yes	Yes	Yes
Loan type FE	Yes	Yes	Yes	Yes
Clustered SE	Borrower & Bank	Borrower & Bank	Borrower & Bank	Loan & Bank
Observations	52410	39757	39460	39460
R^2	0.599	0.580	0.613	0.613
$R^2_{adj.}$	0.573	0.549	0.584	0.584

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 18: Corporate bonds and Climate Policy Exposure Post 2015

The dependent variable is the corporate bond spread at issue and the Climate Policy Exposure is measured by the CCPI. This table compares pre- and post-2015 periods. The sample covers the period 2007-2017. All variables are as defined in Table 4. 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: Bond spread			
	(1)	(2)	(3)	(4)
Fossil fuel	128.760***	105.669***	93.594***	39.097
	(10.021)	(4.616)	(3.904)	(1.283)
Fossil fuel*Climate Policy Exposure (CCPI)	0.604*	1.241**	1.185*	1.724***
	(2.004)	(2.341)	(2.046)	(2.929)
Fossil fuel*Post2015	56.214***	-5.282	-5.422	48.540
	(2.908)	(-0.088)	(-0.086)	(0.890)
Fossil fuel*Post2015*Climate Policy Exposure (CCPI)	-1.411*	-0.179	-0.072	-0.477
	(-1.863)	(-0.111)	(-0.043)	(-0.336)
Bond amount	-33.303***		43.144***	40.494***
	(-22.602)		(11.910)	(11.325)
Maturity	-0.325***		0.491***	0.856***
	(-3.472)		(6.015)	(10.719)
Firm size		-44.583***	-57.284***	-44.887***
		(-40.407)	(-27.217)	(-31.672)
Market-to-book value		-37.359***	-40.553***	-33.823***
		(-26.154)	(-26.069)	(-36.510)
Asset tangibility		-0.286***	-0.246***	-0.182***
		(-13.115)	(-17.616)	(-22.650)
Leverage		2.055***	2.006***	1.659***
		(69.990)	(56.449)	(27.963)
Crude oil price		-0.037	-0.062	-0.051
		(-0.950)	(-1.402)	(-1.382)
Constant	885.045***	677.652***	-64.535	-163.752***
	(30.269)	(37.437)	(-1.298)	(-2.891)
Borrower 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	Borrower	Borrower	Borrower	Borrower
Observations	5054	4212	4205	3687
R^2	0.418	0.577	0.590	0.513
$R^2_{adj.}$	0.401	0.563	0.576	0.495

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 19: Summary statistics - Loan versus bond choice 2017-2017.

This table presents summary statistics on key variables: Column 1 for the whole sample, and Column 2 for the fossil fuel sector subsample. Column 3 reports t-tests of the difference between fossil fuel and non-fossil fuel firms. Total debt amount is in USD and has been logarithmized.

	Whole sample		Fossil fuel sector		Difference	
	mean	sd	mean	sd	b	t
Loan versus bond choice	0.62	0.48	0.64	0.48	-0.01	(-0.86)
Loan versus bond choice (non-binary)	0.60	0.45	0.59	0.44	0.01	(1.00)
Total amount	19.35	2.42	20.35	1.41	-1.08***	(-24.16)
Observations	16910		1256		16852	

Table 20: Loan versus bond choice and Climate Policy Exposure (CCPI). Regression results for the period 2007-2017.

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 coefficient of interest is the fossil fuel dummy and Climate Policy Exposure (CCPI) interaction term. The dependent variable is equal 1 if the firm receives a new loan in the year, zero otherwise. All variables are as defined in Table 4. 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.

	Dependent variable: Loan versus bond choice		
	(1)	(2)	(3)
Fossil fuel	0.034	0.170	0.162
	(0.096)	(0.405)	(0.393)
Fossil fuel*Climate Policy Exposure (CCPI)	0.007***	0.007***	0.007***
	(9.871)	(7.406)	(6.353)
Total amount	0.056***	0.062***	0.059***
	(3.907)	(4.531)	(4.205)
Firm size		-0.093***	-0.090***
		(-4.455)	(-3.707)
Asset tangibility		-0.004	-0.005
		(-1.308)	(-1.623)
Leverage		-0.001	-0.000
		(-1.134)	(-0.783)
Market-to-book		-0.009	-0.020
		(-0.655)	(-1.421)
Lending growth rate	0.124	0.173	0.291**
	(0.866)	(1.292)	(2.519)
Non-performing loans	-0.009***	-0.011**	-0.003
	(-2.865)	(-2.517)	(-0.842)
GDP growth	0.008**	0.008*	-0.001
	(2.284)	(1.791)	(-0.239)
Crude oil price	0.005***	0.004**	
	(2.716)	(2.616)	
Constant	-0.591**	0.180	0.300
	(-2.058)	(0.501)	(0.694)
Borrower FE	Yes	Yes	Yes
Year FE			Yes
Clustered SE	Borrower country	Borrower country	Borrower country
Observations	6908	5862	5862
R^2	0.498	0.510	0.521
$R^2_{adj.}$	0.325	0.328	0.341

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 21: Loan versus bond choice and Climate Policy Exposure (C3I). Regression results for the period 2007-2017.

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 coefficient of interest is the fossil fuel dummy and Climate Policy Exposure (C3I) interaction term. The dependent variable is equal 1 if the firm receives a new loan in the year, zero otherwise. All variables are as defined in Table 4. 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: Loan versus bond choice		
	(1)	(2)	(3)
Fossil fuel	-0.107	-0.157	-0.185
	(-0.283)	(-0.317)	(-0.372)
Fossil fuel*Climate Policy Exposure (C3I)	0.013***	0.013***	0.012***
	(12.855)	(6.764)	(6.791)
Total amount	0.057***	0.059***	0.057***
	(3.943)	(4.297)	(4.319)
Firm size		-0.111***	-0.071**
		(-4.002)	(-2.609)
Asset tangibility		-0.004	-0.007*
		(-0.993)	(-1.976)
Leverage		0.001	0.001
		(0.946)	(1.534)
Market to Book		-0.002	-0.011
		(-0.139)	(-0.604)
Lending growth rate	0.121	0.131	0.289**
	(0.816)	(1.042)	(2.287)
Non-performing loans	-0.010*	-0.011**	-0.007
	(-1.925)	(-2.715)	(-1.361)
GDP growth	0.010**	0.006	-0.006
	(2.265)	(1.132)	(-0.877)
Crude oil price annualized	0.006	0.011***	
	(1.407)	(2.800)	
Constant	-0.642**	0.239	0.160
	(-2.565)	(0.715)	(0.419)
Borrower FE	Yes	Yes	Yes
Year FE			Yes
Clustered SE	Borrower country	Borrower country	Borrower country
Observations	4655	3864	3864
R^2	0.545	0.553	0.563
$R^2_{adj.}$	0.325	0.320	0.334

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 22: Loan versus bond choice (non-binary) and Climate Policy Exposure (CCPI). Regression results for the period 2007-2017.

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 coefficient of interest is the fossil fuel dummy and Climate Policy Exposure (CCPI) interaction term. 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. All variables are as defined in Table 4. 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: Loan versus bond choice non-binary		
	(1)	(2)	(3)
Fossil fuel	0.051	0.193	0.189
	(0.158)	(0.485)	(0.479)
Fossil fuel*Climate Policy Exposure (CCPI)	0.006***	0.006***	0.006***
	(14.524)	(13.122)	(13.764)
Total amount	0.012	0.017	0.015
	(0.809)	(1.202)	(1.048)
Firm size		-0.067***	-0.062***
		(-5.179)	(-4.015)
Asset tangibility		-0.005*	-0.005**
		(-1.898)	(-2.443)
Leverage		-0.000	0.000
		(-0.496)	(0.309)
Market-to-book		-0.008	-0.015
		(-0.742)	(-1.213)
Lending growth rate	0.187	0.224*	0.305***
	(1.546)	(1.933)	(2.977)
Non-performing loans	-0.005	-0.007*	-0.002
	(-1.487)	(-1.859)	(-0.369)
GDP growth	0.005	0.004	-0.001
	(1.560)	(1.002)	(-0.149)
Crude oil price annualized	0.003**	0.003**	
	(2.211)	(2.095)	
Constant	0.258	0.818**	0.843**
	(0.825)	(2.554)	(2.035)
Borrower FE	Yes	Yes	Yes
Year FE			Yes
Clustered SE	Borrower country	Borrower country	Borrower country
Observations	9251	7902	7902
R^2	0.396	0.405	0.415
$R^2_{adj.}$	0.241	0.242	0.252

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 23: Overview of lead manager in the corporate bond and syndicated bank loan market

This table presents an overview of the lead managers that have underwritten both corporate bonds and syndicated bank loans of fossil fuel firms in our sample during the period 2007-2017.

Lead manager	**Bond**	**Loan**
ANZ Banking Group	3	255
Agricultural Bank of China	3	7
Axis Bank Ltd	4	11
BBVA	25	84
BMO Capital Markets	51	96
BNP Paribas SA	72	560
Bangkok Bank	5	15
Bank Mandiri	2	29
Bank Negara Indonesia PT	2	10
Bank of China Ltd	4	117
Bank of Shanghai	1	2
Barclays	232	251
BofA Securities Inc	326	496
CIBC World Markets Inc	15	125
CIMB Group Holdings Bhd	2	35
CITIC	9	3
Capital One Financial Corp	13	49
China Construction Bank	2	19
Citi	255	495
Comerica Inc	5	3
Commerzbank AG	2	83
Commonwealth Bank of Australia	2	159
Credit Agricole CIB	32	331
Credit Suisse	129	161
DBS Group Holdings	6	202
DNB ASA	18	250
Danske Bank	2	34
Deutsche Bank	146	212
Fifth Third Bancorp	1	16
Gazprombank	18	11
Goldman Sachs & Co	113	111
HDFC Bank Ltd	1	3
HSBC Holdings PLC	77	262
ICICI Bank Ltd	1	20
IMI - Intesa Sanpaolo	12	89
ING	6	351
Industrial & Comm Bank China	3	7
Itau Unibanco	2	18
JP Morgan	332	624
Jefferies LLC	8	26
Landesbank Baden-Wurttemberg	2	15
Lloyds Bank	1	80
Macquarie Group	3	20
Mediobanca	6	3
Mitsubishi UFJ Financial Group	72	496
Mizuho Financial Group	35	13
Morgan Stanley	160	81
National Australia Bank	1	95
Natixis	10	220
Nordea	2	105
PNC Financial Services Group	14	108
RBC Capital Markets	125	30
SEB	3	76
Santander Corp & Invest Bkg	11	34
Sberbank CIB	14	23
Scotiabank	46	32
Siam Commercial Bank PLC	2	1
Societe Generale	48	261
State Bank of India	3	39
Sumitomo Mitsui Finl Grp Inc	17	466
Swedbank	2	31
TD Securities Inc	35	103
UBS	61	83
UniCredit	20	131
United Overseas Bank Ltd	1	103
VTB Capital	20	1
Wells Fargo & Co	244	602

Table 24: Bank's loan versus bond choice and Climate Policy Exposure (CCPI). Regression results for the period 2007-2017.

The dependent variable equals one if a lead manager bank underwrites a syndicated bank loan and zero if the lead manager underwrites a corporate bond. The coefficient of interest is the fossil fuel dummy and Climate Policy Exposure (CCPI) interaction term. We weight 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 4. 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: Bank's Loan versus Bond Choice			
	(1)	(2)	(3)	(4)
Fossil fuel	-0.110	-0.180	-0.177	-0.562***
	(-0.778)	(-1.177)	(-1.155)	(-3.309)
Fossil fuel*Climate Policy Exposure (CCPI)	0.008***	0.008***	0.007***	0.008***
	(2.971)	(3.134)	(2.967)	(4.299)
Issue amount	0.034***	0.038***	0.037***	0.071***
	(3.597)	(3.602)	(3.638)	(7.221)
Maturity	-0.022***	-0.022***	-0.022***	-0.019***
	(-11.256)	(-11.215)	(-11.194)	(-9.163)
Borrower size	-0.056***	-0.054***	-0.049***	-0.052***
	(-6.192)	(-5.290)	(-4.248)	(-4.581)
Borrower asset tangibility	-0.003***	-0.004***	-0.004***	-0.003**
	(-2.608)	(-3.151)	(-3.162)	(-2.611)
Borrower leverage	0.001***	0.001***	0.001***	0.002***
	(4.505)	(5.637)	(6.675)	(7.850)
Borrower market-to-book	-0.025***	-0.029***	-0.033***	-0.033***
	(-5.783)	(-6.334)	(-7.023)	(-6.950)
Bank size		-0.098***	-0.030	-0.032
		(-3.081)	(-1.010)	(-1.201)
Bank EBIT-over total assets		0.262	0.285	-0.028
		(0.630)	(0.646)	(-0.068)
Bank cash over total assets		-0.068	0.073	0.066
		(-0.339)	(0.388)	(0.384)
Bank deposits over total assets		-0.107	0.199	0.006
		(-1.212)	(1.471)	(0.050)
Lending growth rate	0.178***	0.150**	0.211***	0.134**
	(3.347)	(2.612)	(3.599)	(2.511)
Non-performing loans	-0.006***	-0.008***	-0.003	-0.002
	(-3.151)	(-3.436)	(-0.896)	(-0.786)
Crude oil price annualized	0.005***	0.006***		
	(6.348)	(7.370)		
GDP growth	0.006***	0.008***	0.003	-0.001
	(3.243)	(4.258)	(1.243)	(-0.678)
Constant	0.538***	1.853***	0.790*	0.296
	(2.794)	(3.504)	(1.681)	(0.641)
Lead manager FE	Yes	Yes	Yes	
Borrower FE	Yes	Yes	Yes	
Year FE			Yes	Yes
Lead manager*Borrower FE				Yes
Clustered SE	Lead manager	Lead manager	Lead manager	Lead manager
Observations	64824	55963	55963	53501
R^2	0.541	0.530	0.533	0.646
$R^2_{adj.}$	0.526	0.514	0.517	0.580

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 25: Bank size and Climate Policy Exposure (CCPI). Regression results for the period 2007-2017.

The dependent variable is the All-in Spread Drawn and the Climate Policy Exposure is measured by the CCPI. The sample period is 2007-2017. The coefficient of interest is the fossil fuel dummy and Climate Policy Exposure (CCPI) interaction term. We weight each observation by one over 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 number of general covenants. Firm controls include firm size, leverage, market-to-book, asset tangibility. Bank controls include EBIT-over total assets, market value of equity over book value of equity, cash over total assets, deposits over total asset. Marco controls GDP growth rate, lending growth rate, and non-performing loans. For readability, omitted variables due to collinearity are left out.

	Dependent variable: All-in Spread Drawn			
	(1)	(2)	(3)	(4)
Fossil fuel	16.849	-47.046	35.517	29.999
	(0.149)	(-0.650)	(0.616)	(0.491)
Bank size	-7.072	-7.744**	-5.469**	-5.207**
	(-1.583)	(-2.216)	(-2.568)	(-2.340)
Fossil fuel*Climate Policy Exposure (CCPI)	3.714	5.873*	7.190**	6.717*
	(0.986)	(1.788)	(1.986)	(1.839)
Fossil fuel*Bank size	1.142	5.875	0.202	0.462
	(0.143)	(1.126)	(0.048)	(0.105)
Fossil fuel*Climate Policy Exposure (CCPI)*Bank size	-0.247	-0.401*	-0.502**	-0.466*
	(-0.936)	(-1.753)	(-1.979)	(-1.818)
Constant	703.608***	745.739***	691.915***	687.389***
	(8.542)	(9.467)	(12.940)	(12.735)
Loan-level controls	Yes	Yes	Yes	Yes
Borrower-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	
Borrower 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	Borrower & Bank	Borrower & Bank	Borrower & Bank	Borrower & Bank
Observations	35888	33092	26529	26504
R^2	0.522	0.517	0.530	0.537
$R^2_{adj.}$	0.520	0.515	0.527	0.531

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 26: Large versus small bank choice and Climate Policy Exposure (CCPI). Regression results for the period 2007-2017.

This table provides within-firm evidence on small-to-large bank loan substitution along firm's Climate Policy Exposure. The table reports the results of the linear probability model for the period 2007-2017. The coefficient of interest is the fossil fuel dummy and Climate Policy Exposure (CCPI) interaction term. The dependent variable equals one if a firm receives a loan from a syndication group with at least one large lead manager bank in the syndication group, zero other-wise. All variables are as defined in Table 4. 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 crude oil price annualized, asset tangibility, and leverage coefficients have been scaled by ten for better readability.

	Dependent variable: Large versus small bank choice		
	Large bank= top 1/5	Large bank= top 1/4	Large bank= top 1/3
	(1)	(2)	(3)
Fossil fuel	-0.257**	-0.282	-0.291*
	(-2.297)	(-1.357)	(-1.948)
Fossil fuel*Climate Policy Exposure (CCPI)	0.004*	0.002	-0.003
	(1.832)	(1.043)	(-0.828)
Total amount	0.077***	0.077***	0.080***
	(3.602)	(3.962)	(4.046)
Firm size	0.121**	0.091**	0.069**
	(2.377)	(2.527)	(2.478)
Leverage	0.007	0.001	-0.010*
	(0.900)	(0.147)	(-1.689)
Asset tangibility	-0.004	-0.002	-0.000
	(-1.385)	(-0.534)	(-0.094)
Market-to-book value	0.066***	0.052***	0.011
	(2.833)	(2.720)	(1.302)
GDP Growth	0.022***	0.006	0.010
	(3.903)	(0.506)	(1.299)
Crude oil price annualized	-0.004	-0.006	-0.005
	(-1.239)	(-1.590)	(-1.449)
Constant	-2.303***	-1.872***	-1.554***
	(-3.360)	(-4.340)	(-5.225)
Firm FE	Yes	Yes	Yes
Clustered SE	Borrower country	Borrower country	Borrower country
Observations	7836	7806	7809
R^2	0.556	0.566	0.645
$R^2_{adj.}$	0.406	0.420	0.525

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 27: Large versus small bank choice (non-binary) and Climate Policy Exposure (CCPI). Regression results for the period 2007-2017.

This table provides within-firm evidence on small-to-large bank loan substitution along firm's Climate Policy Exposure. The table reports the results of the linear probability model for the period 2007-2017. The coefficient of interest is the fossil fuel dummy and Climate Policy Exposure (CCPI) interaction term. The dependent variable equals one if a firm receives a loan from a syndication group with at least one large lead manager bank in the syndication group, zero if the syndication group consists only of small lead banks, and any number between 0 and 1 is indicating a mix of loan financing from syndication groups with at least one and none large lead banks. All variables are as defined in Table 4. 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 crude oil price annualized, asset tangibility, and leverage coefficients have been scaled by ten for better readability.

	Dependent variable: Large versus small bank choice		
	Large bank= top 1/5	Large bank= top 1/4	Large bank= top 1/3
	(1)	(2)	(3)
Fossil fuel	-0.321***	-0.343***	-0.340***
	(-3.295)	(-2.859)	(-2.718)
Fossil fuel*Climate Policy Exposure (CCPI)	0.005**	0.003	-0.002
	(2.457)	(1.273)	(-0.317)
Total amount	0.084***	0.082***	0.084***
	(4.400)	(4.961)	(4.988)
Firm size	0.114**	0.087**	0.063**
	(2.379)	(2.679)	(2.467)
Leverage	0.004	-0.003	-0.013**
	(0.459)	(-0.364)	(-2.167)
Asset tangibility	-0.004	-0.003	-0.001
	(-1.421)	(-0.625)	(-0.312)
Market-to-book value	0.061**	0.048**	0.007
	(2.658)	(2.647)	(0.873)
GDP Growth	0.021***	0.005	0.009
	(3.558)	(0.432)	(1.239)
Crude oil price annualized	-0.003	-0.005	-0.004
	(-1.118)	(-1.427)	(-1.339)
Constant	-2.354***	-1.919***	-1.556***
	(-3.734)	(-5.352)	(-6.766)
Firm FE	Yes	Yes	Yes
Clustered SE	Borrower country	Borrower country	Borrower country
Observations	8506	8507	8505
R^2	0.537	0.546	0.620
$R^2_{adj.}$	0.393	0.405	0.502

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix

Table 28: 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	192	6.3	6.3
Wells Fargo Bank NA	162	5.32	11.62
BNP Paribas SA	149	4.89	16.51
Wells Fargo & Co	108	3.54	20.05
BMO Capital Markets Financing Inc	88	2.89	22.94
Bank of America Merrill Lynch	80	2.63	25.57
Royal Bank of Canada	78	2.56	28.13
Bank of Nova Scotia	73	2.4	30.52
Citibank	67	2.2	32.72
Bank of America	66	2.17	34.89
National Bank of Canada	66	2.17	37.05
JP Morgan Chase Bank NA	63	2.07	39.12
Bank of Montreal	62	2.03	41.16
Toronto Dominion Bank	52	1.71	42.86
Deutsche Bank AG	42	1.38	44.24
Citigroup	41	1.35	45.59
Bank of Tokyo-Mitsubishi UFJ Ltd	40	1.31	46.9
Credit Suisse AG	40	1.31	48.21
Sumitomo Mitsui Banking Corp	37	1.21	49.43
Societe Generale SA	34	1.12	50.54

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